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FPTU Student Research Conference

Ho Chi Minh, May 2017

FPT UNIVERSITY

The Student Research Conference Proceedings

The 1st FPT University Student Research Conference - Spring Semester 2017

May, 2017
Ho Chi Minh, Viet Nam

Introduction

Students' scientific research is intellectual activities that support students to apply methodologies and methods of scientific research in studying and practicing; since, using a combination of learned knowledge to conduct research-based cognitive activity, contributing to solving scientific problems in real life and occupation. Recognizing scientific research is one of important tasks that FPT University has been step by step building, deploying and encouraging scientific research for staff, lecturers and students since the first day of establishment.

As a result of fact, The 1st Student Research Conference was held in May of 2017, which the purpose of bringing environments for students to report their results of research to the Scientific Research Council; contributing to encouraging and promoting scientific research activities as well as applying results of research in reality as soon as possible. The conference is the place to receive the comments and suggestions from Board of Management, lecturers and staff to improve movement and quality in students' scientific research. Throughout this conference, FPT University hopes to promote the students' scientific research which also to raise awareness of the importance of science in improving the quality of teaching and training.

In the conference, there are 8 groups with 8 different subjects belonging to two faculties: Software Engineering and Business. The Scientific Research Council has based on an evaluation process in order to select five topics to be presented in the Conference.

The organizers sincerely appreciate the interest of Board of Management, Scientific Research Council, Department Directors, Lecturers, staff and all students whom have contributed for the success of the Conference. We also thankfully give our honor to Mentors who have guided students in their scientific research. We would like to acknowledge all comments and suggestions in order to develop and improve the quality of scientific research in the future.

Best Regards. /.

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Conference Program

Saturday, May 13th, 2017

7:30 – 8:00	Welcome Delegates and Guests
8:00 – 8:10	Introduction of conference opening Speech of Mr. Tran Ngoc Tuan (Ph.D) – Vice Rector
8:10 – 8:25	Keynote 1: "Software StartUp Project Contest" Mr. Kieu Trong Khanh (M.E)
8:25 – 8:40	Keynote 2: "Kanban Methodology in multi small projects context" Mr. Lam Huu Khanh Phuong (M.E)
Reports of Students from Economic Sector	
8:40 – 9:05	Customer Behavior in focus: A case study of Tiki Vietnam Presented by: Le Hoang Vinh Bui Nguyet Hieu Nguyen Hoan Vu Nguyen Thi Thanh Thuy
9:05 – 9:30	A Study on Perceived Benefits in E-commerce: Case study on Hochiminh City Presented by: Nguyen Nhat Truong Nguyen Thi Anh Thi Huynh Ngoc Khanh Linh
9:30 – 9:45	**Breaktime**
Reports of Students from Technical Sector	
9:45 – 10:10	Automatic Alternative Image Recognition To Voice Presented by: Phan Trung Thanh Nguyen Vu Hoang Son Vo Ha Quan
10:10 – 10:35	Engineer a Remote Code Execution System: A sandboxing approach using Docker's container technology Presented by: Le Ta Dang Khoa
10:35 – 11:00	Building Material C2b Website Presented by: Cao Minh Thuy Vy Dang Minh Tung Tran Anh Nguyen Nguyen Dinh Thien
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11:15 – 11:30	Statement for closing conference – Mr. Than Van Su (M.E), Head of Academic Affairs FPTU HCM

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Technical Sector

Automatic Alternative Image Recognition To Voice

Phan Trung Thanh – Nguyen Vu Hoang Son – Vo Ha Quan – Kieu Trong Khanh
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Abstract

People with visual impairment face a lot of challenges in their everyday life, even with very basic tasks. One of the most challenging problem for blind people is communication with others. Many solutions are proposed to comfort their life (ex: assistances, smartphone application that can detect objects…), but the blinds are still not independent. Because of that, a solution is proposed: a system that can recognize the faces of people and objects around the blinds, then describes it back to them through voice notification. System will provide an application that blind users can control by their voice, and help it become smarter through training process.

Key Words

Microsoft Cognitive Service, Clarifai, HOG patterns, Convolution Neural Networks, face detection, face recognition.

I. INTRODUCTION

The biggest problem that a blind person is facing every day is the lack of social communication advantages. Because of their visual impairment, they can hardly tell differences between people, or everyday life objects. And since that, blind people cannot participate in social events, having difficulties to complete their basic tasks. A lot of smart phone applications are made to help blind people recognize or navigate in surround environments. Those applications can be divided into 2 main categories:

- **Applications that help identifying objects** (LookTel [7], KNFB Reader App [8],TapTapSee[9]…): these applications help users to navigate and identify specific objects or describe scenes through taken pictures such as money, text, and color.
- **Applications that help blind people through sighted volunteers** (Be My Eye [10]): these applications help the blind people by using the help of sighted volunteers. The blind person will request assistance in the application (the challenge can be anything from knowing the expiry date on the milk to navigating new surroundings…). Then the volunteer helper receives notification for help and a live video connection is established. From the live video, the volunteer can help the blind person by answering the question they need to be answered.

Our premise in this paper is the following: instead of having a human assistance, the blind will have a virtual assistance provided in a form of a mobile application; which can helps them identify their relatives, friends and also common objects around them. All of the processes will be controlled by user voice commands. This approach provides an important missing feature that other applications have not yet solved: facial recognition. The scenario is in which a blind person can run into friends or their relatives on the street, and instead of spend time figuring out who is the person greeting them, the application can recognize that person through captured picture, and describe back to them.

The principle behind the recognition process is to capture an image of the person, or object that needs to be identified, and then run it through the Image Recognizer. The result will

be returned and processed to describe by voice. The performance and accuracy of this approach is tested through more than 1000 cases, with different images of human faces and objects. The results are very promising.

In Section 2 we formalize the problem and describe our approach to solving it. Section 3 describes the data structures that need to be set up and the algorithms. We analyze our algorithm in Section 4. Experimental results and the software used are described in the concluding Section 5.

II. PROBLEMS AND SOLUTION PLAN

Our approach contains two mains problem: Facial Recognition and Object Recognition.

1. Facial Recognition

Problem: Our solution is to capture a picture of the person who is needed to be identified, pass it through an Image Recognizer to identify the person. The result that is received is described by voice to the blind. How can a machine recognize and identify a human face?

Solution: By using Microsoft Cognitive Service (MCS) [11], which is an artificial intelligence third party service that provides Facial Recognition and Training functions.

Microsoft Cognitive Service provides a clear and convenient way to manage Person Identification Process. The service consisted of 3 main terms: Person Group, Person and Face.

- **Person Group:** is a group that contains people. Each user in the system will have 1 unique Person Group, the reason for this will be discussed more detail in section 4. Each Person Group will have a unique Person Group ID to helps identified from others Person Group in Identifying Process.
- **Person:** representing a real person in real life. Person can be the blind friends, family, relatives…whoever the blind want the system to recognize for them. A Person in the system has a Name, for latter described back to the blind user after successfully identified, a Description for detail information, and a unique Person ID to identified from another person. Each Person will belong to a certain Person Group. Each Person Group can has up to 1000 Person.
- **Face:** representing the faces of a real person. Each Person can have different faces of them, up to 248 faces. A Face can be added by providing a picture of that Person Face, Microsoft Cognitive Service will detect that person face and give it a unique Persisted Face ID for storing. The Detecting Process will be discussed in section 3.

From our approach idea, our plan to implement this solution is: Each blind user will have a Person Group, which contains Person representing their friends and relatives. When the blind user meet someone that they want to identify, they will give command for the application to begin the Identifying Process. The application then will capture a picture of the person through device camera, then pass it to MCS. MCS will detect the human face inside that image, then it compares the detected face with all the Person inside user's Person Group. When a match is found, MCS will return the Person information back to the applications, the information then will be processed and describe back to the blind through voice notification.

2. Object Detection

Image classification is the task of taking an input image and outputting a class (a cat, dog, etc) or a probability of classes that best describes the image.

When a computer detects an image (taking an image as input), it will see an array of pixel values. Depending on the resolution and size of the image, it will see a 32 x 32 x 3 array of numbers (The 3 refers to RGB values). Just to drive home the point, let's say we have a color image in JPG form and its size is 480 x 480. The representative array will be 480 x 480 x 3. Each of these numbers is given a value from 0 to 255 which describes the pixel intensity at that point. These numbers, while meaningless to us when we perform image classification, are the only inputs that are available to the computer. The idea is that give the computer this array of numbers and it will output numbers that describe the probability of the image being a certain class (.80 for dog, .15 for cat, .05 for bird, etc.).

What CONVs (Convolution Neural Networks) [1] do is pass image through a series of convolutional, non-linearity, pooling (down sampling), and fully connected layers, and get an output. The output can be a single class or a probability of classes that best describes the image.

1. CONV (Convolution Neural Network) layer will compute the output of neurons that are connected to local regions in the input, each computing a dot product between their weights and a small region they are connected to in the input volume.[1]
2. RELU [1] layer will apply an elementwise activation function, such as the max(0,x) thresholding at zero[1]. This leaves the size of the volume unchanged ([32x32x12]).
3. After some RELU layers, programmers may choose to apply a pooling(POOL) layer. POOL layer will perform a down sampling operation along the spatial dimensions (width, height), resulting in volume such as [16x16x12].
4. Fully connected(FC) layers, this layer basically takes an input volume (whatever the output is of the convolution or pool layer preceding it) and outputs an N dimensional vector where N is the number of classes that the program has to choose from. (Figure 1)

In this way, CONVs transform the original image layer by layer from the original pixel values to the final class scores. Note that some layers contain parameters and others don't. In particular, the CONV/FC layers perform transformations that are a function of not only the activations in the input volume, but also of the parameters (the weights and biases of the neurons). On the other hand, the RELU/POOL layers will implement a fixed function. The parameters in the CONV/FC layers will be trained with gradient descent so that the class scores that the CONV computes are consistent with the labels in the training set for each image.

III. PLAN IMPLEMENTATION

1. Facial Recognition

After captured an image of the person who needed to be identified, the system will compress the image to reduce the size but still remain the quality of the image. Then the image will be sent to Microsoft Cognitive Service to begin Identifying Process, which is briefly summarized in Figure 2.

The Identifying Process consisted of 3 main steps:

1.1 Detect a Human Face [5]

A human face consisted of "Face Landmark"

(Figure 3) which is points representing specific locations of human face components, i.e. left / right eyes corners, side nose, top of the nose, mouth corners and so on. Computers will look for these face landmarks to determine which human face inside the image is.

Using a method called "Histogram of Oriented Gradients" (HOG) [4] – the basic concept is to detect the dark and light parts of the Human Face then compare with pre-trained human face patterns to determine if there is a human face – A computer can detect a human face through the following steps:

Step 1: turn the image into black and white form. Since in black and white, we can determine the shadows of human face easier.

Step 2: look at every pixel of the image. For each pixel, we also want to look at the surrounding pixels. Then, we draw an arrow in direction where the image is getting darker. Repeat it for all of the pixels.

Step 3: divide the image into smaller sections. Each section consists of 16 X 16 pixels. In each section, count up how many gradients point in each major direction; then replace that section in the image with the arrow directions that were the strongest.

Step 4: compare the processed image with HOG patterns to determine where is the human face inside the image. (Figure 4)

1.2 Identify Person Face [6]

After detected an existed human face inside the image, Microsoft Cognitive Service will generate a temporary unique Face ID for each of the detected faces, along with the gender of that face. The Face ID will only be existed in 24 hours.

MCS then will compare each of the detected faces with every Person inside user's Person Group using deep learning algorithms. With each match, MCS will return a candidate with their Person ID and a Confident Rate.

Confident Rate is a number with a range of 0 to 1, which represents the similarity between the detected face and the compared Person's face. After testing, we decided to only accept results with confident rate higher than 0.65; which mean that the detected face is belong to the compared Person.

1.3 Get Identified Person Information

After identified the person inside captured image, the system receives back a Person ID from MCS. The system now will look for the Person who has the same Person ID in the database. If a match is found, the system will describe the name of that Person back to the blind user through voice notification.

In case MCS does not return any candidates, or the confident rate is less than 0.65, the system will describe the gender of the person back to the blind, then request to add person whether or not.

2. Object Detection

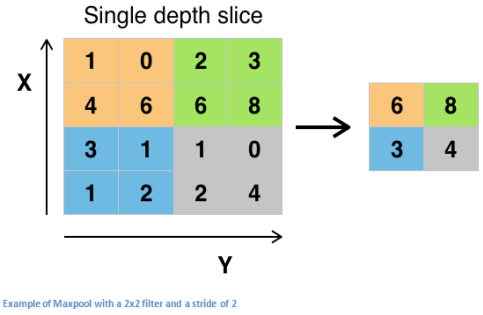
2.1 Convolution

The first layer in a CONV is always a Convolutional Layer (CONL). Like we mentioned before, the input is a 32 x 32 x 3 array of pixel values. Now, the best way to explain a CONV layer is to imagine a flashlight that is shining over the top left of the image. Let's say that the light this flashlight shines covers a 5 x 5 area. And now, let's imagine this flashlight sliding across all the areas of the input image. In machine learning terms, this flashlight is called a filter (or sometimes referred to as a neuron or a kernel) and the region that it is shining over is called the receptive field. Now this filter is also an array of numbers (the numbers are called weights or parameters). A very important note is that the depth of this filter has to be the same as the depth of the input (this makes sure that the math works out), so the dimensions of this filter are 5 x 5 x 3. Now, let's take the first position the filter is in for example. It would be the top left corner. As the filter is sliding, or convolving, around the input image, it is multiplying the values in the filter with the original pixel values of the image

(Also known as computing element wise multiplications). These multiplications are all sum up. As a result, we have a single number. However, this number is just representative of when the filter is at the top left of the image. Now, we repeat this process for every location on the input volume. (Next step would be moving the filter to the right by 1 unit, then right again by 1, and so on). Every unique location on the input volume produces a number. After sliding the filter over all the locations, you will find out that what you're left with is a 28 x 28 x 1 array of numbers, which we call an activation map or feature map. The reason you get a 28 x 28 array is that there are 784 different locations that a 5 x 5 filter can fit on a 32 x 32 input image. These 784 numbers are mapped to a 28 x 28 array [2]. (Figure 5)

2.2 Pooling

It is also referred to as a down sampling layer. In this category, there are also several layer options, with max pooling being the most popular. This basically takes a filter and a stride of the same length. It then applies it to the input volume and outputs the maximum number in every sub region that the filter convolves around.



Example of Maxpool with a 2x2 filter and a stride of 2

We can calculate output height/length by:

$$O = \frac{(W - K + 2P)}{S} + 1$$

Where O is the output height/length, W is the input height/length, K is the filter size, P is the padding, and S is the stride [1]

IV. ANALYSIS

Our solution's performance and functionality are tested through extended testing process. The testing result is presented in the next section: **1.**

1. Facial Recognition

1.1 Person Group Performance

The following part of this report is to demonstrate why each user of the system only

has 1 unique Person Group.

MCS provides the term Person Group, to manage Person by divide them into smaller group. This function can help fasten the identifying process since the service only has to look at a certain chosen Person Group.

But since the main user of the system is people with visual impairment, they cannot choose which specific Person Group that the Identify Process should look at, and therefore, MCS would have to check every Person Group if the user has multiple Person Groups. This will make the main purpose of the Person Group function became meaningless, and reduce the performance of the Identifying Process significantly.

The solution for this problem is to create only unique Person Group for each user in the system. This will approach will only have minor effect to the performance of the identifying process. A test is conducted to calibrate and compare performance of Identifying Process under different amount of Person in a Person Group and with different Internet connection. The result is presented as bellow:

Amount of Person	Speed – Using 3G Internet connection 10 Mbps	Speed – Using Fiber Optic Internet connection 36 Mbps
2	1,6 seconds	0,73 second
50	1,7 seconds	0,79 second
300	2 seconds	1,1-1,6 second

As the result shows a minor different in performance between person group with 2 people and person group with 300 persons, we decided that each user in the system will have unique Person Group.

1.2 Voice Recognition Process

Since the main user of the system is blind user, every task and function will have to be controlled by voice commands.

Android operating system platform provides a voice recognition service which is supported in all Android based smartphone. By using this service, system can receive and process user voice commands and trigger suitable functions accordingly.

Since the complexity of the process is not documented, we spent times testing the performance of voice recognition process with different commands and Internet connection speed. The result is presented as bellow:

Network Type / Input Voice	3G Network (Ping 24ms, Download: 15.31 Mbps, Upload: 1.36 Mbps)	Wi-Fi Network (Ping: 3ms, Download: 30.55Mbps, Upload: 22.17 Mbps)
"Nhận diện hình ảnh"	0.512	0.312
"Thêm người mới"	0.482	0.315
"Cái gì đây"	0.465	0.3

The latency of voice recognition process is also considered as a part of the Identifying Process, which will be presented in the following sections.

1.3 Person Identification Process

Since the person identifying process is done by using Microsoft Cognitive Service facial recognition API, the complexity of the process is not included in the documents.

We spent times conducting tests to determine the performance of the identifying process under different Internet connection speed. The test bellow was done with a Person Group of 20 Person with both 3G and high speed internet connection. The latency is consisted of both Voice Recognition process and Facial Recognition process. The result is presented as bellow:

Network Type	Speed (Voice Recognition + Image Recognition)
Wi-Fi Network (Ping: 3ms, Download: 30.55Mbps, Upload: 22.17 Mbps)	1,699 ms
3G Network (Ping 24ms, Download: 15.31 Mbps, Upload: 1.36 Mbps)	2,372 ms

The test result show highly acceptable performance of the identifying process, therefore proving the usability of our system.

2. Object Detection

2.1 Training

Back-propagation for training: stochastic gradient ascent [3]:

- Like last lecture output interpreted as a class label probability

$$x = p(t = 1|z)$$

- Now x is a more complex function of the inputs z
- Can optimize same objective function computed over a mini-batch of data points

Data-augmentation [3]:

- Always improves performance substantially (include shifted, rotations, mirroring, locally distorted versions of the training data)

Typical numbers [3]:

- 5 convolutional layers, 3 layers in top neural

network
- 500,000 neurons
- 50,000,000 parameters
- 1 week to train (GPUs) (Figure 6)

V. EXPERIMENTAL RESULT AND CONCLUSIONS

Our system has solved the basic problem showed from the beginning, that is to help people with visual impairment to recognize different persons and objects without the help of any human assistance.

The performance and usability of the solution are proved through extensive testing process. Compare to others available similar approach, our system has several improvements:

- Our system supports Facial Recognition, which is rarely supported by other similar system.
- The accuracy of identifying process is tested with positive results (higher than 80%)
- Support Voice Control to perform different tasks and functions.

Besides achievements, our system still has some limitations:

- The identifying process still requires Internet Connection to be functional.
- Voice Recognition functions have not yet performed as expected. Performing at crowded environments shows high latency in voice recognition process and poor accuracy with native accents.
- The system still only supports Android platform.

In reality, the solution can be extended and implemented with different devices which support image and sound record functions. User would not necessarily require to having a smartphone device.

Acknowledgments

We would like to thank to Mr. Kieu Trong Khanh for helping us defining project scope and improving the functionality.

References

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[8]: KNFB Reader: http://www.knfbreader.com/

[9]: TapTapSee: http://taptapseeapp.com

[10]: BeMyEyes: http://bemyeyes.com/

[11]: Microsoft Cognititve Service: https://www.microsoft.com/cognitive-services/

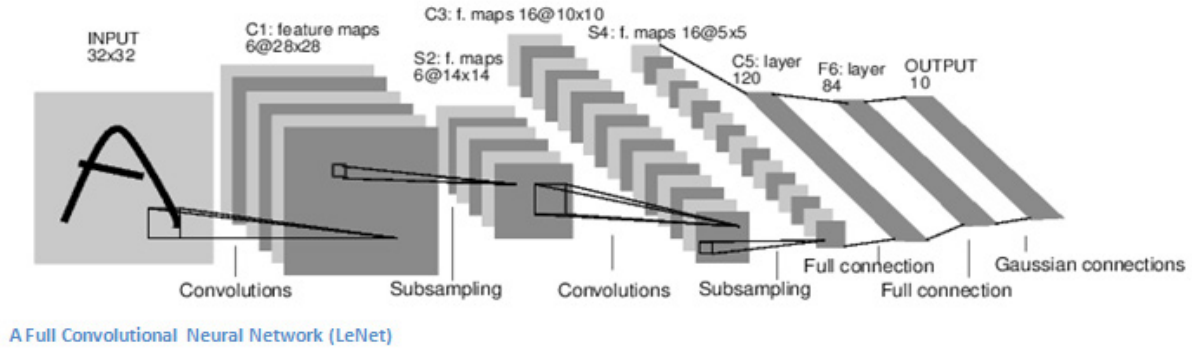

Figure 1: Fully Connected Layers

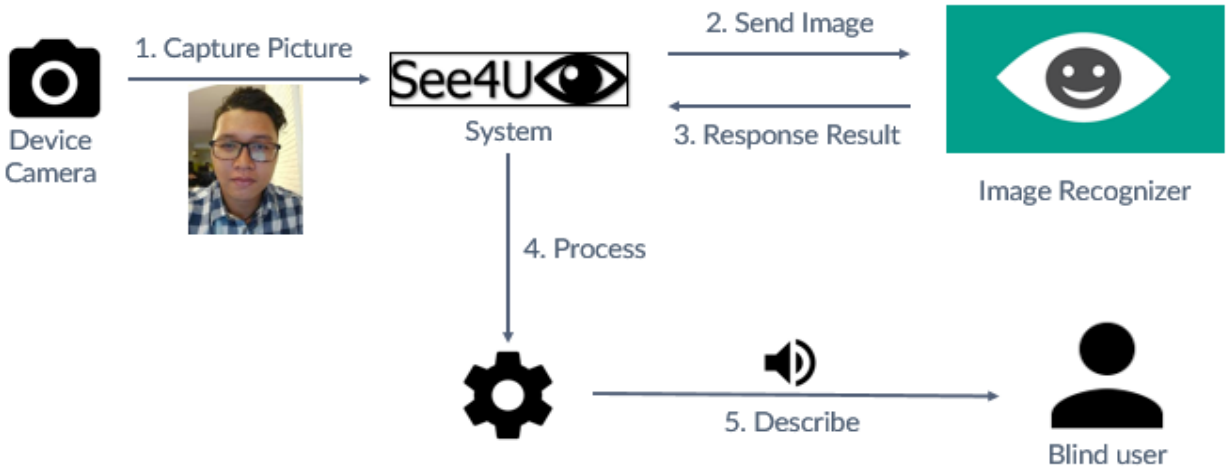

Figure 2: Person Identification Process

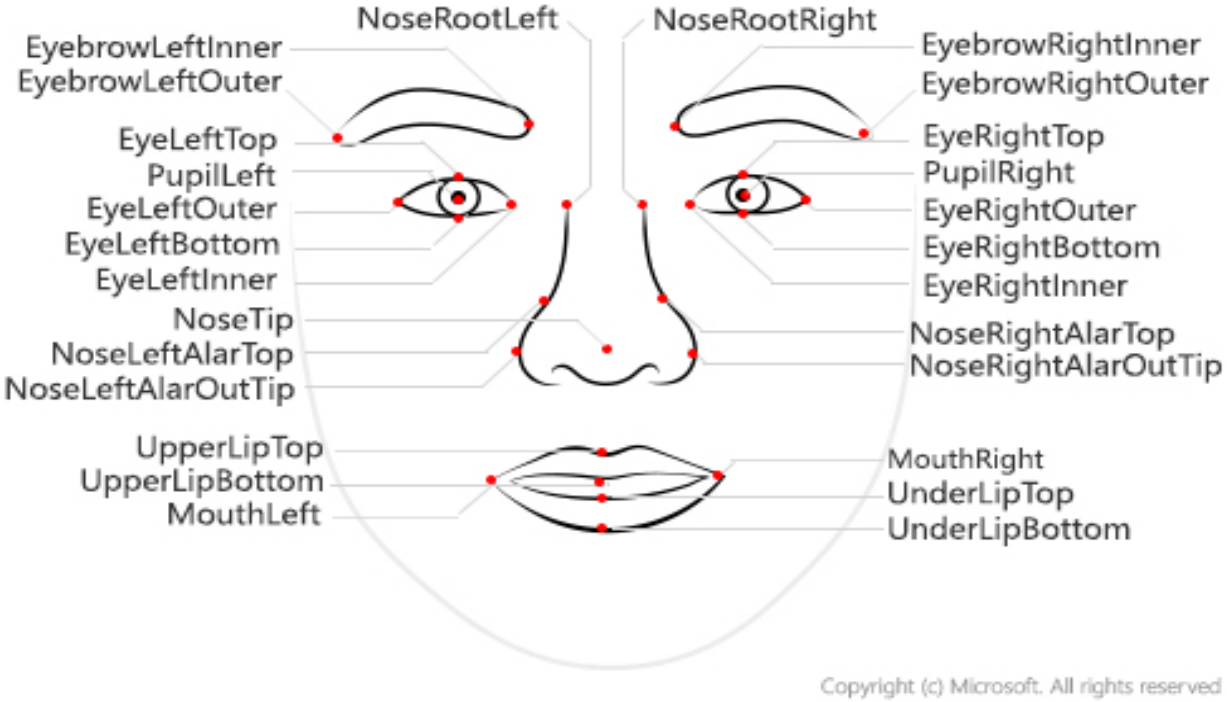

Figure 3: Face Landmarks

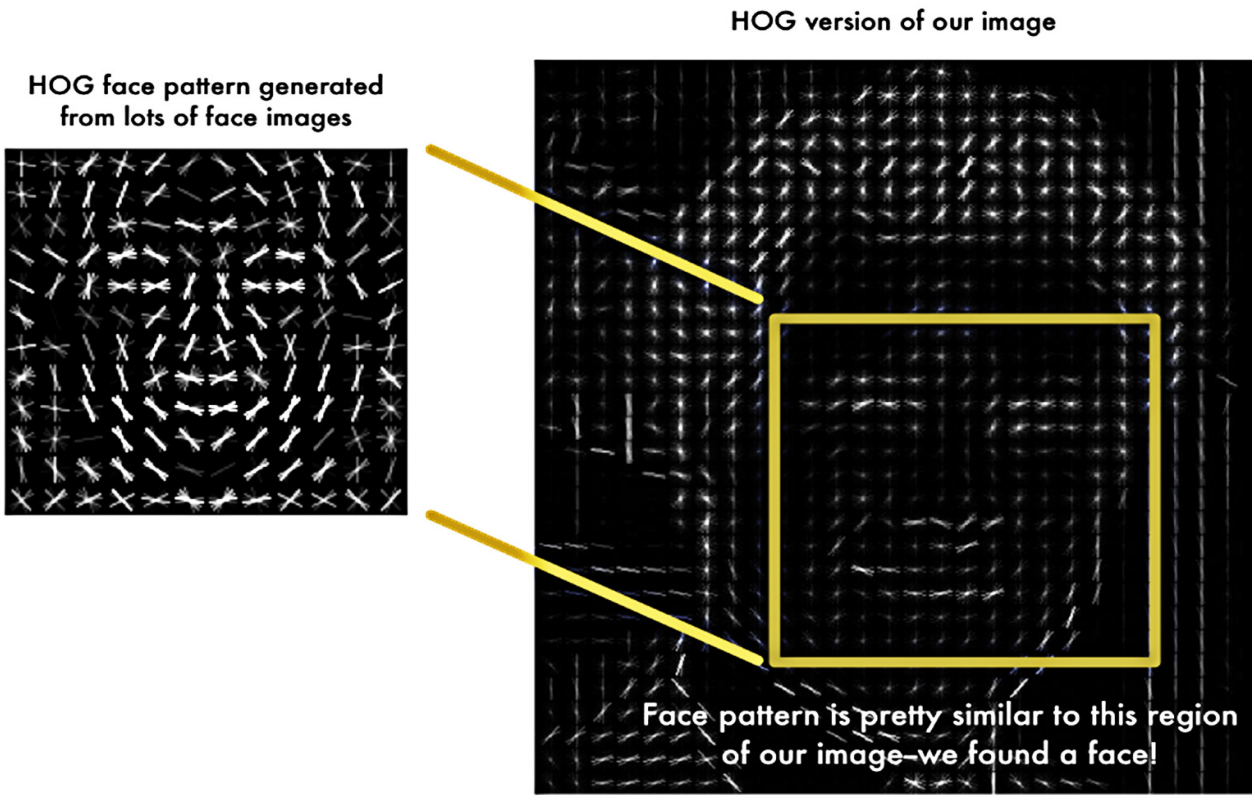

Figure 4: Compare HOG version of origin image with pre-trained HOG face

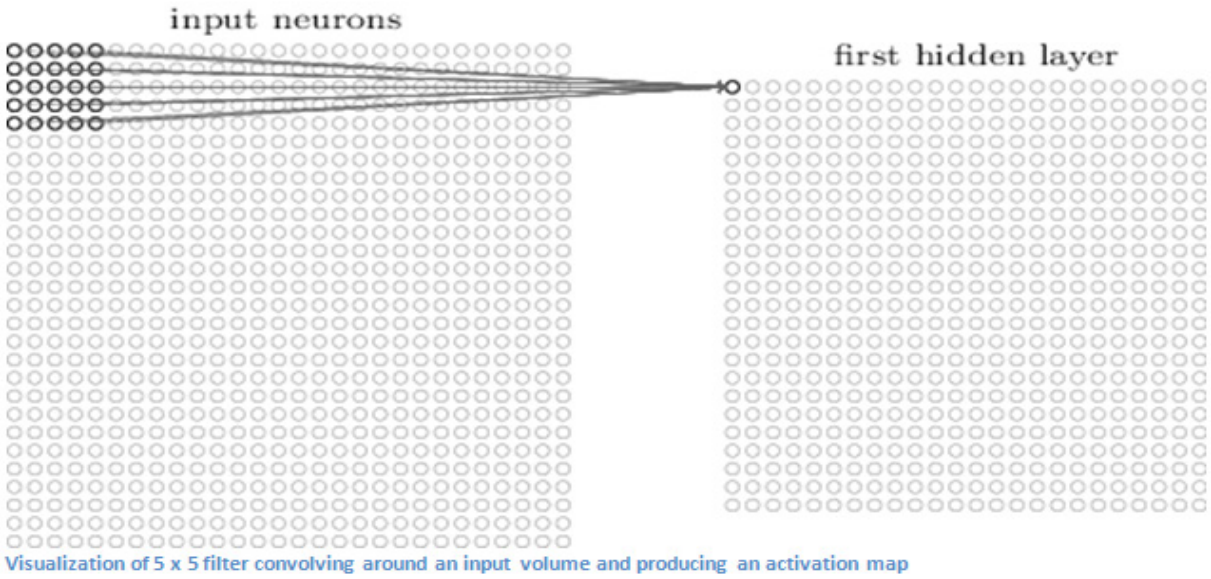

Figure 5: Visualization of a 5x5 filter convolving around an input volume and producing an activation map

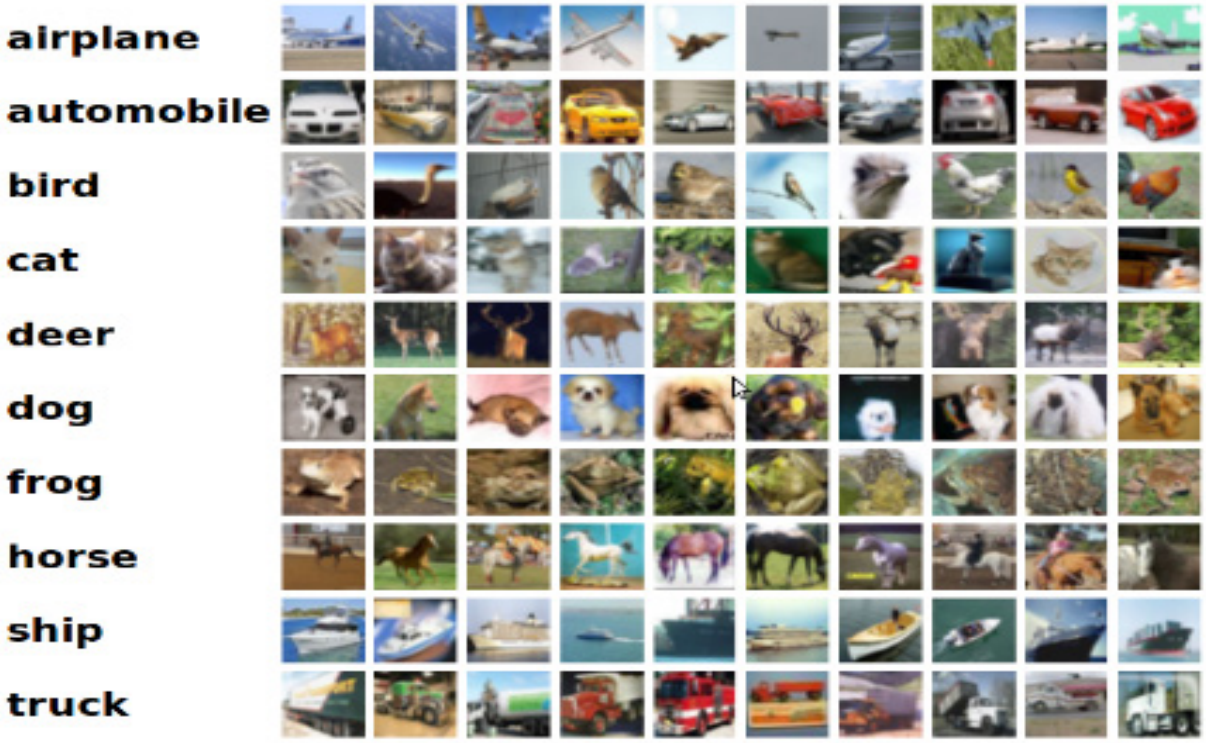

Figure 6: CIFAR 10 dataset: 50,000 training images, 10,000 test images [3]

Building Material C2b Website

BMW

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Abstract

The problem's solution is to help users to find the best building material suppliers when they are planning to build a house. Constructors can find more customers, contracts. Building material shops can also improve revenues by helping customers to find the best suitable materials.

Keywords

C2B • B2C • Full-text search • Reverse auction • E-commerce • E-procurement

I. INTRODUCTION

Nowadays, Electronic commerce (e-commerce) is increasingly developed in Vietnam economy and building material had become a potential factor in it. E-commerce involves buying and selling between organization and individuals on the Internet. Today, e-commerce is the fastest growing area in the economy with electronic procurement being a major component. E-procurement is an umbrella term that encompasses a number of tools with electronic capabilities used to replace the conventional purchasing process [1]. These typically include Reverse Auctions.

Reverse auction are the opposite of traditional auction. In a traditional of forward auction, buyers bid against each other to purchase an item until the one willing to pay for the highest remains. In contrast, reverse or backward auction, buyers request for a product from multiple sellers who bid against each other to purchase the item until the one willing to sell at the lowest price remains (see Figure 1)

As a result of fact, many e-commerce websites become more and more saturated. Thus, it is easily caused boring to buyers. Therefore, we hope to create for our customers a new experience in shopping online based on C2B. Consumer to Business (C2B) is an electronic commerce business model in which consumers (individuals) offer products and services to companies and the companies pay those [2].

We are intended to create a website that provides many shopping methods for customer to choose. Instead of using traditional B2C–E-commerce model in which businesses sell to individual shoppers [3], we have already combined be-tween B2C and C2B to give our customers a great experience when shopping online.

With this remaining problem, we provided many ways such as: deal, retail, and real-time bidding.

With deals, we offer a deal with specified time and reasonable price. With retails, we provide visualization for customers to compare price and location as well. For the last one, with real-time bidding, we provide many bidding mechanisms such as: cancelling bid, editing bid, retracting bid, and automating bid.

Besides, there're many things that we are not able to implement because of limited time. We haven't implemented payment through banking accounts and PayPal. We haven't finished Chat function allowing customers to perform conversation with Supplier. Function "budget management" is omitted temporarily due to out of scope and specification. When it comes to reality, we have to face with many business constraint issues.

II. PROBLEM AND SOLUTION PLAN

After spending time on researching and analyzing, we have realized many problem in buying material. Firstly, in construction market, there're many materials with different

styles and usages as well. This makes difficult for customers to purchase the most suitable product from reputation suppliers. Moreover, customers do not know where to buy materials. Secondly, it's time-consuming to go directly to the material shop to compare prices. Finally, as for suppliers, they need to seek for large orders and handle inventory products as well.

From many defined problems, we offer some solutions to solve problem above. We are using Google Map API to determine location based on latitude and longitude. Our solution is based on customer's location; we can suggest the nearest place for them to compare prices. With search function, we are using "Full-text search" algorithm to help customer in case they don't know the exactly name of products. If customers intend to buy materials with small quantity, we'll provide buying retails that help customers compare prices conveniently. If customers intend to buy building materials with large quantity, we'll introduce real-time bidding that helps customer purchase easily.

III. PLAN IMPLEMENTATION

3.1 System Architectural Design

Our system is developed based on MVC architectural style (see Figure 2). We choose this architecture because of the following advantages:

- We can separate business code with Controller and View. Therefore, we can use the business code in web service without repeat the code.
- We can organize the code better for maintainability, extensibility, and reusability.
- MVC architecture makes it easier to split the big project into small modules and make it easier to assign each module.

3.2 Algorithm

The solution we described in the previous section mentioned about "Full-text search" algorithm, which helps customers in case they don't know exactly the name of products. **Step 1: Inverted Index**

For example, we have 3 documents:
D1 = "This is first document"
D2 = "This is second one"
D3 = "one two"

Inverted index will save as:
"This" => {D1, D2}
"Is" => {D1, D2}
"First" => {D1}
"Document" => {D1}
"Second" => {D2}
"One" => {D2, D3}
"Two" => {D3}

If you want to query the phrase "This is first" or "First is this", instead of having to scan each document, the search for the document containing the three terms becomes the union operation of the three sets of the three terms in inverted Index. Indexing with Lucene breaks down into three main operations: extracting text from source documents, analyzing it, and saving it to the index.

Step 2: Tokenization

To create an inverted index, we have to extract a string into terms. Then we will index that string by the extracted term. We use both (hybrid) two techniques:

- N-Gram: is a technique for dividing a string into terms (substrings). Terms have the same length n. With n = 2 we have example:
- "good morning" => {"go", "oo", "od", "d ", " m", "mo", "or", "rn", "ni", "in", "ng"}

Lucene has "openable" MA library package so we can build custom MA library, which has words can be searched by user, for our web application. Basically what words are difficult / impossible to analyze by MA, then we will use N-grams

Step 3: Boolean Logic

If we input a query string, the search engine will provide us with the most relevant results. When searching in a large block of data that has been indexed as an "inverted index" by tokenization, the search engine will use "Boolean Logic"

Boolean logic used in Full-text search will usually consist of three main operations: AND, NOT and OR. We have 5 documents below:
D1 = "This is first document"
D2 = "This is second one"
D3 = "one two"
D4 = "This one is great"
D5 = "This two is great"
Inverted index:
"This" => {D1, D2, D4, D5}
"Is" => {D1, D2, D4, and D5}

“First” => {D1}
“Document” => {D1}
“Second” => {D2}
“One” => {D2, D3, D4}
“Two” => {D3, D5}

So that the complexity of search will equivalent to the complexity of parsed query string + the complexity of the index lookup + the complexity of the Boolean logic operation based on the results of the index lookup

The complexity of:

- Query is not usually large.
- The index lookup is equivalent to finding the value of a key in the hash table.
- This can be optimized based on set theory, or mathematical libraries for big numbers

In summary, the original search problem was put into three smaller, easier to optimize calculations

Step 4: Ranking Model

The problem will be simple when there are only 5, 10 results, but when the result reaches hundreds of thousands, things will not simply return the results. At that time there will be a new problem to be solved, which is to bring the results first. That’s a ranking problem.

Ranking in FTS will normally be done through scoring, based on the relationship between “query terms” and “document”. It is divided into three main categories: Static, Dynamic and Machine Learning.

IV. ANALYSIS

In the previous sections, we described system architectural design and algorithm. In this section, we are going to introduce advantages and disadvantages of these ones. Firstly, we’ll analyze benefits and limitation of using MVC architectural. Here are benefits of using MVC:

- Many MVC vendor framework toolkits are available.
- Multiple views synchronized with same data model.
- Easy to change or plug in new interface views, allowing updating of interface views with new technologies without overhauling the rest of the system.
- Very effective for developments if graphics, programming, and database development professionals are working in a team in a designed project.[4]

Limitations of using MVC:

- Not suitable for agent-oriented applications such as interactive mobile and robotics applications.
- Multiple pairs of controllers and views based on the same data model make any data model change expensive.
- The division between the View and the Controller is not clear in some cases.[4]

Secondly, we’ll analyze advantage and disadvantage of using “Full-text search” algorithm. Here are advantages:

- Indexing: full-text indexes can offer a lot more flexibility in terms of matching words, how close those words works together.
- Weighted result: A full-text index can encompass multiple columns. For example, you can search for “cement PCB40”, and the index can include a title, keywords, and a body. Results that match the title can be weighted higher, as more relevant, and can be sorted to show near the top

Disadvantages of using this algorithm:

- Index can potentially be huge. For this reason, many hosted providers who offer database instances disable this feature, or at least charge extra for it.
- Full-text indexes can also be slower to update. If the data changes a lot, there might be some lag updating indexes compared to standard indexes.

V. EXPERIMENTAL RESULTS AND CONCLUSION

With problem described in Section 2, we have implemented successfully some important functions such as: deal buying, retail buying, and real-time bidding.

Figure 3 summarize our experimental result. We draw a bar chart to show the average time of each function in second.

After researching and analyzing problem, we draw a conclusion based on SWOT analysis below [5]:

1. Strengths:

- For suppliers: Creating motivation to improve quality; reducing prices; and providing fair competition environment.

- For customers: bringing maximum profit.

2. Weaknesses:

- For suppliers: selling products at a lower price than other material shop.
- For customers: too rigid in price may lead to the quality of the items and the services offered to the buyer is not at maximum level although satisfying the demand.

3. Opportunities: In Vietnam, real-time bidding website is not popular. If our website goes well, it will definitely have success.

4. Threats: new e-commerce model, unfamiliar with culture and shopping's habit.

Acknowledgement

We wish to thank various people for helping us to finish this project. We would like to give special appreciation to Mr. Lai Duc Hung for his professional guidance throughout the course of this project.

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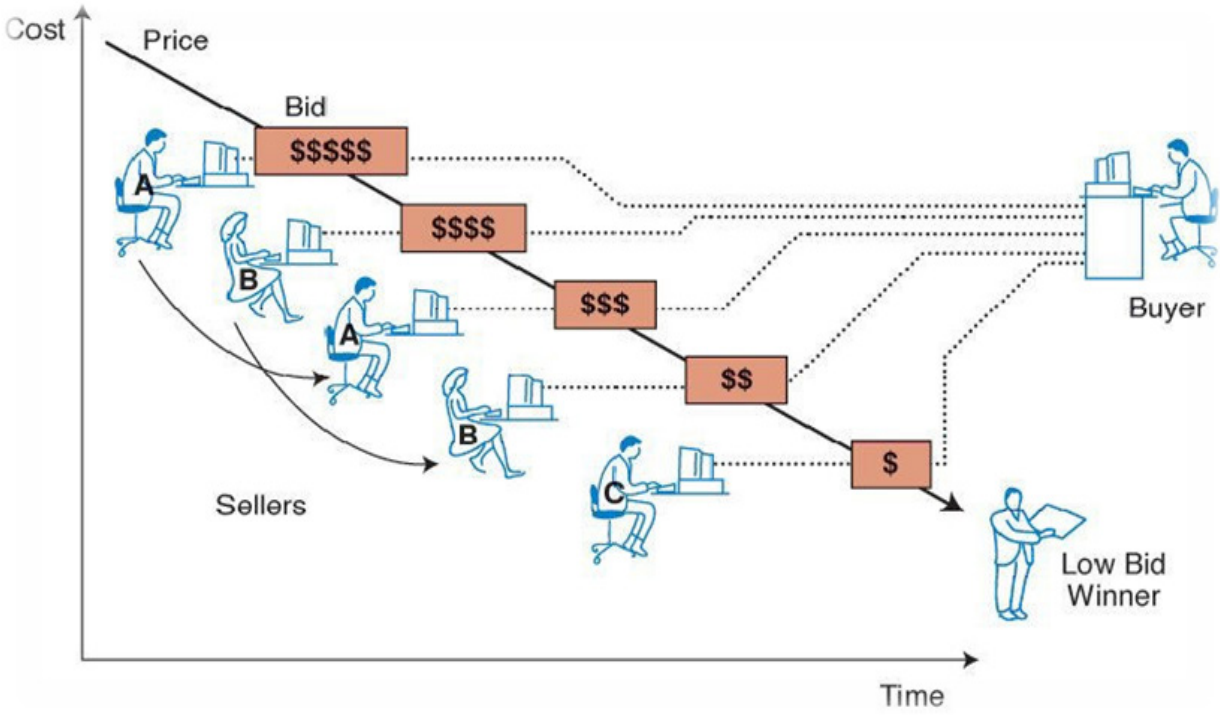

Figure 1: Reverse auction
Source: Turban, E. (2002)

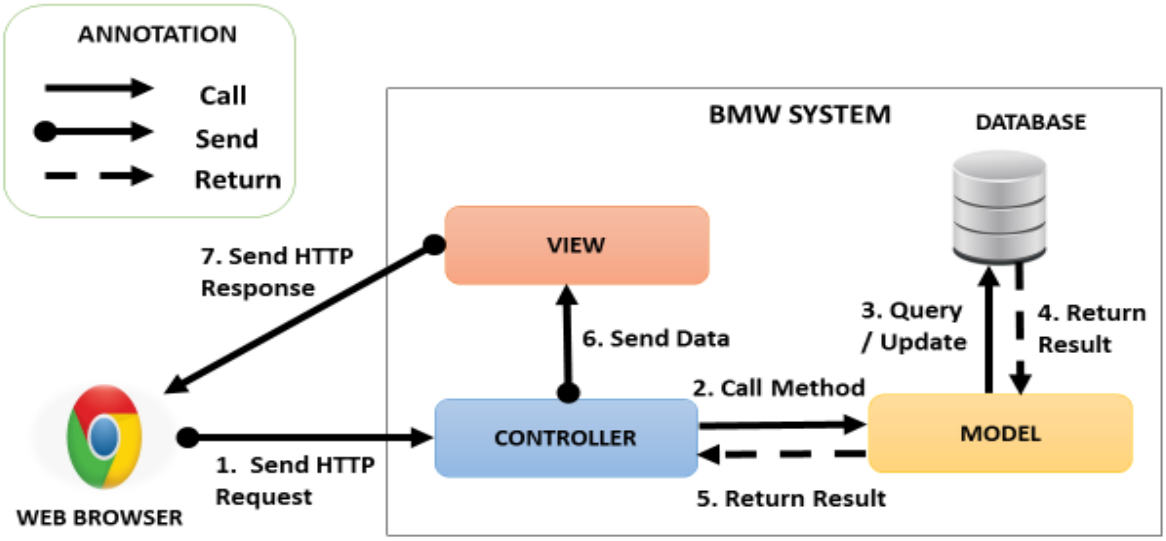

Figure 2: System Architectural Design

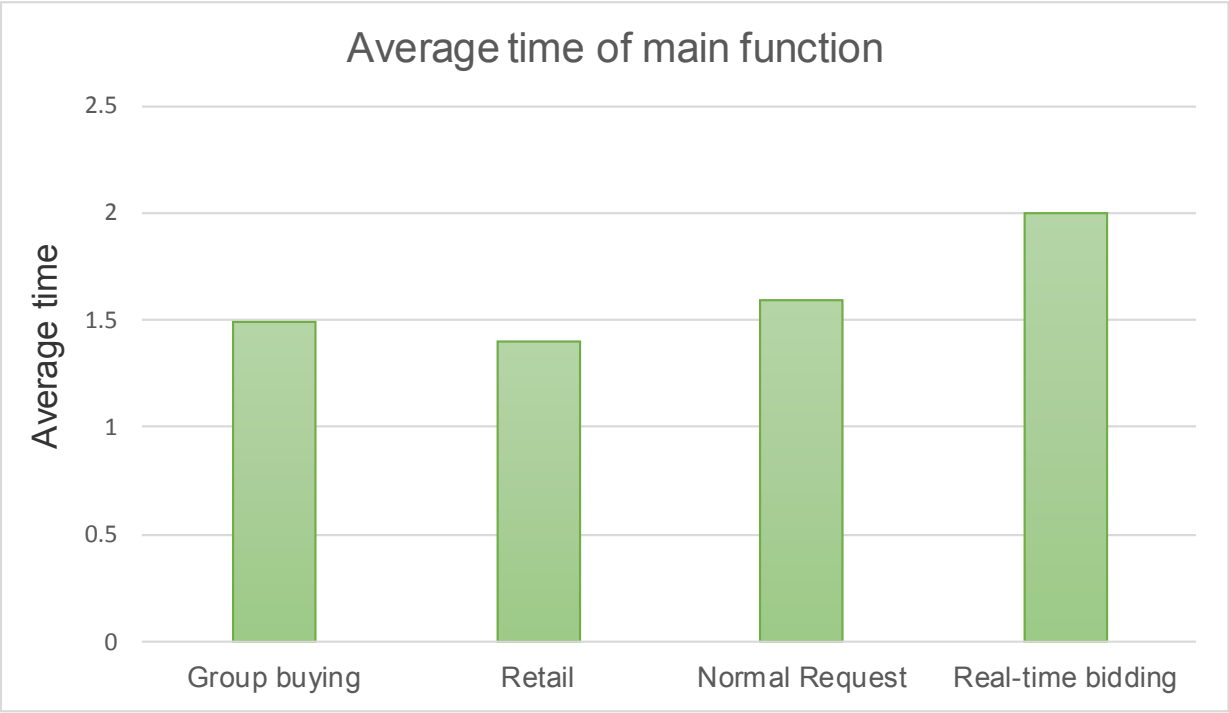

Figure 3: Average Time of Main Function

Engineer a Remote Code Execution System

A sandboxing approach using Docker's container technology

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Abstract

In this paper, we address the problem of building a Remote Code Execution System (RCES). An RCES is a web service that empowers any clients with the ability to execute user's code safely, even if the code is malicious. This is the key technology behind all sites which support in-browser code execution, such as CodeCademy. Although there are some RCES APIs for developers to consume, none of them allows clients to build and run a full project instead of a single code file, so we decided to build an in-house RCES for our Capstone project. The key idea is to use Docker's container technology for sandboxing and then integrate it with file management to allow full project code execution. This paper demonstrates our effort in implementing such idea, together with successful results of our system's protection against common destructive snippets, as well as its ability to build projects in Python and Java.

Keywords

Code execution, sandboxing, Docker, operating system.

I. INTRODUCTION

Like all RCES projects, we have to solve 2 key problems:

1. Language Scalability:

The system's ability is to support a new programming language, library, framework, and so on. Since we want a complete control over the list of supporting engines, this is one of the main reasons we decided to build an in-house RCES.

2. System Protection:

The system's ability to stay safe from malicious code submitted by the user.

Since all submitted code is untrusted, they can be anything from infinite loop to stressing CPU and RAM, causing the system to hang or even crashes. Our system must have a mechanism to stay safe under these conditions.

Moreover, there is a third challenge we have to face, which is unique to our Capstone project:

3. Project Execution:

The system's ability to build-and-run a full code project, not just a single code file.

Instead of building everything from scratch, we looked for open source projects of existed RCES. There aren't many of them, except repl.it [1] and CompileBox [2]. Though both projects are no longer actively maintain and only support single-file code execution, we decided to go with CompileBox as the codebase looks simpler and easier to modify.

II. PROBLEM AND SOLUTION PLAN

Closely look at the first 2 problems; we can restate them as follows.

Problem 1: For a given code engine, mimic the way a proper IDE build and run its code.

Problem 2: Execute the submitted code in an isolated environments so that every destruction only happens inside that machine (also known as "Sandboxing").

To solve these problems, CompileBox uses Docker's container as a sandbox, which is quite clever since Docker is originally built for exporting an application environment so that developers can easily deploy. Their solution can be summarized as follow [3]:

1. Build a Docker image of every supported engine

2. Whenever there is a request, writes the submitted code to a temporary file, then pick the corresponding Bash script to mimic the way IDEs execute that file
3. Instantiate a Docker's container that run the above Bash script on the temporary file
4. Return the output, delete the file then destroy the container

Since the whole architecture is heavily designed towards temporary single-file code execution, with limited Bash scripts and no project-manipulation system in-place, we have to re-write it with the following plan:

Step 1. Study Docker's API to re-architect CompileBox. From now on, the new system is referred as ThinkCode.

Step 2. Study the way IDE executes code projects to re-write the Bash scripts. Currently, we support Ruby, Python, and Java.

Step 3. Build a file management service that keeps tracks of user's code projects, then appropriately prepares them for each execution request.

III. PLAN IMPLEMENTATION

This section includes 4 sub-sections, which describes in order the architecture of ThinkCode and its working mechanism, how to scale the system to new programming languages, and how to configure Docker to be safe under possible attacks.

A. The new Architecture

Before jumping in, let's briefly talk about Docker and how ThinkCode utilizes its API to configure the containers.

At its core, the Docker engine has the following properties [4].

Property 1. Using a Dockerfile written in Bash commands to build Docker's images.

Property 2. Using Namespaces to provide containers with their own view of the underlying Linux system, limiting what a container can see and access.

Property 3. Using Control Groups to ensure containers only use the resources they need.

ThinkCode uses property 1 to install and configure the coding engines. Property 2 is used to assign a non-root user to every instantiated container, limiting the attacking surface for malicious users. Property 3 is used for configuring the resources available to each container, so that every attempt to stress the system's resources are killed.

With a proper Docker engine set-up, let's talk about the other 3 components:

1. NodeJS API: Its responsibility is to orchestrate the whole code execution process, from client's request to server's response.

2. File Management Service (FMS): Allow users to upload code templates, do project navigation, editing code files and prepare temporary directories for code execution.

3. Bash scripts Payload: A collection of Bash scripts that are necessary for mimicking the code execution process of IDEs.

B. The new Mechanism

Before describing the core mechanism, let's take a common use case of ThinkCode.

1. An instructor creates a code project with code templates for his students to code upon.
2. A student starts that project; FMS creates the student's workspace, and then copies the code templates to this folder.
3. The student start editing files in this folder save and click run. What will happen behind the scene?

The mechanism can be divided into 3 stages, first is preparation, second is execution, and third is cleaning up.

Stage 1 – RCES Preparation
1. Client sends a request to the API, the request includes language, target_file and workspace_path 2.1. Based on language, the API requests FMS to find appropriate Bash script in Payload 2.2. Based on workspace_path, the API requests FMS to locate corresponding directory 2.3. Then, FMS prepares a temporary directory that includes both the Bash script and the workspace's code files. Returning its location to the API. 3.1. The API issues a Bash command that requests Docker to instantiate a container. This command includes time-out and resource's constraints for the container. 3.2. That Bash command also requests Docker to mount the temporary directory to the instantiated container, and then run the Bash script with target_file as starting point.

Up to this point, the preparation is done, let's move to execution.

Stage 2 – RCES Execution
4.1 During code execution, the container continuously outputs to temporary directory, with stdout to log.txt and stderr to error.txt. 4.2 If code execution is done, it will output to a file named complete.txt. Else, code execution will be stopped after the set time-out, since the container is killed by Docker. 5.1 At the same time, the API periodically reads the temporary folder for complete.txt. 5.2 If complete.txt has output before time-out, the API will return its content to the client. Else, the API will return "Execution time out!" after the set time-out.

The final step is to clean things up, making sure there is no trash container processes, as well as trash temporary directories.

Stage 3 – RCES Clean-up
6. Regardless of execution result, the container is killed by Docker after the set time-out, which is issued by the API at the start. 7. At the same time, regardless of the output files' contents, the API requests FMS to completely remove the temporary folder after a set time-out.

The whole mechanism is described in Figure 1.

C. Scaling the System

Actually, we can scale the system to new code engine with these 3 simple steps:

Step 1. In Dockerfile, write Bash commands that install the new code engine.

Step 2. Use that Dockerfile to build a new Docker's image. Let Docker refer to this image whenever an appropriate code execution request is received.

Step 3. Add the new Bash script to Payload to mimic how IDE runs that coding engine.

For example, the following Bash script is used to runs the compiled Java's .class files.

```
# 1. Get targeted-file's fullname
fullpath=$1
IFS='/' read -r -a fullpath_array <<< "$fullpath"
fullname=${fullpath_array[-1]}

# 2. Build the targeted-file's classname
IFS='.' read -r -a fullname_array <<< "$fullname"
fullpath_array[-1]=${fullname_array[0]}
classname=$(IFS=. ; echo "${fullpath_array[*]}")

# 3. Go to usercode and run compiled java-file
cd /usercode
java $classname
```

D. Protecting the System

Let's take a look at possible system attacks and our solutions by configuring Docker.

Attacks	**Solutions**
Gain root permission	Login as non-root user, blocked "sudo" command.
Infinite Loop	Set time-out for Docker
CPU Stress	25% CPU-time for each container
Memory Stress	64MB RAM for each container
Download viruses	No Internet connection
Spamming Hard Disk	Limit I/O speed to 1MB/second

Table 1. Possible attacks and solutions

IV. ANALYSIS

We set out building ThinkCode with the following objectives.

Objective 1: The ability to stay safe under common destructive snippets.

Objective 2: The ability to scale the system to support new code engines.

Objective 3: The ability to build a full code project.

In theory, objective 1 is met. Since we utilize Docker's Namespace and Change Group, which is already quite robust, with an extra layer of non-root privileges. However, we have to test the system with actual destructive codes; this will be done in section V.

Objective 2 and 3 are also met, but this is very hard to prove on paper. So we decide to upload

actual Python and Java projects to test these functionalities, all in section V.

V. EXPERIMENTAL RESULTS AND CONCLUSIONS

A. Test Results

Test	Meanings - Result
Execute “whoami” and “sudo”	Check non-root privileges – Passed.
Infinite Loop	Passed
Compute the factorial of 200 thousands	CPU stress – Passed
Execute “whoami” and “sudo”	Memory stress – Passed
Accessing “google.com”	No Internet connection – Passed
Check I/O speed	Limit I/O speed – Passed.
Run a Java project	Passed.
Run a Python project	Passed.

Table 2. System tests and outputs

B. Conclusions

In this paper, we have demonstrated our approach to engineer an RCES, accomplishing all 3 objectives, namely Language Scalability, System Protection and Project Execution.

On extending the project, we planned to implement a grading system. Since grading a code project is simply running the test files, this is completely possible as we’ve already achieved full project code execution.

Acknowledgment

First, this paper owes massive thanks to Mr. Nguyen Huy Hung, my instructor during the Capstone project, for his dedicated time and help that guided me through tough problems.

Second, I’d like to thank Mr. Tran Quang Khoi Nguyen, my teammate during the Capstone project, who crafted an AngularJS client to allow real users to interact with the built API.

Without the help of these people, this paper wouldn’t be possible.

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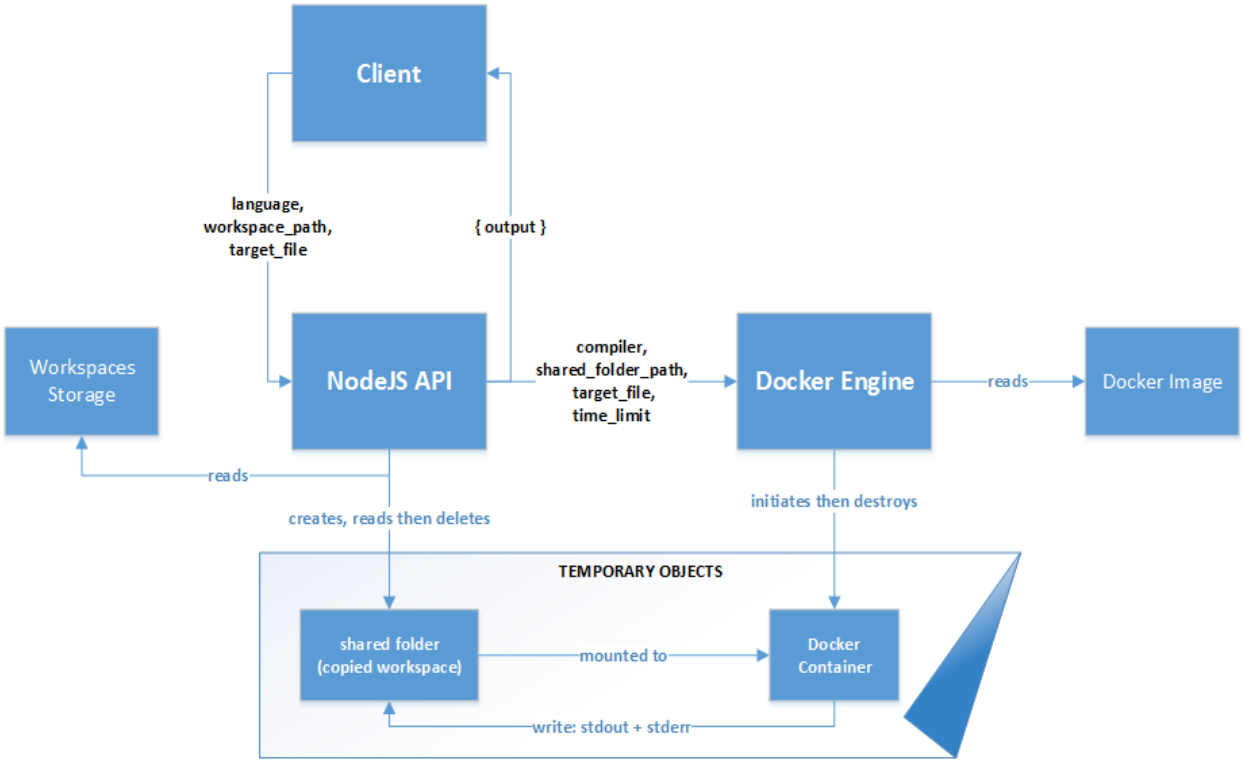

Figure 1 – ThinkCode's RCES mechanism.

Just Walk Out Library

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Abstract

The problem came out from author's own experience. On the first day of new semester, lots of students are tired of queuing in front of the librarian desk to borrow book while librarians are overloaded. The idea, JWL Library, is proposed applying NFC [3], Beacon [7], RFID [8] and QR Code [9] to improve the existing process. The positive contribution is to reduce the number of task for librarian and empower to borrower for a more flexible and convenient process. This was strengthening by our analysis and experimental results.

Keywords

Library, Borrow books, Radio frequency identification (RFID), QR Code, Near Field Communication (NFC), Beacon, Arduino, Bluetooth, Bluetooth Low Energy (BLE).

I. INTRODUCTION

For a very long time, library has been a reliable place for people to study and borrow books. However, almost library nowadays still uses a traditional system. A borrower has to carry all the books that (s)he wants to the librarian desk, after filling in the forms, (s)he takes back library card and bring the books home. With this process, librarian can only communicate with one borrower at a time, this would be very painful for a crowded library.

The development of information technology has opened the door of a more and more convenient life. The story of borrowing books now is also more modern. Some libraries have applied new technology in managing the process and gain some first positive results. With the installation of RFID, Hybrid Security Gate and Camera, the two libraries of Nha Trang University and Vietnam National University of Hanoi [1, 4, 5, 6] has become more effective. Borrower could autonomous-ly take the books without librarian by 4 steps: (1) Press "Borrow" button on the screen, (2) Insert library card for account identification, (3) Enter the Pin or Password, and (4) Scan the books. They only need to call the librarians in the case of systematic issues which lead them to failure in borrowing. However, this process still has many limitations. Users must insert card and enter password, which could be forgotten. Besides, they have to spend time to scan the books, this just seems like the task of traditional librarian now is transferred to you. Therefore, the process will also be stuck if the library is crowded.

Some specialized companies have developed and provided E-Library with the same technology [2]. Time is still not well managed and this is the biggest disadvantage of any existing library system.

It is extremely necessary to build up a new system which could save a huge amount of time in book-borrowing process as well as improve books management performance.

II. PROBLEM AND SOLUTION PLAN

It can be seen that the traditional process has its advantages as well as disadvantages. One big positive point is that no technical skills related to information technology are needed with the old process. Unluckily, this has been bringing many limitations:

- Borrowing books need to go through complicated steps, thus during the rush hour, it might take too much time to wait for checking out for both borrowers and librarians.
- The librarian should work very hard when having many borrowers.
- Paper records are hard to manage and easy to be damaged.

• Librarians may forget to remind borrowers about their deadlines.
• Borrowers have to memorize the deadline of their borrowing books.
• It is hard for borrowers to know when a wanted book is available.
• All activities that relate to borrowing and returning books are manual.

Our proposed solution is to build a system named Just Walk out Library (JWL), which uses NFC, QR Code, RFID technologies to create a more easily and efficiently book - borrowing process: Borrowers only need to use smartphones to check in the library and borrow books, the system will automatically match and save the right books to the right borrower. Therefore, our solution helps to reduce librarian's work in book – borrowing process, let them have more time for other tasks. Furthermore, librarians and borrowers can manage the borrowing books better. Out idea comes up with the following features:

• Check in: JWL application supports both NFC and QR Code. To gain permission to the library, borrower only needs to open the application on his/her phone, and scan it on our check - in device. He/she will be checked in automatically.
• Borrow books and check out: the borrower finds all the books he/she needs on the shelves, and takes them out. The RFID Reader Device and the iBeacons at the gate will automatically recognize that borrower and record the list of books he/she borrows.
• Ring the alarm: The alarm will go off if someone:
  - Takes the books out without having JWL's mobile application turned on and a logged in, valid account, or turn off Bluetooth, internet connection.
  - Exceeds the book limit that they can borrow.
  - Does not have enough money to borrow more books.
  - Checks in, or borrows books with invalid account.
• Search: a borrower can search for the books they want by title. The search result will show the book (if it is stored in the library) and its availability (if it is still available to be borrowed).
• Make wish list: a borrower can mark a book to his/her wish list so as to receive notification when the book is available again.
• Manage borrowing books:

Librarian can manage borrowing books by getting information of the books, their borrowers, and books borrow status (late or not). Librarian can also help borrowers to borrow books.

Borrower can get information of his/her borrowing books, receive notification when a book is near its deadline, and renew a book's borrow time.

• Returning books: Librarian can help borrower return book by using Book Scanner Device.
• Renewing books: Extend the deadline of borrowing book.

III. PLAN IMPLEMENTATION

A. System Technology

In order to solve the stated problems, we apply four technologies: NFC, QR Code, iBeacon and RFID.

1. Near Field Communication (NFC)

JWL System uses NFC for its check-in function, which needs two devices:

a. Check-in device, implements NFC Reader/ Writer Mode.
b. JLib application for borrowers, implements NFC Card Emulation Mode without secure element.

Source: Google Android

When a borrower uses his smartphone (with JLib opened) to tap on the check-in device, the device sends a request with JWL's Application ID (AID) to the phone. Android OS send with AID to the service. The service handles the request and responds to the check-in device with needed information. The check-in device sends the received information to JWL System for checking in that borrower (see Figure 1).

2. Quick Response Code (QR Code)

JWL System uses also QR Code for its check-in function as an alternative for NFC, which needs two devices:

a. Check-in device, reads and decodes QR Code from smartphones.
b. JLib application for borrowers gets and

displays the QR Code of a borrower.

When a borrower uses the QR Code on the main screen of JLib Application to scan on the check-in device, the device reads and decodes the code, then sends the decoded data to JWL System for checking in that borrower (see Figure 2).

3. iBeacon

JWL System uses iBeacon in its automatic book-borrowing process:

a. Initializing checkout: to recognize which borrower is getting out of the library.

b. Finishing checkout: to notify the system whether to stop the automatic book-borrowing process, so that the system can save all the borrower's books and check out.

4. Radio Frequency Identification (RFID)

JWL System uses RFID to identify book copies:

a. RFID tag: is attached to each book copy in the library.

b. RFID Reader: is used to scan ID from RFID tags on book copies and send that data to the system to handle.

B. Algorithms

1. Check-in Algorithm

The check-in algorithm helps the system be aware of the present of a borrower in the library. Checking-in has two meaning to the system: (1) Help librarian identify a borrower before giving the access right to that borrower, and (2) Record the presence of the borrower to the system, to enable the book – borrowing method for that borrower.

Define the problem

- To prevent robbery, book damaging, and other delinquencies that may happen in the library, a borrower needs to check-in so that the librarian and the system can verify his/her authentication.
- To check-in, each borrower needs a unique identification key.
- Someone may take another's identification key to have long-term access right to the library.
- With tradition library card, a librarian must check borrower's information by himself/herself. The job can be inaccurate if the librarian has a long working day.

Solutions

To solve those problems, the check in algorithm has the following features:

- Use a check in device that has both sound and text message to assist librarian in identifying a borrower.
- Use the borrower's user ID and server's current date to encode a unique identification key the current date.
- For encoding, the system uses Secure Hash Algorithm 1 [10].
- Borrower can use either QR Code or NFC in his/her smart phone to check-in with the check-in device. This device will interpret the information in borrower's phone and send the system's server for validation.

To be able to provide those features, the check in algorithm includes two children processes:

- Generate identification key for borrower.
- Check-in with the given identification key.

2. Automatic book-borrowing Algorithm

The automatic book - borrowing algorithm proposes method to automate the book – borrowing process in the library.

Automatic book - borrowing algorithm has two meanings to the system: (1) Help librarian reduce the workload, and (2) Provide borrower an easier and faster way to borrow books.

Define the problem

Traditional book – borrowing process can be time-consuming and tiring for both librarian and borrower. In order to borrow books, a borrower has to follow a long process; including bringing books to the librarian and fill in borrow forms. On the other hands, librarian has to manually check a borrower's forms and books. This could lead to long waiting lines if there are many borrowers.

Solution

To solve those problems, the book - borrowing algorithm needs the following setup:

The book – borrowing algorithm needs three child processes, including Initialize checkout, Scan book and Finish checkout.

IV. ANALYSIS

Our solution's performance and functionality are tested through extended testing process. The testing result is presented in the next section:

1. Check-in Algorithm

1.1 Generate identification key for borrower.

When borrowers log into the mobile application, the application will get the user ID and the current server's current date to generate identification key. Then, the application stores it and ready to use.

1.2 Check in with the given identification key.

The application's screen shows a QR Code, borrower can check in by scanning it through camera of check in device or using NFC. In the case of using NFC, user puts the back of mobile phone on the check in device. After-ward, identification key will be encoded and sent to server. Servers also generate its own key by the same way and compare to the borrower's key. If they are the same, JWL system will allow borrower to enter the library.

2. Automatic book-borrowing

2.1 Init checkout

When user enters the region existing initialized iBeacon's wave, the initialized checkout function will be sent to server, including two parameters which are iBeacon Id and user Id. Server check whether borrower's status is "in library". Borrower cart then will be created for that borrower.

2.2 Scan book

When user scans books that they want to borrow through the RFID scan book device, iBeacon Id and Books' RFID will be sent to server. The next step is implemented by server, it will find books based on books' RFID and add those books into borrow cart.

2.3 Finish checkout

When user enters the region existing finish iBeacon's wave, the finish checkout function will be sent to server, including two parameters which are iBeacon Id and user Id. Server then find the borrow cart by user Id and check whether it has books. If the answer is yes, server will save the books into borrow list and remove the corresponding borrow cart. Finally, the status of "in library" will be changed from TRUE to FALSE.

V. EXPERIMENTAL RESULTS AND CONCLUSION

The testing for this project consists of Integration System test level. Testing the program after integrating and completing system clarifies whether the software requirements have been met.

Integration testing would be performed by all member of team and approved by team leader. System testing focuses on assessing the system's reliability. This process is concerned with finding errors that result from unanticipated interactions between components and component interface problems using black-box testing and check list.

Our system test cases include Web and Mobile Application Test Cases.

- **Web Application Test Cases**

Test Cases Description	Pass
<Unauthorized User> Login	
Login with valid user Id and password	86/102
Login with invalid user Id or password	84/98
Sign in with blank user id or password	88/92
<Librarian> Borrow book	
Borrow book for borrower	45/50
<Librarian> Return book	
Return book for borrower	43/60

- **Mobile Application Test Cases**

Test Cases Description	Pass
<Unauthorized User> Login	
Login with valid user id and password	70/100
Login with invalid user id or password	82/ 98
Sign in with blank user id or password	87/92
<Borrower> Check in with NFC	
Normal borrower scan NFC under emulator	57/78
Deactivate borrower scan NFC under emulator	52/80
Borrower scan phone with out-dated NFC code.	40/52
<Borrower> Check in with QR Code	

Borrower scan QR code under emulator	52/75
Deactivate borrower scan QR code under emulator	55/88
Borrower scan phone with out-dated QR code.	43/59
<Borrower> Scan book	
Borrower's balance is smaller than the needed money to borrow book.	33/39
Borrower scan borrowed book.	30/42
Borrower scan available book and his balance is possible to borrow.	31/45
Borrower scan book does not belong to library.	35/40
<Borrower> Check out	
Go check out without carrying any book.	51/60
Go check out with available book.	52/57
Go check out with available book and open app.	56/60
Go check out with available book and app run in background.	52/60
Go check out with available book and turn off monitor mobile.	55/62

After hundreds of times testing to improve the system and eliminate errors, the whole process of JWL System now can run smoothly and stably. In order to use the services of library, borrower just need to check in JWL System using NFC or QR code, then they can scan books to borrow by themselves and check out to complete the process.

VI. ACKNOWLEDGMENT

First and foremost, we would like to express our greatest gratitude to our supervisor, Mr. Kieu Trong Khanh, for his support during our 9 semesters, especially this project. Enthusiastic guidance given by him, plus insightful suggestions and feedback made it possible for us to conduct this report. This has been a great instruction in this strenuous journey.

Additionally, our project would not be completed without experimental support from Mr. Dinh Truong Lam, Head of Library of FPT University. We would like to give him sincere thanks for his inspiration and enthusiasm. Those were great motivations for us to accomplish this work

Last but not least, we would like to send our special appreciation to all FPT University Lecturers who have taught and guided us from the very beginning. The knowledge and experiences they provided are valuable resources, which help us prepare for this research.

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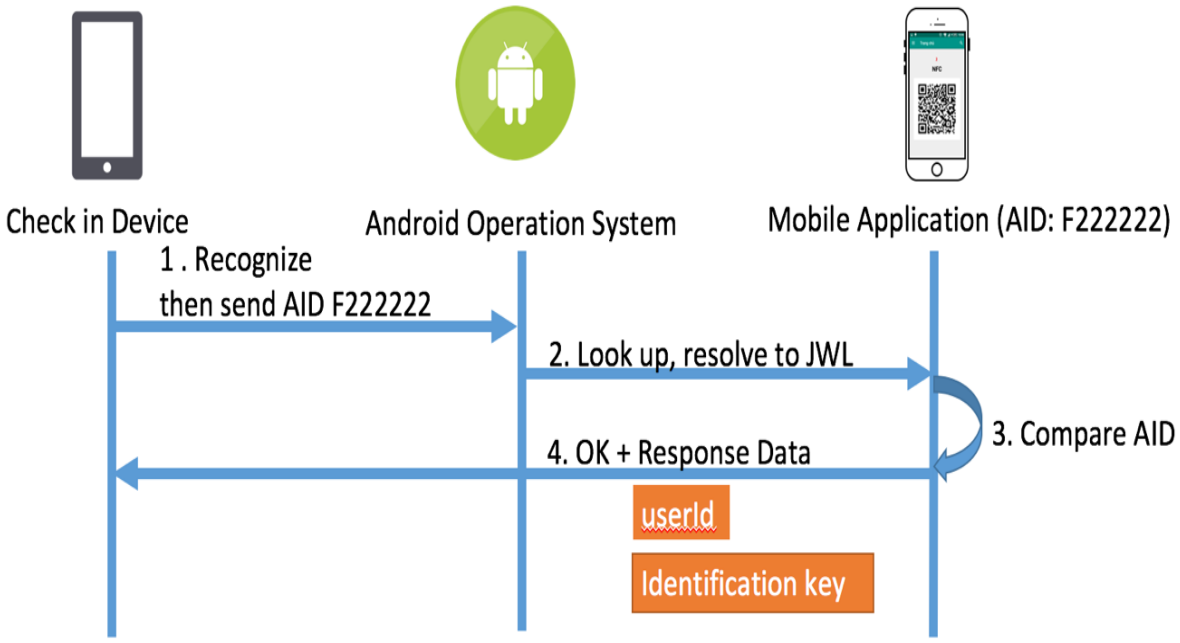

Figure 1: How the check-in device gets information from user's smartphone with NFC

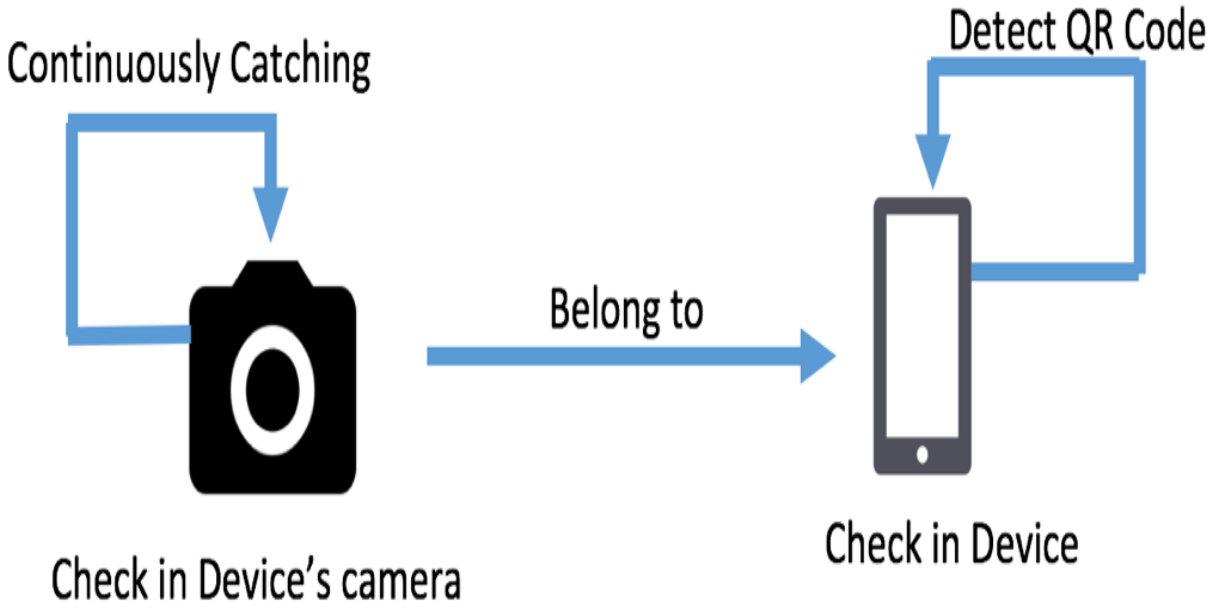

Figure 2: How the check-in device gets information from smartphone with QR Code

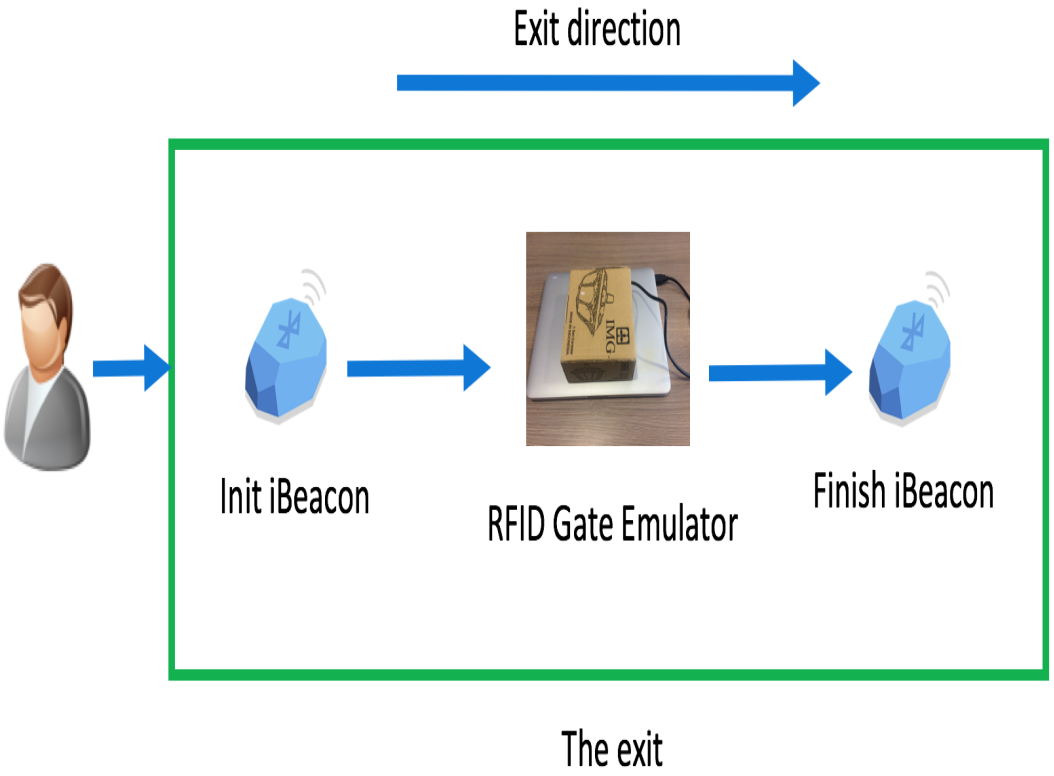

Figure 3: Book-borrowing devices setup

Shopping Clothes with Pictures

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Abstract

The problem centered on the process of extracting properties of given images using Convolutional Neural Network or CNN. These properties will later be used to search for appropriate clothes. Images with low resolution and quality may produce unexpected results. From a set of data collected from the past we can use them to figure out an estimate function. Later we combine these functions into Neural Network that can be used to determine properties of an image. Finally, we also apply Convolution to break down an image into tiles, collecting most important properties of given images and Max-pooling to reduce the size of the data while processing.

Keywords

convolution • neural network • estimate function • max-pooling • CNN

1. Introduction

Shopping online has become very popular among the world but they are lacking of a way to do visual shopping. Sometimes, people want to buy clothes but they do not really know what is the type or properties of them. As a result of fact, solving visual shopping problem is necessary. There are different ways to solve the problems.

Using supervised learning is one of the approaches to solve image recognition. This approach will apply algorithms to figure out the label of an image (these labels have been predefined). Bernd Heisele - senior scientist of MIT - has successfully applied this method. Another way is using CNN to solve the problem. This method will break down given images into titles of picture to get all properties and combine them to the final result.

Our proposal in this paper is not going to introduce a new way of doing image recognition, this is our mere attempt on applying CNN and some basics of Deep learning into visual shopping, which particularly in this case, are clothes. Human eyes can effortlessly recognize different kinds of pattern on a shirt, almost instantly, because our brains are programmed to do more complex image processing by nature. All the work is done unconsciously, therefore, human normally do not know how tough a problem our visual system solves.

The difficulty of image recognition arises when we attempt to make a machine-like computer to do the work for us. What seems easily to recognize like a T-Shirt has a shape of a letter “T” and often comes with round neckline, short sleeves and no collar turn out to be rather difficult to describe it algorithmically. The idea of Neural Network is to take a large number of T-Shirt images, captured in different perspectives, known as training data. The machine will then learn from those training data to form a set of rules or estimate functions for recognizing images of T-Shirt.

However, clothes have a wide range of type, category, color and pattern, having a large pool of training data is insufficient and will apparently require a method of breaking down what properties or patterns are there in

the T-Shirt. Convolution comes in handy in this situation, combined with Neural Network, we have a Convolutional Neural Network functioned as a human brain for machine with a visual cortex containing millions of neurons.

2. Problem and Solution Plan

Supposedly given an image consisting of different types of clothes with distinct patterns like below:

How can we possibly feed this image to a computer and teach it? How many types of clothes are there in the image? How many of them are not actually clothes and what are the properties of them?

Plan To make computer process an image, we have to turn it into some sort of numerical data type. After turning an image into processable input, we proceed to figure out estimate function and neural network from a given data set. An image can contain different kinds of clothes, to get the desired one, we have to break it down into tiles to process. To reduce the amount of processing times, we apply the technique called max-pooling. Once we are able to figure out all the numbers, what left is the accuracy of the whole process, we have to ensure the chance of recognize the same product in the future is acceptable.

3. Plan Implementation

3.1 Common shopping process

After doing some researches, we have come up with 3 most common steps people would normally do when they want to buy a piece of clothes:

- First, you have to decide what is the type or category of the clothes you want to buy
- Then you need to find the properties of it
- Finally, find the suitable color

From the above steps, we are introducing 3 terms: concepts (or properties) and colors. In order to implement these terms, we make use of Clarifai – a visual recognition API that based on Deep learning, to create 3 models with the same name.

A quick example on a common shopping process:

Applying 3 steps above to define this piece of clothes:
-Its category is T-Shirt
-Its concept is stripe
- Its color is white and blue

3.2 Produce estimate function and neural network

- Step 1: turn the image and labels into numerical data type
- Step 2: apply algorithms to figure out possible functions that receive images as inputs and produce labels as outputs. In another way, we find functions that fit in the data set
- Step 3: using different methods of testing to figure out the best functions that can produce appropriate outputs from new inputs (inputs not included in the above data set)
- Step 4: combine the estimate function above to produce neural network. Neural network is a set of estimate function, each node of the network represent an estimate function. A new input can be put into the network and output the properties of it.

Above are basic steps to produce estimate functions and form a neural network. Let's get into detail:

Category	Size	Color	Price
T-Shirt	S	Blue	500.000
T-Shirt	L	Red	1.200.000
Shirt	M	Blue	800.000
Shirt	M	Red	???

Given that we have a set of data collected from the past listed in a tabular view including the

inputs: Category, Size, Color and output is Price, how can we predict the outcome of the new entry, which is Price, in the future?
Following the above steps, we first enumerate the data into numerical data type

- { T-Shirt, Shirt, Jeans } = { 0, 1, 2 }
- { S, M, L, XL, XXL } = { 0, 1, 2, 3, 4 }
- { Blue, Red, Green } = { 0, 1, 2 }

So the requirement turns to → Find functions (f) that satisfy

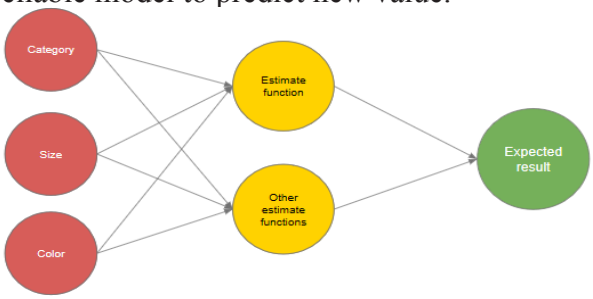
1. The function has three inputs (x, y, z)
2. The function has one output (the price)
3. It must satisfy:

- f(0, 0, 0) = 500
- f(0, 2, 1) = 1200
- f(1, 1, 0) = 800

From math and computer science we can have multiple functions to satisfy the requirement. For example, simple linear functions:

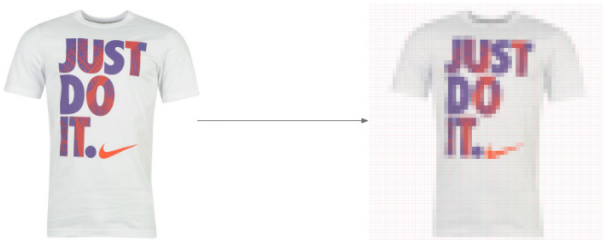
1. f(x, y, z) = 100*x + 200*y + 300*z + 500
2. f(x, y, z) = 200*x + 100*y + 400*z + 500

There are a lot of estimate functions that satisfy the solution. In real life, to determine the best one we have to make hundreds of tests.
Finally, using those estimate functions, we can form a neural network. Basically, Neural network is a set of results from estimate functions that later help us form a complex and reliable model to predict new value.

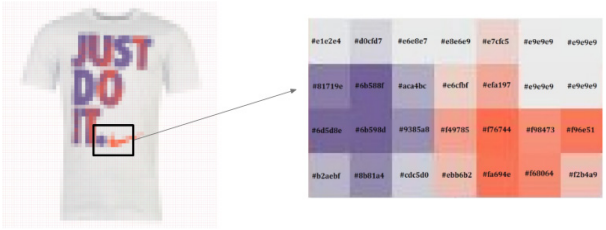


3.3 How to turn an image into numerical data type?

We can enumerate { S, M, L, XL, XXL } to number { 0, 1, 2, 3, 4 }, but questions arise when it comes to image.
In computer science, an image is created by thousands of pixels, each pixel hold a hex code that represent the color code of it in RGB.

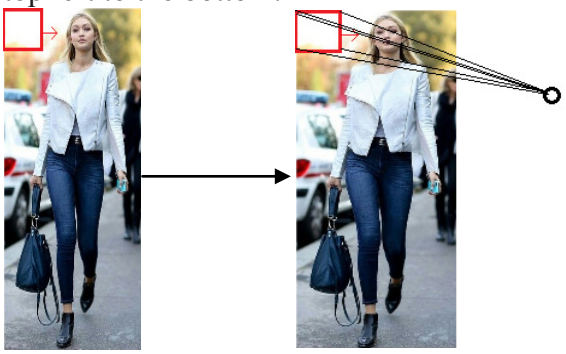


Taking this information, we can turn an image with the size n * m into a numerical matrix of n * m.



3.4 How can a picture be broken down into tiles?

An image may have many things in it. To recognize all of these things, we can use convolution. The concept is having the local receptive field or so called a sliding window slide across the image in size of m*m from the top left to the bottom.



We store all the properties collected from each tile into an array and continue to do so.

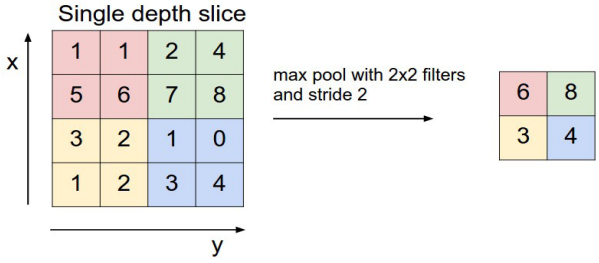
Result is the image being broken down into tiles of m*m, these tiles will later be put into our

neural network to produce the properties of it. At the end, we can combine all these properties to get the desired result.

3.5 How to reduce the amount of processing time

Using technique called max-pooling we will introduce functions that transform a set of data into another the set of data that have simple form, structure and taking less time to analyze.

For example, to find a max value of 16 numbers in a 4x4 matrix, we can first find the max value of each 2x2 matrix (there are 4 2x2 matrixes). After that the problems have turn into finding a max value of 2x2 matrixes (each value in the matrix represents the max value in a smaller problem above).



As for clothes, it is necessary to use max-pooling to filter the most important or significant part of an image. After we've done convolution, we apply max-pooling for each tile. Example: if you are looking for a shirt with various numbers on it, max-pooling will filter each tile to take out all the parts that do not represent the numbers.

3.6 Increase accuracy of the method

To increase the accuracy of a method we can fit the algorithm more and more data to produce more efficient estimate function and neural network. More testing methods are also needed to be taken into account

4. Analysis

Applying convolutional neural network into image recognition can be able to solve the problem of visual shopping.

Outcome:

- Able to retrieve all of the properties and filter the most important properties of an image without losing the quality of input data.

Limitations:

- The chance of getting a result is low if the provided image has low resolution or quality.
- Need a large pool of training data to enhance the recognition rate.
- In case of spontaneous input that does not already have training data in the system, the chance of getting a result is rather low

5. Experimental result and conclusion

We have executed some testing on 2 main criteria consists of clothes' category and concept (or pattern).

Testing result for category:

input	expect	actual	value	success
input/jeans_	jeans	jeans	0.66335034	TRUE
input/jeans_	jeans	jeans	0.8683362	TRUE
input/jeans_	jeans	jeans	0.7980292	TRUE
...				
total: 561				93% success

Testing result for concept (pattern):

input	expect	actual	value	success
input/jeans_	modern	modern	0.47318998	TRUE
input/jeans_	modern	modern	0.65074277	TRUE
input/jeans_	modern	modern	0.759209	TRUE
...				
total: 561				81% success

CNN has been widely used in image recognition, after our attempt to experiment CNN on clothes, we conclude that it is feasible and practical to recognize clothes using this technique, however, it is needed to take into consideration that the result is not always exactly the clothes that you want but rather close to what you want since clothes have a variety of types and patterns and apparently you will need an unlimited pool of training data to recognize them all exactly.

Acknowledgements

We sincerely thank to Mr. Kieu Trong Khanh, our instructor and research supervisor for his professional guidance and the useful, constructive recommendations throughout the course of this project.

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Economic Sector

A Study on Perceived Risk in E-Commerce

Case study in Ho Chi Minh City

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Abstract

In recent years, Vietnam E-Commerce is a potential and fast-growing market. In order to maximize its potential and understand the importance of Perceived Risk, researchers decided to conduct the research. The objectives of this study are to identify the components of Perceived Risk in E-Commerce context, and to determine whether there are differences in Perceived Risk in terms of genders; and to propose some managerial implications. The research method includes qualitative research (in-depth interview and focus group) and quantitative research (survey). Sample size is 400 with respondents living in Ho Chi Minh City and having already purchased online. The key finding is that Perceived Risk in E-Commerce consists of Perceived Risk associated with Product/Service, Perceived Risk happening during Transaction and Psychosocial Risk. Moreover, Male are more aware of Perceived Risks than Female. Managerial implications for companies are also mentioned in the study.

Keywords

Perceived Risk, E-Commerce, Gender Difference, Ho Chi Minh City.

I. INTRODUCTION

In Vietnam, E-Commerce is considered as new exchange market with many benefits for enterprises. E-Commerce industry includes prominent brands such as Vatgia.com, Lazada.vn, Adayroi.com, Tiki.vn, Sendo.vn, so consumers are gradually accustomed to shopping online instead of traditional shopping. According to VECITA (2015) [38], E-Commerce is developing rapidly through telecommunications systems, booming to about 1/3 of Vietnam Internet users. The percentage of websites featuring online ordering is 58%, while that of online payment is 15%.

However, E-Commerce does not reach its potential yet due to some barriers. One of the most noticeable reasons that prevent potential online consumers from joining E-Commerce activities is their Perceived Risks (Liebermann and Stashevsky, 2002 [22]; Snoj, Korda and Mumel, 2004 [31]; Mitchell, 1999 [26]). Since E-Commerce is a new market and there is not enough reliable information and trust towards the market, consumers are often reluctant when deciding whether to make an online purchase or not (VECITA, 2015 [38]; Pallab, 1996 [29]). In the study of Snoj, Korda and Mumel (2004) [31], belief about the potential uncertain negative outcomes from the online transaction is the major barrier for trading online.

Understanding consumers' Perceived Risk is

of great concern to managers (Kalakota and Whinston, 1996 [15]). However, according to Macintosh (2002) [23], Perceived Risk is the least studied concept of sacrifices. In Vietnam, there are few types of research focusing on Perceived Risk in E-Commerce. Therefore, researchers have decided to conduct "A Study On Perceived Risk In E-Commerce: Case study in Ho Chi Minh City".

II. THEORETICAL BASIC & LITTERATURE REVIEW

2.1 Theoretical basis

In Oxford Dictionary (2015) [28], Internet is defined as a worldwide computer network, which comprises interconnected networks using standardized communication protocols to supply a diversity of information and communication readiness. For further details, since 1995, Resolution of the U.S. Federal Networking Council has propounded the definition of the Internet, which is accepted by many researchers and organizations (Kahn and Cerf, 1999) [13].

Academic definitions of E-Commerce are narrowed and focused on applications and business supports. For example, Zwass (1996) [39] defines E-Commerce as using many means of telecommunication networks to share business information, converse business relationships and conduct business transactions. Turban, King, Lee, Liang, Turban, and Lang (2013) [37] defined E-Commerce as the process of buying, selling, transferring, or exchanging products, services, and information through computer networks, mostly the Internet and Intranet.

Consumer behavior is the study about processes that individuals, groups, or organizations use to select, secure, use, and dispose products, services, experiences, or ideas, so as to satisfy their needs and wants. It is also concerned with the social and economic impacts of purchasing and consumption behavior on both the consumer and wider society (Kuester and Sabine, 2012) [20].

According to Kotler and Armstrong (2004) [18], Marketing is considered as the process in which companies create value for consumers, build mutual relationships, and capture value from consumers in return. Besides, basing on the viewpoint of organization, Perreault, McCarthy, Cannon and Perreault (2010) [30] said that marketing is the process of carrying out activities to achieve the goals of organizations by anticipating the needs of consumers to control the flow of goods and services to meet them. In other words, marketing can be also understood as the economic and social mechanism that organizations and individuals use to satisfy their needs and wants through the process of exchanging products on the market (Thai, 2017) [36].

2.2 Literature review

In 1960, Bauer pioneered the application of Perceived Risk theory to consumer behavior and indicated that Perceived Risk is developed on the basis that all consumer behavior involves risk and that, in uncertain circumstances, actions conducted by consumers may produce consequences that are beyond their expectations and unpleasant. On the other hand, Featherman and Pavlou (2003) [2] defined Perceived Risk as consumers' feeling unclearly about possible negative consequences when using product or service. They also identified seven dimensions of Perceived Risk: performance risk, financial risk, time risk, psychological risk, social risk, privacy risk, overall risk. In their research in predicting E-Service adoption based on Perceived Risk Theory, Featherman and Pavlou (2003) [2] combined the psychological and social risk facets of Perceived Risk into one Psychosocial facet as defined by Cunningham (1967) [1]. In addition, as mentioned by Lee, Park and Ahn (2001) [21], there are two sections of Perceived Risk in the process of online shopping, including Perceived Risks associated with Product/service and Perceived Risks happening during online Transaction.

To understand the negative utility (potential losses) attribute to e-service adoption, Featherman and Pavlou (2003) [2] did a research "Predicting E-Service adoption based on Perceived Risk Theory". The research gave out a proposed E-Services adoption model by operationalizing, integrating, and empirically testing specific risk facets within the Technology Acceptance Model. Also in the research, due to the low number of items when

measuring the psychological and social risk facets, the authors combined these facets of Perceived Risk into one psychosocial facet as defined by Cunningham (1967) [1]. Research findings indicated that performance-based risk facets (time risk, privacy risk, financial risk) adversely influenced e-services adoption, and perceived ease of use decreased these risk concerns. Performance-related risks proved to be the most salient concerns for the sample and context, with the fact that they appears to be the basis for all other risk facets. Meanwhile, the social risk concerns—the chance of losing status by using the e-service, were not noticeable.

In 2001, Dongwon Lee, Jinsoo Park (University of Minnesota) and Joong-Ho Ahn (Seoul National University) [21] conducted "On the Explanation of Factors Affecting E-Commerce Adoption" article. They integrated the technology acceptance model with the theories of Perceived Risk to explain the E-Commerce Adoption Model (e-CAM). In details, they examined the influence of Perceived Ease of Use, Perceived Usefulness, Perceived Risk with Products/services (functional loss, financial loss, time loss, opportunity loss, and overall perceived risk with product/service), and Perceived Risk in the context of online Transaction (privacy, security (authentication), nonrepudiation, and overall perceived risk on online transaction) on the consumer's Purchasing Behavior. Subjects for the study were the undergraduate and MBA students at two major universities in the United States. The survey lasted about a month and collected 183 responses, among which there were only 176 valid responses. The results revealed that Perceived Usefulness, Perceived Risk with Products/services and Perceived Risk in the context of online Transaction have strong direct effect on the adoption of E-Commerce.

Thus, from related researches mentioned above and qualitative researches, the authors propose the model of Perceived Risk in E-commerce as follows:

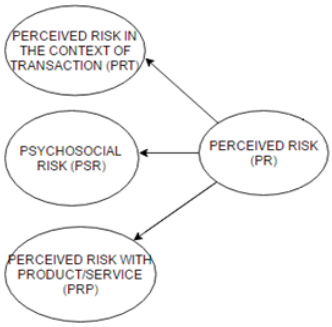


Figure II.4. Proposed Research Model.

Furthermore, according to the research of "Gender differences in the Perceived Risk of buying online and the effects of receiving a site recommendation", conducted by Garbarino and Strahilevitz (2004) [5], there is gender difference in how men and women perceive risks associated with online shopping. Even when controlling for differences in Internet usage, women perceive a higher level of risk in E-Commerce than do men.

Therefore, the researchers develop hypotheses to test how gender affects risk perception in E-Commerce, case study in Ho Chi Minh City. The proposed null hypotheses are stated as follows.

H01: There is no significant difference of Perceived Risk associated with Product/Service between male and female.

H02: There is no significant difference of Perceived Risk happening during online Transaction between male and female.

H03: There is no significant difference of Psychosocial Risk between male and female.

III. METHODS & DATA

3.1 Data

In-depth interview is method in which participant was asked by an interviewer face-to-face. The authors decide to interview an expert working for Vat Gia Corporation. In the interview, the expert introduced E-Commerce market in Vietnam was in the explosive period. She thanked to some reports, in which many evidences were showed to realize that this market was potential. However, she also mentioned that there were too many risk for consumers when they bought products or service

via E-Commerce website. For more specifics, the consumers were facing various types of risk such as product risk, time risk, financial risk, security risk, privacy risk, and non-repudiation risk. Moreover, she emphasized that especially in Vietnam market, there were the appearance of opportunity risk, relationship risk and social risk, since buying via E-Commerce website was not popular, while the traditional trade played an important role in everyday trading.

A focus group is a group interview that focuses on a particular issue, product, service or topic by encouraging discussion amongst participants and the sharing of perceptions in an open and tolerant environment (Krueger and Casey, 2009) [19]. In this research, eight participants had purchased through E-Commerce website. They include four students, two professors and two employees in FPT University Campus Ho Chi Minh City. In the interview, the participants said that they bought many kinds of products via E-Commerce websites, such as cosmetics, fashion items, household devices and electronic devices. Moreover, Tiki.vn, Lazada.vn, Amazon.com, Taobao.com were the popular websites that they often visited to look for the information and make orders. Most of them knew these websites by their friends and the advertisement banners in other websites. When asked about their Perceived Risk when buy on E-Commerce websites, they realized that there were many types of risk including time risk, financial risk, performance risk, privacy risk, security risk, non-repudiation risk, social risk and psychological risk. The interviewees also mentioned that if they felt the risk in some E-Commerce websites, they would not buy products or service via these websites, never introduced these websites for their friends. On the other hands, six over eight participants agree with the interviewer about the opportunity risk when purchase in E-Commerce websites. Most of the reasons why they perceived the opportunity risk were that they found other websites sell the same products with low prices, that buying this products means they waived buying other products. Participants in the interview also assisted the author in developing and adjusting variables that fit the scale, adding, subtracting or changing the wording for comprehension and relevance to all participants who attempt the official survey. Qualitative research results help the authors get the corrected scales.

The authors decided the sample size in this paper would be 400. In terms of sample demographics, respondents' characteristics are varied widely (Morgan and Hunt, 1994) [27], and are considered in this section. While demographics information has no impact on the level of analysis of this study, this reporting may provide a generalized views of gender, career, income and age in term of buying via E-Commerce websites. Table III.1 presents for more specific information.

Table III.1. Respondents' Profiles

Demographic Feature		**Frequency**	**Percent (%)**
Gender	Male	183	45.8
	Female	217	54.2
Career	Student	263	65.7
	Teacher	16	4.0
	IT	44	11.0
	Business man	17	4.3
	Officer	60	15.0
Age (year old)	From 18 to 25	366	91.5
	From 26 to 35	34	8.5
Income/ month (million)	Less than 5	240	60.0
	From 5 to 10	91	22.7
	From 10 to 15	69	17.3

The questionnaire structure consists of three parts: screening questions, survey questions, and personal information. Part 1 employs Nominal Scale to develop Screening Questions, whereas Part 2 applies the 5-point Likert Scale to determine consumers' Agreement level in three factors. The measurement scales of Perceived Risk are demonstrated as follows.

Component	No. of items	Adopted from authors
Perceived Risk associated with Product/ Service (PRP)	5	Forsythe and Shi (2003) [3]; Tan (1999) [35]; Forsythe, Liu, Shannon and Gardner (2006) [4]; Stone and Gronhaug (1993) [34]; Featherman and Pavlou (2003) [2].
Perceived Risk happening during online Transaction (PRT)	4	Kim, Ferrin, and Rao (2008) [17]; Hartono, Holsapple, Kim, Na, and Simpson, J. (2014) [10].
Psychosocial Risk (PRS)	3	Featherman and Pavlou (2003) [2].

3.2 Methods/Framework

Descriptive statistics is applied to not only describe the basic characteristics of the data but also provide an elementary summary of sample and measures. This provides the basis for all quantitative data analysis. When summarizing a quantity of consumer characteristics such as gender, age, income, the statistical parameters usually mentioned are frequency, percentage.

The reliability of scale is evaluated by using the Cronbach's Alpha coefficient. This is the reliability confidence used to measure the correlation between observed pair variable. According to Hair, Wolfinbarger, and Money (2011) [8], the Cronbach's Alpha coefficient over 0.7 is usable, Corrected Item - Total Correction correlation between each item and the scale is no less than 0.3.

Factor Loadings are the single correlation coefficients between variables and factor systems. The selected observational variable is the factor whose Factor Loading is greater than or equal to 0.5 (Hair, Wolfinbarger, and Money, 2011) [8] and KMO coefficient (Kaiser Meyer Olkin) is from 0.6 to 1 (Kaiser, 1974) [14]. Cumulative of variance is the percentage of total variance cited by the factors. Total variance accounted for with the addition of each successive factor. According to Kaiser (1974) [14], the criterion for accepting factorial analysis is cumulative of variance greater than 50%.

Confirmatory Factor Analysis helps to clarify the indicators: the reliability of the scale, the convergence and divergence value. A study model is considered appropriate for market data if the Chi-Square test has P-Value less than 5%; Chi-Square divided by degree of freedom (CMin/df) less than or equal 3 (McIver and Carmines, 1981 [24]); both Goodness of Fit Index (GFI), Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) are equal to or greater than 0.9; Root Mean Square Error of Appropriation (RMSEA) is less than or equal to 0.08 (Steenkamp and van Trijp, 1991 [32]; Hair, Black and Babin, 1998 [9]). The reliability of the scale is assessed by the composite reliability and cumulative of variance. The scale is valid if the cumulative of variance of each concept and composite reliability are greater than 0.5 (Hair, Black and Babin, 1998) [9].

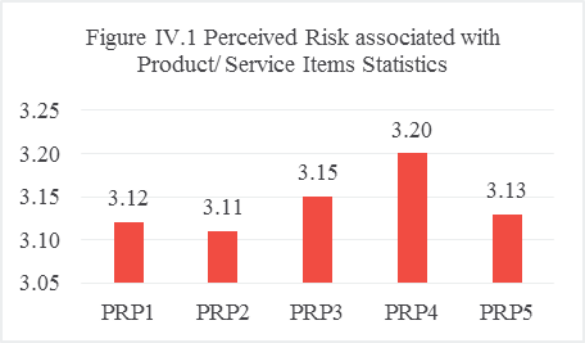
Using SEM allows researchers not only to explore measurement errors and incorporate abstract concepts that are difficult to distinguish but also to incorporate the hidden concepts into theoretical models at the same time (Hulland, Chow and Lam, 1996) [12].

The Independent-Samples T-Test assesses whether the means of two independent groups (Meyers, Gamst and Guarino, 2013) [25]. The result of Independent-Samples T-Test has an effect on testing the hypothesis about the equality between the mean of two independent groups by significance in equal variances assumed or not (Hair, Wolfinbarger, and Money, 2011) [8].

IV. RESULT & FINDING

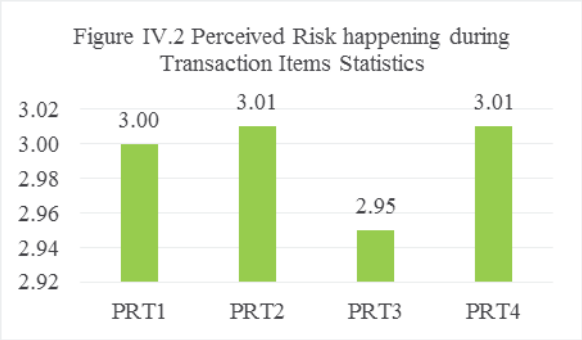
4.1 Mean Values

Figure IV.1 Perceived Risk associated with Product/ Service Items Statistics

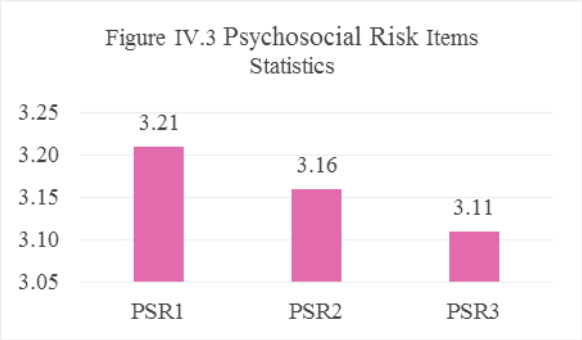


In terms of Perceived Risk associated with Product/Service (PRP), PRP4 ("I am concerned about that it is too complicated to make an

order") has the highest rate of agreeableness, while PRP2 ("I am concerned that the product cannot reach my expectation.") is the lowest.



In Perceived Risk happening during Transaction scale, PRT2 ("I am concerned that the website will use my personal information for other purposes without my authorization.") and PRT4 ("I am concerned about the trustworthiness of the website") have the highest mean value, while PRT3 ("I am worried that my personal information is not securely managed in the website") is the lowest.



In Psychosocial Risk scale, the highest rate of agreeableness is PSR1 ("I am concerned about using the website will negatively affect the way others think of me"). PSR3 ("My signing up for and using the website would lead to a social loss for me because my friends and relatives would think less highly of me") is the lowest mean value.

4.2 Reliability test

Cronbach's alpha scores shown in Table IV.2 below indicated that each risk facet exhibited strong internal reliability. The Cronbach's alpha score for adoption intention suggests that both observed variables of the Perceived Risk scales are kept stably for Exploratory Factor Analysis (EFA).

Table IV.2. Cronbach's Alpha results

Scale	No. of items	Cron-bach's Alpha	The lowest Corrected Item-Total Correlation	The highest Cronbach's Alpha if item deleted
PRP	5	0.882	0.661	0.870
PRT	4	0.870	0.679	0.852
PSR	3	0.786	0.603	0.735

4.3 Exploratory Factor Analysis

Based on the EFA test, all indexes (Table IV.3) meet the requirement. So, all observed variables have correlation with each other, the factors analysis is applicable and the components have the best meaningful summary information. In more specific, 12 observed variables are reduce and separated into three components (Table IV.4).

Table IV.3. KMO results

Evaluation factor	Value
KMO measure	0.893
Sig of Bartlett's test	0.000
Eigenvalue	1.342
Cumulative Variance Extracted	70.105%

Table IV.4. Principal Components

	Compo-nent		
	1	2	3
PRP1	0.814		
PRP3	0.784		
PRP2	0.776		
PRP5	0.762		
PRP4	0.749		
PRT3		0.825	
PRT2		0.817	
PRT1		0.791	
PRT4		0.749	
PSR1			0.823
PSR3			0.802
PSR2			0.787

4.4 Confirmative Factor Analysis (CFA)

The CFA result of Perceived Risk scales is present in the Figure IV.4. This model has degrees of freedom at 51 and Chi-square at 107.630 with P at 0.000. Moreover, the model

is suitable for market significance since both GFI (0.957), TLI (0.969) and CFI (0.976) are larger than 0.9. Besides that, RMSEA is 0.053 and smaller than 0.08. Besides that, all standardize regression weights are over 0.5, so the scales meet the convergence and divergence values. Moreover, the composite reliability and average variance extracted of all components in Perceived Risk are over 0.5 (Table IV.5). These results indicate that all Perceived Risk scales meet the requirement about the value and reliability. Overall, the fit statistics indicated a moderate fit between the data and the theoretical model. Based on these results and in accordance with literature on Perceived Risk, the three-factor model is used for further analysis.

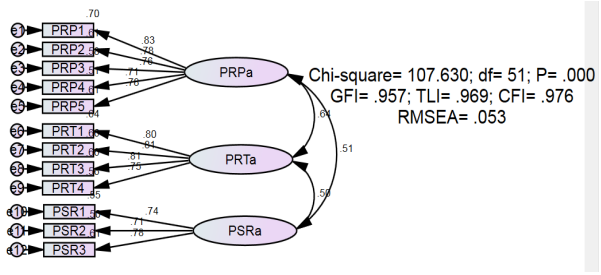


Figure IV.1. Confirmative Factor Analysis result

Table IV.5. Result of test summary table

Compo-nent	Number of items	Composite reliability	AVE (%)
PRP	5	0.88	60
PRT	4	0.87	63
PSR	3	0.79	55

4.5 Structural Equation Model (SEM)

The estimated results of the Perceived Risk theoretical model are show in Figure 4.3. This indicates that the Chi-square of 107.630 with 51 degrees of freedom is statistically significant at P equaling 0.000 and being less than 0.05, indicating an appropriate fit. Other fit statistics are within the acceptable values with GFI, CFI, TLI, which are over the commonly acceptable values of 0.9 (GFI = 0.957, CFI = 0.976, TLI = 0969), RMSEA is 0.053 and less than 0.08. Overall, the fit statistics indicated a moderate fit between data and theoretical model.

The estimated results of the Perceived Risk theoretical model are show in Figure IV.5. All indexes meet the requirements. The results demonstrate that the Perceived Risk includes three main components, Perceived Risk associated with Product/Service, Perceived Risk happening during online Transaction and Psychosocial Risk. Moreover, according to these results, Perceived Risk is measured by 12 observed variables or can be considered as 12 criteria.

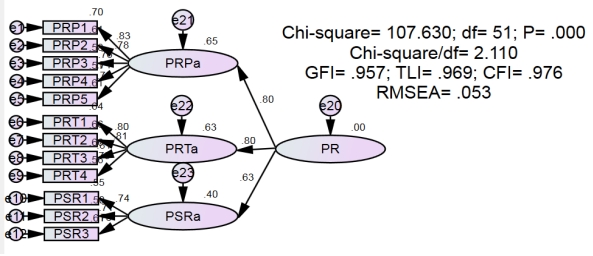


Figure IV.2. Estimated results of the Perceived Risk theoretical model

4.6 Independent Samples T-Test

According to Table IV.6, there are no different in variance of PRP, PRT, and PSR. Moreover, T-teest results imply that there are differences between male and female, in all three components of Perceived Risk, with reliability up to 90%.

Table IV.6. Independent statistics of Perceived Risk between male and female

Null hy-pothesis	Sig of Levene's Test	Sig of T-Test in Equal vari-ance not assumed	Result
H01	0.810	0.052	Rejected
H02	0.626	0.063	Rejected
H03	0.667	0.047	Rejected

Table IV.7. Means of Perceived Risk components between male and female.

Component	Gender	Mean
PRP	Male	3.28
	Female	3.08
PRT	Male	3.21
	Female	2.99
PSR	Male	3.33
	Female	3.12

4.7 Findings

Perceived Risk in E-commerce consists of three

components: Perceived Risk associated with Product/Service, Perceived Risk happening during Transaction and Psychosocial Risk. Among these three components, the most influential are Perceived Risk associated with Product/Service (PRP) and Perceived Risk happening during Transaction (PRT), with Estimated Standardized Regression Weight of 0.88 and 0.87 respectively. Meanwhile, the Psychosocial Risk (PSR) has the least impact on Consumers' Perceived Risk (Estimated Standardized Regression Weight equals 0.79).

Moreover, gender affects Risk Perception in E-Commerce. Male are more aware of Perceived Risk than Female, with nearly the same difference among the three components.

V. CONCLUSION AND POLICY IMPLICATION

In conclusion, based on the results, Perceived Risk in E-commerce Perceived Risk associated with Product/Service, Perceived Risk happening during Transaction and Psychosocial Risk. This is consistent with the results of Lee, Park and Ahn (2001) [21], Featherman and Pavlou (2003) [2].

Besides, men are more likely to perceive Risks in E-Commerce than women. This finding is in line with previous research documenting gender differences in perceptions of risk (Hersch, 1996 [11]; Gutteling and Wiegman, 1993 [6]; Gwartney-Gibbs and Lach, 1991 [7]; Steger and Witt, 1989 [33]).

These results suggest that online marketers may want to work on reducing Perceived Risk. Online companies should build trust with consumers by giving them complete confidence in the product/service that they provide. This can be achieved when online vendors improve the following service quality factors: reliability, responsiveness, assurance, and empathy (Kettinger and Lee, 1997) [16]. Making visual instruction on online buying process, Providing many payment methods, Applying quickly order tool, with which consumers do not have to register an account or login to make an order, and Fast Delivery Services are options to consider as well.

Furthermore, it is more important that online vendors enable consumers to place full trust on the privacy, security, integrity and availability of vendor information. Effective risk-reducing strategies may include money back guarantees and prominently displayed consumer satisfaction guarantees, and Simple statements and graphics stating that transactions are guaranteed. In addition, a privacy policy such as ''we will never sell your personal information period'' may reduce risk concerns (Lee, Park and Ahn, 2001) [21].

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Customer Behavior in Focus
A case study of Tiki Vietnam

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Abstract
In recent years, E-commerce or electronic retailing over the Internet has been continuously developed and become progressively important in the global economy. In Vietnam, there are more and more people trading via the Internet. As there are many e-retailers who provide poor quality of service and products, there are a large number of their customers deciding not to repurchase. This means it is not easy for the e-retailers to convince their customers to buy their products again. As a result, online repurchase intention is a crucial concept with directly affect the success or failure of an e-retailer. Within this research, authors would like to find the factors which affecting customers' online repurchase intentions in the specific case of Tiki Vietnam. We also figure out how they affect this intention. From this, we would like to suggest some recommendations for the Tiki Vietnam in specific and for E-retailers in Vietnam in general to enhance the online repurchase intention of their customers.

Keywords
E-commerce, Consumer behavior, Online Repurchase Intentions, Tiki Vietnam

1. Introduction
1.1. Research Background
In recent years, E-commerce has been rising in both quality and quantity due to the explosion of the Internet. After starting in 1994, E-commerce or electronic retailing over the Internet has been continuously developed and become more and more important in the global economy (Chua et al., 2006). According to the report of Worldwide Retail E-commerce Sales: The eMarketer Forecast for 2016 (eMarketer, 2016), worldwide retail E-commerce sales is estimated to reach $1.915 trillion in 2016, and a double-digit growth will continue through 2020, when sales will top $4 trillion. According to Vietnam E-commerce Market Survey proposed by Q&Me (2015), Tiki is a successful business model established by Vietnamese; we, therefore, would like to do a research about it in order to gain in-depth understanding about its success.

Tiki Corporation is a Business-to-Customer company which was established in 3/2010 by Mr. Tran Ngoc Thai Son. The name "Tiki" derived from the abbreviation of the words "Tiet kiem" (save) and "Tim kiem" (seek). The core values of Tiki.vn are: ease of search, affordability, and trustworthiness. It provides a wide variety of products such as books, electronic goods, consumer goods, housewares, fashion, beauty and healthy cares. The book on Tiki was sold with the price that was 10% - 20% lower than the prices offered by physical bookstores. In 2012, Tiki.vn was rated as the ECAWARD most favorite E-commerce website in all of 3 awards which are "Favorite E-commerce service", "Favorite delivery", and "Favorite online book store".

1.2. Research Objectives
We have two main objectives when doing this research:

- Identify key factors which affect online repurchase intentions.
- Understand the relationships between these factors and online repurchase intentions.

1.3. Research Scope and Limitations

Our research will be limited in Ho Chi Minh City and the result will be collected from January 2017 to March 2017. This report will concentrate on the customer behavior's aspect

during the research period that is customer repurchase intentions. This study primarily focuses on the Tiki's customer who already made the payment in Ho Chi Minh City. The research time is from 5th January 2017 to 17th April 2017. Moreover, the respondents of survey must be over 18 years old to analyze their behaviors, because in this age, people have to take the responsibility for their action. Hence, the behavior from this age is appropriate in order to analyze the topic.

Besides, according to Customer and Consumer Definition from Smallbusiness, the terms "consumer" and "customer" are often used interchangeably, but a consumer and customer are not always the same entity. In essence, consumers use products while customers buy them. A consumer may also be a customer and a customer can also be a consumer. Investopedia also confirms that "customer" and "consumer" are almost synonymous. Therefore, the customer behavior study is also the limitation of the consumer behavior research.

2. Theoretical framework and hypothesis development

In Vietnam, in spite of the rapidly development in online retailing, there is lacking in understanding of the facilitators of customer's online purchase intention because of little research or study done within Vietnam context and market. It is essential for researchers, investigators, especially for those who run online business to notice of the factors that impact to customers' repurchase from an online store. The expanded technology acceptance model (TAM) developed by Davis (1989) is the adopted as the underlying model with two most important determinants – perceived usefulness and perceived ease of use; integrates with perceived value, privacy, firm reputation, reliability, trust and functionality. These eight independent variables are considered to understand their effect on Tiki customers' repurchase intentions. This research develops eight hypotheses based on this framework to test the effect of each independent determinant in Tiki context.

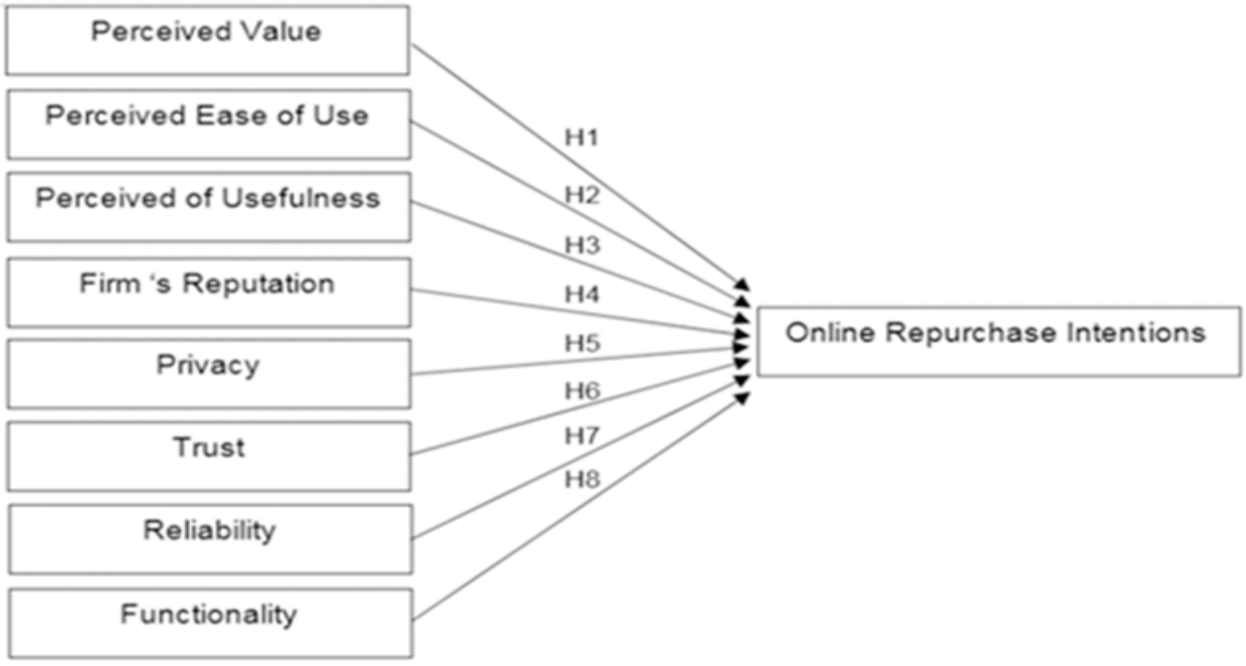

Figure 1: Theoretical framework of key determinants of online repurchase intentions in Tiki Vietnam

There have been many different scholars (Jacoby and Kyner 1973; Morgan and Hunt 1994; Quick and Burton 2000; Hillier et al. 2003; Fullerton 2005; Serders et al. 2005; Hume, Mort and Wizar, 2007) doing researches about the concept of repurchase as well as its indicators. According to Peyrot and Van Doren (1994), repurchase is a customer's action of continuously purchasing the same product or service more than one times. This means the customers decide to repeatedly purchase the same products from the same sellers. In a popular article, Serders et al. (2005) assumed that repurchase intention might increase the chance of actual repurchase behavior in the future; and, therefore, increase the possibility of future growth of a business.

Perceived value is the result of the equation that customer's perceived benefit exceed their perceived cost (Day 1990, p.142). Hume (2008), in addition, addresses that perceived value is the essential indicator of repurchase intention. It can be considered that if customer pay amount of money that create the high level of value, this would increase the return and repurchase willing. Based in the preceding discussion, we state the following hypothesis:

H1: There is a significant relationship between perceived value and customer online repurchase intentions.

Davis (1989) defined perceived ease of use as "the degree to which a person believes that using a particular system would be free from effort". Results of many scholars show the evidences that the perceived ease of use has a crucially and positive influence on customer's attitude when shopping online (Bisdee, 2007). Chiu et al (2009) clarified that the ease of use in e-shopping refer to the extent to which customer believes that it will be effortless when shopping online. It is consistent with the work of Selamat et al. (2009) which argued that the easier technology is always easily accepted for online shopping rather the complex technology. Thus, when web site is estimated to be ease to use, it would affect customer intentions to repurchase in the future. Hence, the hypothesis is stated as follow:

H2: There is a significant relationship between perceived ease of use and customer online repurchase intentions.

According to Davis (1989), perceived of usefulness is the degree to which a customer believes that the using technology will enhance his or her performance of an activity. It is the result of the work carried on by Chiu et al. (2009) that an individual is more likely to continue using when the usage is perceived to be useful. Customer accomplished the shopping in efficiency will have strongly intention to repurchase (Chiu et al., 2009). In addition, Chiu et al. (2009) argued that the perceived usefulness has the significant impact on customer loyalty intention. It is in the line when perceived usefulness is an important determinant of Technology Acceptance Model (Davis, 1989). Hence, we can base on the previous research to establish the following hypothesis:

H3: There is a significant relationship between perceived usefulness and customer online repurchase intentions.

It is defined by Hess (2008) is customers' perception on how responsible the firm is with their customer and is honestly take care of their welfare. Hess (2008) claims that with the great reputation, the firm can be protected from the negative consequences of failures; besides, firm reputation moderated the relationship between failure severity and satisfaction, lowered attributions of controllability and stability, and led to higher repurchase intentions following service failures. Attributions of the controllability and stability were connected to repurchase intentions; satisfaction is not the only intermediate of these relationships. From these previous study's findings, the excellent reputation can lead to the higher online repurchase intentions. It leads to the next hypothesis:

H4: There is a significant relationship between firm reputation and customer online repurchase intentions.

According to Chiu et al. (2009), privacy is defined as the degree to which the customers' information is protected and the web site is safe. It is consistent with Ward and Lee (2000) that privacy is talking about security and guards of customers' information online shopping in site. As the result of Collier and Bienstock research

in 2006, many buyers are afraid to purchase online or provide their personal information online due to fears of lack of privacy and possibility in which their personal information will be misused by online retailers. For example, it has been shown that customer will hesitate to make to transaction online if they are insecure about their credit card information that is not prevented from the potential hackers. The importance of this issue used to reveal by Flavián and Guinalíu (2006) that the protection of privacy is the greatest concern of Internet purchasers. Therefore, we base on the prior researches to establish the hypothesis as:

H5: There is a significant relationship between privacy and customer online repurchase intentions.

Customer's trust is the crucial role on long-term relationships maintenance with vendors. According to Chiu et al. (2009), trust is considered as a specific beliefs set that mentions about the integrity, capability and benevolence of another party. Integrity is the belief of honesty that trustee shows in its commitments (Chiu et al., 2009; Ndubisi, 2011). Capability is the belief of competence to carry out the duties as the trustor's expectation (Chiu et al., 2009). Benevolence is the belief that even given opportunity to act against trustor, the trustee will not do harm to their settlor (Chiu et al., 2009; Ndubisi, 2011). Customer's uncertainties, as a result of Eisingerich and Bell's work (2007) can imply the potentials transaction failure and negative consequences; thus, trust is the important role to maintain the long-lasting relationships. The decrease of trust in customer will make the firm lose much more chance the engage with them in online shopping because people will not willing to pay money for whom they feel doubt. The analysis comes to the hypothesis as:

H6: There is a significant relationship between trust and customer online repurchase intentions.

According Goode and Harris (2007), the perceived online reliability is the working consistence of a particular site that operates as expected. The research of Kim et al. (2009) shows that service reliability is one of the important criteria leading to customer's satisfaction. While, it is crucial to focus in perceived reliability because this factor attracts new customer and retain the existing (Goode and Harris, 2007). This prior study found that online customer will not believe in failure performance, after that shopper will often leave this site and feel frustrated with the bad performance. Thus, many experts argue that consumer's perceive of a site is reliable; the loyalty will increase (Goode and Harris, 2007). Hence, the following hypothesis is:

H7: There is a significant relationship between reliability and customer online repurchase intentions.

Functionality refers to the degree to which a website is built to provide the sufficient information about the product or service (Law and Bai, 2008). In a study of Yates (2005), the functionality is defined as how the firm can efficiently and effectively deliver their information by mechanism in the providing time. In prior research, Chang and Chen (2008) give the evidence that the important issue is when surfing website and customer cannot find out the required or desired information. Therefore, website is used as an environment to match customer's finding and website's providing. Thus, this environment must be trustworthy and easy to make to transaction. If customer faces a lot of difficulty in this website, the chance to repurchase is less as well (Chang and Chen, 2008). In other way, customer will be willing to buy again in the future from that store when that website is more functional (Yates, 2005). Consequently, the last hypothesis is:

H8: There is a significant relationship between functionality and customer online repurchase intentions.

3. Methodology

The secondary data is collected from the website of Tiki. Some other reliable sources are FPT University's Library, literature Researches, SPSS Lectures and so on.

In this research, the quantitative approach will be used. The data was collected from questionnaire. The language of the questionnaire is simple, clear and easy to understand so that participants are encouraged to complete their questionnaires. It consists of three parts: screening questions, survey questions and demographic information.

4. Result and findings

There are 362 responses were collected, and 12 of them were invalid because the items were not completely fulfill. Thus, there were 350 usable responses. Male and female have equivalent percentage, which accounts for 50.29% and 49.71%. The age group 18-25 takes the highest proportion which accounts for 63.43%. The second top is the age group 26-35 which accounts for 16%. It is reasonable with the occupation descriptive that most of the sample is student and officer, which account for 51.43% and 30.57%.

Table 1 presents the Cronbach's alpha for dependent variable and 8 independent variables in this study. The result determines that the value range of Cronbach's alpha is from 0.714 to 0.907. According to Nunnaly and Berstein (1994), the Cronbach's alpha has to be from 0.7 to 0.95 in order to be acceptable. Therefore, these variables are reliability.

Table 1: Reliability test

ID	Variable name	Number of items	Cronbach's alpha
PV	Perceived Value	5	0.869
PE	Perceived Ease of Use	5	0.907
PU	Perceived Usefulness	5	0.858
FR	Firm's Reputation	5	0.877
PR	Privacy	4	0.862
TR	Trust	4	0.897
RE	Reliability	5	0.822
FU	Functionality	5	0.9
RI	Online Repurchase Intentions	3	0.714

The Appendix 1 illustrates the rotated components matrix indicating that the factor loading of the variables are higher than 0.5. In other words, the set of tested items have the internal consistency. The Table 2 reveals some statistical value in the Exploratory Factor Analysis (EFA) included KMO value, Bartlett test significant value, eigenvalue and cumulative%. According to Hair et al (1998) an appropriated EFA has to have the KMO is from 0.5 to 1, eigenvalue of each components is higher than 1 and cumulative% is higher than 50%. In this research, both of dependent variable's and independent variables' EFA were satisfied the standard. Thus, their EFAs are appropriate. In addition both Bartlett test significant values are lower than 0.05; thus, the dependent variable's and independent variables correlation matrix are nonidentity matrix, consequently variables have some relationship with each other.

Table 2: Exploratory Factor Analysis

Independent variable			**KMO**		**0.825**	**Sig (Bartlett test)**		**0.000**
Component	1	2	3	4	5	6	7	8
Eigenvalue	9.123	6.433	2.808	2.312	2.210	1.916	1.631	1.127
Cumulative%	24.007	40.935	48.323	54.409	60.223	65.266	69.559	72.525
Dependent variable			KMO		0.675	Sig (Bartlett test)		0.000
Component	1							
Eigenvalue	1.914							
Cumulative%	63.816							

From Table 3, Adjusted R-square is 0.756. It means that 75.6% dependent variable's variation (RI) can be explained by 8 independent variables (PV, PE, PU, FR, PR, TR, RE, and FU). Besides, Sig (F) is lower than 0.05. Therefore, the regression analysis model is reliable. Many statisticians clarified that if the Variance inflation factor (VIF) is
higher than 10, the multicollinearity may occur. In this research, all of 8 factors' VIF are lower than 10, it means that situation will be rejected. Based on the table, the significant relationship value of PE, PU, FR, TR, RE, and FU are lower than 0.05. Thus, they can be used to explain the dependent variable. The significant relationship value of PV and PR are higher than 0.05. Therefore, they cannot be used to explain the dependent variable. The higher Beta value means the stronger relationship between the independent and dependent variable. According to the equation, Firm's Reputation (FR) has the strongest correlation with Repurchase Intention (RI); Perceived Ease of Use has the lowest correlation with Repurchase Intentions.

Table 3: Multiple Linear Regression Analysis

Model	**Unstandardized Coefficients**	**Standardized Coefficients**	**Sig.**	**Collinearity Statistics**
	B	Beta		VIF
(Constant)	.281		.076	
PV	-.047	-.058	.079	1.562
PE	.078	.124	.000	1.540
PU	.307	.333	.000	1.810
FR	.206	.335	.000	1.571
PR	-.022	-.025	.489	1.902
TR	.216	.326	.000	1.611
RE	.145	.215	.000	1.394
FU	.126	.258	.000	1.534
Adjusted R-square			0.756	
Sig value (F) in ANOVA			0.000	

The Table X illustrates the Levene test for three demographic variables. It attempts the null hypothesis that all tested items' variance is equal. As the result, the Levene test significant value is higher than 0.05; thus the all items' variances in the same variable are equal. This table also presents the discriminant analysis of those variables, which is used for testing the difference among different demographic groups in term of online repurchase intentions. The significant value is lower than 0.05; therefore, there is no difference in online repurchase intentions among difference demographic groups.

Table 4: Discriminant Analysis

	Age	**Gender**	**Occupation**
Sig (Levene test)	0.823	0.791	0.281
Sig (One-way ANOVA)	0.55	0.657	0.99

5. Discussion and conclusion

5.1. Recommendation

Unlike some of the other previous studies as well as the expectations of the researchers, there is not a significant relationship between Perceived Value and the customer Online Repurchase Intentions.

This may be resulted from the shortages and limitations while generating the sample. The firm has to prove that the value customers received is higher than the cost they paid. The value is not only the functional value but also the social and personal value which the customer will receive after purchasing the product. Then, by demonstrating and promoting about the diversity of benefit, customer will affirm that the product is reasonable and acceptable.

Despite perceived ease of use is the driver of repurchase intention model, the investment in this category is not as much as others. When customer has already paid for their product, they have known how to do it again efficiently. Therefore, firm should enhance the friendly user interface to make sure that in the first transaction, customer will not switch their decision because of difficulty in shopping. Thanks to the easy-to-use system of booking, users is provided the enjoyable online shopping experiences so that customer's perception will be enhanced in order to raise the repurchase intention.

Concentrating on the usefulness of system is the key word for Tiki in this case. Saving time is the important element make customer purchasing online; hence, the process of searching and booking must be simple and fast. Searching part must include the highlight key word and category arrangement in case customer lost in vast of information; the booking process should be easy-to-click when user intends to buy something so that they can easily put products into bags and ready to take the payment. In brief, Tiki has to create the enjoyable environment for customer to search and pay so as to feel it is useful to buy product from Tiki's website instead of other E-commerce web sites.

Tiki should always release and appear the good image in user's mind. In other words, user will consider many retailers and then choose the one that have the good reputation and this meet their expectation so as to purchase product and repurchase in future. Moreover, the firm which is popular can become the consideration of user when choosing the E-commerce supplier. There are many ways to increase the firm reputation in customer's mind such as doing the social responsibility, fighting fraud, being honest in business. First of all, firm should declare their official information about their business model and whenever its model is changing, customer must receive the notification. Furthermore, Tiki have to spend their resources to training parents in how to protect their kids from the bad side effect of technology explosion or warning about the Internet's fraud which can do harm to Tiki's users. Last but not least, spending resources in marketing to build the great image of company and being more popular in market is the crucial consideration for E-commerce firm.

According to the multiple linear regression result, the relationship between Privacy and customer Online Repurchase Intentions has been rejected. However, it may be because of the information safety awareness of Vietnamese is low. In the age of e-commerce, the information safety becomes one of the critical issues in every country. Nonetheless, in Vietnam, the information safety awareness is lesser extent. According to ESAT report (2016), Vietnam has the lowest online information safety awareness in the region, compares to Singapore, Malaysia, Thailand, Indonesia, India, Hong Kong, etc. In Asia, Vietnam is one of the countries which have the highest Internet and smartphone usage rate (Eric CW Yeo, 2016). Nevertheless, other research from ESAT illustrates that 87% Vietnam Internet users are afraid of the online issues; but only one third of them have the protective actions. Therefore, there is a plan from the government established in order to raise the customer's awareness. These are many recommendations were sent to Vietnam Government and have been accepted. Those suggestions were built up the "Scheme for Propagating, Disseminating, and Enhancing the Responsibility about Information Safety to 2010" (Vietnam Privacy Policy and Information Security, 2015). The main missions are to propagate, disseminate and enhance information safety awareness and responsibility in educational institution, through mass and social media, and through basic information system.

With the investment to prove their integrity and other parties, Tiki could gain customer trust in order to affect repurchase intention. To help Tiki

gain the long-term relationship with customer, they should make commitments to ensure that they will not break their promise and many performances to show that they have done the right things during the business time. If Tiki broke any commitment or promise, they will lose customer's trust. Long-term relationship needs time and effort to build up and maintain. In this case, Tiki has built the good one so they must take effort to maintain it.

The performance of web site might affect to customer online shopping experience and in case Tiki's performance is not good with broken links, scripting errors will make user disappointed and leave the buying process. Because of the importance of reliability variable, Tiki should conserve the best performance to avoid the frustrated feeling of customer. To maintain that situation, firm should invest in infrastructures e.g. database, front-end and back-end development combine with the stability of server to generate the pleasant environment for customer during online shopping.

Functionality concentrates on the user experience with the website's organization to persuade customer repurchase in the near future. In detail, user might feel happy when they are in the desire website – environment that combines user's finding and web's providing. People will leave the page if they cannot find the required information. Hence, Tiki should categorize the product to meet the need of each user. Besides, user interface must be simple to attractive the return in customer intention. If customer faces too much difficulty to find out the desired product, the chances to make him repurchase is less as well. Lastly, there should be some utilities e.g. live supporting, decision change policy due to the great functionality to establish the return willing.

5.2. Conclusion

In summary, the research objectives have been achieved. The key factors which affect the research object and the relationships between them are clarified. In case of Tiki, there are six factors affecting Online Repurchase Intention which are Perceived Ease of Use (PE), Perceived Usefulness (PU), Firm Reputation (FR), Trust (TR), and Reliability (RE). According to this research, all of those factors have a significant positive effect to Online Repurchase Intention. In other words, the increase in those factors' value will lead to the increase in customer repurchase motivation. Perceived Value (PV) is confirmed that there is not a significant effect between Perceived Value and Customer Online Repurchase Intention. In fact, it is reasonable due to the difference between each individuals' perception. The Perceived Value is defined as the result of the equation that customer's perceived benefit exceed their perceived cost (Day 1990, p.142). For the same product, a customer may feel it is cost-effective because the product meets his/her needs and the price is acceptable; while another may feel it is ridiculous with its lack of benefit and overpriced. Therefore, each individual's perceived value will be contrasted with others. The extra factor which does not have relationship with Customer Online Repurchase Intention is Privacy (PR). According to ESET antivirus program company market research (2015), Vietnam is the country which has lowest information safety awareness. The low awareness about information safety leads to many problem and risks for customer while using E-commerce. However, in this research, it becomes the reason which makes the privacy have no effect to the repurchase intention, in case of Tiki.

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7. Appendices:

Appendix 1

Factor	Components							
	1	2	3	4	5	6	7	8
PV1	.837							
PV2	.786							
PV3	.645							
PV4	.694							
PV5	.822							
PE1		.794						
PE2		.844						
PE3		.847						
PE4		.787						
PE5		.705						
PU1			.692					
PU2			.700					
PU3			.759					
PU4			.739					
PU5			.659					
FR1				.790				
FR2				.745				
FR3				.700				
FR4				.775				
FR5				.768				
PR1					.725			
PR2					.805			
PR3					.786			
PR4					.754			
TR1						.645		
TR2						.864		
TR3						.869		
TR4						.776		
RE1							.774	
RE2							.757	
RE3							.675	
RE4							.724	
RE5							.656	
FU1								.800
FU2								.794
FU3								.627
FU4								.852
FU5								.849

Appendix 2:

Perceived Value (PV)		**References**
PV1	I will be attracted to repurchase a product online, if I experience tangible values	Moliner et al. (2007) and Oh (2003)
PV2	Online shopping makes it easier for me to purchase at anytime and anywhere	
PV3	I will repurchase online provided the web site offers good value for money	
PV4	Online store that provides a transparent pricing policy would be an additional value to attract me to revisit	
PV5	Online retailers always offer the best selling price to customers	
Perceived Ease of Use (PE)		Chiu et al. (2009) and Davis (1989)
PE1	Online shopping makes it easier for me to make products comparison among few retailers	
PE2	Purchasing products and services online is easy to learn and use	
PE3	Purchasing online does not require a lot of mental effort	
PE4	New service of the web site should be well explained	
PE5	I do not get frustrated when I shop online	
Perceived Usefulness (PU)		Chiu et al. (2009) and Davis (1989)
PU1	I always repurchase online based on my need for the product or service	
PU2	I will repurchase online if it provides more benefit than cost to me	
PU3	Adequate information about the product or service cfrom the web site is necessary for me to be attracted to shop online	
PU4	I find online shopping more convenient compared with offline shopping	
PU5	I find online shopping useful to manage my time.	
Firm Reputation (FR)		Brown et al. (2005) and Hess (2008)
FR1	I compare firms' images before my repurchase decision	
FR2	I will repurchase products or services, if the firm's image meets my expectation	
FR3	I will like to repurchase products or services from web sites that are popular	
FR4	I will repurchase products/services online, if my friends recommend the web sites to me	
FR5	I will repurchase products/services online, if the firm has partners and suppliers that have strong brand name in the market	

Privacy (PR)		Román (2007) and Chiu et al. (2009)
PR1	Web sites that will not share my online shopping behavior, will attract me to repurchase	
PR2	I will review customers' feedback or comments on privacy issue before any repurchase decision	
PR3	I will only repurchase from a web site that keeps my entire personal information private	
PR4	I will repurchase products and services online, if the firm assures that my financial details will not be accessible by a third party.	
Trust (TR)		Pavlou and Fygenson (2006)
TR1	I will repurchase from the online store, if the technical infrastructure of the web site is dependable.	
TR2	Transaction securities enhance the level of trust towards the web site	
TR3	Product attributes and specifications that are delivered as promised are persuasive to me	
TR4	I will repurchase products and services from the web site, if the purchase terms and conditions are clear.	
Reliability (RE)		Swaminathan et al. (1999) and Goode and Harris (2007)
RE1	I will repurchase from same web site rather than making new purchase from other web site if the web site is genuine	
RE2	I will repurchase products/services online, if the web site does not breakdown frequently	
RE3	I will always evaluate the quality of the web site before any repurchase decision	
RE4	I expect web sites that are capable to process large number of transactions are to be dependable	
RE5	Well-recommended online store tend to be trustable	
Functionality (FU)		Chung and Law (2003) and Law and Bai (2008)
FU1	I will repurchase from a web site that provides related links that makes my shopping experience more fun and less frustrating	
FU2	I will repurchase from web sites that is well organized	
FU3	I will be attracted to online shopping sites that can provide live support through the web site	
FU4	I will repurchase products/services online, if it is easy to make changes even after I submit online transaction	
FU5	Simple web sites with great functionality will attract me to revisit	
Repurchase Intention		Chiu et al. (2009) and Davis (1989)
RI1	I intend to repurchase online in near future.	
RI2	I will continue to use Tiki website to search product's information.	
RI3	I will introduce and provide good information about Tiki.	

A Study on Perceived Benefits in E-commerce
Case study on Hochiminh City

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Abstract
This research aims to explore the components of Perceived Benefits when shopping online, construct and test their measurement scales. This theoretical model is suggested along with the scales of perceived benefit's components. The results of the verification of measurement models show that the scales achieve acceptable reliability and qualified value. This research includes qualitative and quantitative approach. A formal quantitative study with a sample of 310 consumers was conducted to test the scale models and theoretical model. In particular, there are 4 components that create consumers' Perceived Benefits to e-commerce websites. The 2 main components that make up the Perceived Benefits are Shopping Convenience and Shopping Selection. The results contribute to the theory of Perceived Benefits through a model of Perceived Benefits in the Vietnamese market. Also, there is a significant difference in Hedonic Shopping among group ages. Finally, it helps marketing executives better understand the components of Perceived Benefits and suggests some managerial implications to design and orient programs as well as improves site features for better performances.

Keywords — Perceived Benefits, E-commerce, Shopping Selection, Shopping Convenience, Ease of Shopping, Hedonic Shopping.

1. INTRODUCTION
Nowadays, E-commerce has developed strongly, played the main role in the development of economy, and brought many benefits to daily life in the world. Based on eMarketer.com (2016) [6] report, online retail sales in 2015 reached 1.548 trillion USD, accounting for 7.4% of online retail sales worldwide. Correspondingly, this figure will leap up 4.058 trillion USD by 2020, accounting for 14.6% of sales worldwide.

Figure 1.1: Retail E-commerce Sales Worldwide, 2015-2020 (eMarketer, 2016)

In Vietnam, it is nearly 62% of online users said that they already bought online by the average expenditure per capita approximately 160 USD. In addition to, the total sales revenue from an online B2B retailer in 2015 is roundly 4.07 billion USD (VECITA, 2016) [18]. Besides, it also reported the factors that consumers care most when shopping online is price (81%), which is followed by website's reputation (75%) and website brands (70%).

Table 1.1: Vietnamese consumer purchase online in 2016 (VECITA)

Vietnam population in 2015 (million)	Internet user ratio	Internet user use online shopping service ratio	Forecast Individual online shopping value in 2015	Forecast B2C e-commerce profit in 2015
91.3	45%	62%	160 USD	4.07 billion USD

Due to the developed technologies and handful devices, everyone is able to access to E-Commerce websites really easily and conveniently through various common devices such as mobile phone (85%), which increased 20% compared to 2014; which is followed by laptop (73%) (VECITA, 2016). Clothing are product category that are purchased the most usually by 64%, which is followed by technological items (56%) and furniture (49%) (VECITA, 2016).

According to a study implemented by Doong et al (2011) [3], it has millions of websites monthly are taking part in e-commerce marketplace, which has created a fiercely competitive market for any retailers. In Vietnam, the online sales business continues to grow and play an important role in the economic development of the country. 38% is the unexploited percentage of Vietnam consumers have never shopping online, so the growth potential this sector is very promising.

2. THEORETICAL BASIS & LITERATURE REVIEW

2.1 Theoretical basis

According to Oxford dictionary, it defines Internet is a global computer network providing a variety of information and communication facilities, consisting of interconnected networks using standardized communication protocols.

Regarding e-commerce, Turban et al. (2011) [17] assume e-commerce is the process of buying, selling, transferring, or exchanging products, services, and information through computer networks, mostly the Internet and Intranet. In the approach to information and communication, the Web is seemed as a medium to assist marketing, bring benefits to customers and build relationships with them. The firm, therefore, can build brand awareness and strong image and can use the Web as an effective way by providing a large amount of information to customers and helping the company to take part in the marketplace as a global position.

In other hand, Solomon et at (2013) [14] defined that consumer behavior is series of the processes included when individual or group choose, purchase, use, or dispose of products, services, ideas, or experiences to fulfill needs and yearnings. He also mentioned that consumers are the people who consume or use the product.

2.2 Literature review

Regarding perceived benefit, Gellman and Turner (2013) [9] postulates that perceived benefit is related to the perception of the positive results that are caused by a specific action. In the medical field, perceived benefit is usually deployed to describe an individual's motivation for performing and adopting a treatment. According to Forsythe, et al. (2006) [8], in e-commerce field, perceived benefit indicates about what customers gain from online shopping. In another explanation, according to Chandon et al (2000) [2], he said that Perceived Benefits relate to the positive results associated with a behavior in response to threats including real and perceived threats. There are some previous studies related to this matter.

Eastlick, M. & Feinberg, R. (1999) [4] has found during shopping online, functional motives consist of perceived value, order services, and convenience which was the strongest stimuli affects buying online. In addition, there are only two of these motives, convenience and hedonic, were shown to be similarly associated with catalog online shopping by past research.

Additionally, To, P. et al (2007) [15] also added to Perceived Benefits subject by their findings. They indicated utilitarian motive is a determinant of shopper expectation to search and buy

intention. Hedonic motivation impacts directly on the search intention and impacts indirectly on buying intention. More detail, utilitarian motivation is represented through convenience, cost saving, information availability, and shopping selection. Additionally, hedonic motivation is demonstrated by adventure, social, idea, value and authority & status.

Furthermore, Bhatnagar and Ghose (2004) [1] revealed that compared with other shopping methods, getting the lowest price is not only the priority of the online-shopper, but also contributing by other factors' effect. They mentioned the extra strength of this e-marketplace is the ease of information access, it is about the availability of information about products, and this is also the primary concern that brings the ease of use for the e-commerce consumers.

3. METHOD AND DATA

3.1 Research approaches

Authors deploy qualitative and quantitative research in this study.

Qualitative research adds, adjusts the scale to suit the topics, with some research questions and information gathered through unstructured interviews. Because this method creates a comfortable atmosphere for the person who took the interview, therefore, the results are more accurate. Information may be adjusted appropriately during the collection process when the new information appears. The survey participants were 8 people who had purchased items through e-commerce website.

Authors deploy quantitative research to measure the scale, test the theoretical model showing the relationship between each component in the scale. Quantitative research allows the authors quantify and measure information collected by specific numbers. The data was collected through a questionnaire survey by Likert 5-Scale from the consumers who purchased online. The authors used SPSS and AMOS software to perform the analysis: descriptive statistics, reliability test, independent t-test, EFA, CFA, and SEM test.

3.2 Data

In this research, the authors utilize primary data and secondary data.

There are many methods of collecting primary data: observations, mail interviews, live interviews, fixed group surveys. Regarding the In-deep interview, the authors invited the expert who is expertise in E-commerce sector and a teacher of e-commerce discipline attend to the meeting in a private room at FPT University to implement the face-to-face interview. The first step, the researchers starts the conversation by the introduction of this topic for the expert understands what will be going on. The second step, researchers begin with some warm-up questions related to e-commerce situation in the Vietnamese market. In a final step, group research implements the series of opened questions for the expert in order to collect the main point and the big picture of e-commerce, especially the benefits that bring to consumers. Group research has sketched out some main Perceived Benefits on the e-commerce market nowadays. In the end, the authors draw a conclusion that it has 4 main components that may contribute to the creation of Perceived Benefits. In order to get the more precise questionnaire for the pilot test and official questionnaire, group research implements the focus group discussion to recheck the translated and adjusted questions from the previous foreign research.

In Group discussion, the authors have invited 8 people who purchased online and they also present for various different jobs: students, teachers, IT staff, staff officer and accountant to discuss again those 6 components. The survey found that participants who responded to the qualitative questionnaire showed a high level of interest and appreciation of the quality of service, the value of feeling, trust, and confidence, familiarity, the reputation. Moreover, they also perceive the benefits when buying online through their story about the convenient ways of purchase, wide selection, enjoyment shopping, and the guide on e-commerce websites are easy to follow to buy. After constructing the questionnaire for the official quantitative questionnaire, the authors also consult the expert and 8 people from group discussion about the quantitative survey to fix some incorrect grammar, vocabulary for respondents to easily understand every single

question in the survey. After many verified steps by an expert, the official survey is distributed. The main data of this research is collected from the quantitative research by more than 300 respondents by Judgmental Sampling technique.

Features	Frequency	Percent
Gender		
Male	140	45.2
Female	170	54.8
Job		
Student	36	11.6
IT	59	19.0
Staff Officer	68	21.9
Teacher	34	11.0
Business	39	12.6
Housework	47	15.2
Other	27	8.7
Age		
18-25 years old	117	37.7
26-35 years old	129	41.6
36-45 years old	41	13.2
Over 45 years old	23	7.4
Income		
Below 5 million	83	26.8
From 5 to 10 million	137	44.2
From 10 to 15 million	46	14.8
Over 15 million	44	14.2

Secondary data helps the researcher save a lot of time and money when relevant parameters and data are available. But in addition to these data have been processed to fit the previous research, the researcher's responsibility to ensure the accuracy of the data, to check whether the results of other research are based on primary or secondary data, double check the original data.

The list of secondary data reference that researchers use throughout the research: Vietnam e-commerce report 2016 (VECITA, 2016) [18], eMarketer.com [6], and World Internet Users and 2017 Population Stats (Internetworldstats.com, 2017).

3.3 Analysis steps

In this research, the authors use SPSS to analyze descriptive statistics provides basic summaries of sample; Cronbach's Alpha ratio is reliability ratio used to estimate correlation scale. Besides, group also deploys AMOS to run Exploratory Factor Analysis (EFA) to reduce observed variables to a smaller set but still maintains almost information content; Confirmatory factor analysis (CFA) to clarify evaluation criteria. Afterward, authors run the SEM model test to estimate measurement error and the abstract relationship between variables.

4. ANALYSIS & FINDINGS

4.1 Mean value

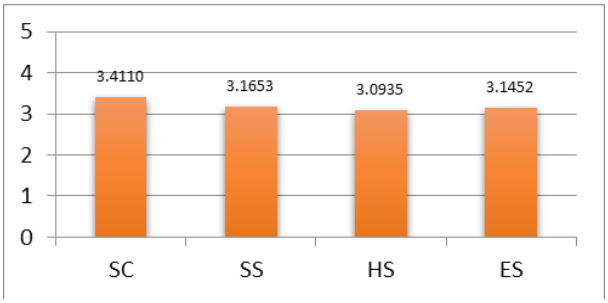

Figure 4.1: The mean value of Perceived Benefits' components

The above result indicates that 6 components contributing to Perceived Benefits. In which, the Shopping Convenience is believed to be the most beneficial reason that consumers consider when shopping online, which is followed by Shopping Selection. The rest components also play a crucial position in making up Perceived Benefits.

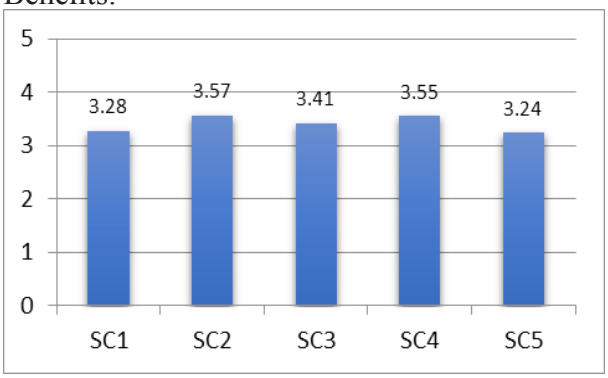

Figure 4.2: Shopping Convenience items statistics

By the mean is 3.24, SC5 which is "Comparison through online shopping is made easier for me" has the lowest score from consumer evaluate. Therefore, E-commerce companies should improve the information of their product to help consumer easy to compare the product. By SC3 - "Shopping online can be done when the stores are closed", it points that consumers appreciate online service partially due to their ubiquity. Moreover, other items also indicate almost convenient reasons that induce consumers to purchase online.

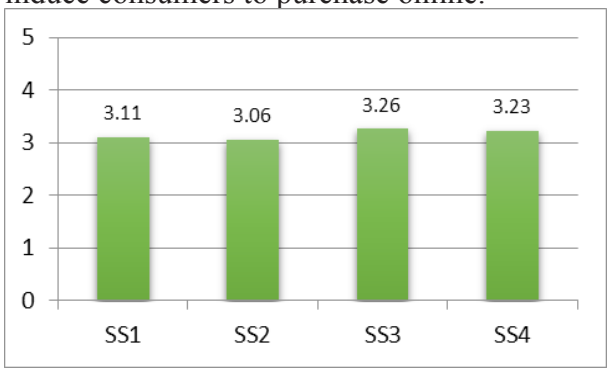

Figure 4.3: Shopping Selection items statistics

It explains that most of the respondents have a neutral attitude with Shopping Selection of Perceived Benefits. The item SS2 which is "Online shopping helps me access to many brands" has the lowest Mean value (3.06) and the highest Mean value is 3.26 from item SS3 which is "Online shopping is available for me to buy products from everywhere". Thus, we can see that the consumer has not felt that they can approach many brands via online shopping yet. On the contrary, the consumer feels very good about they can shop online anywhere.

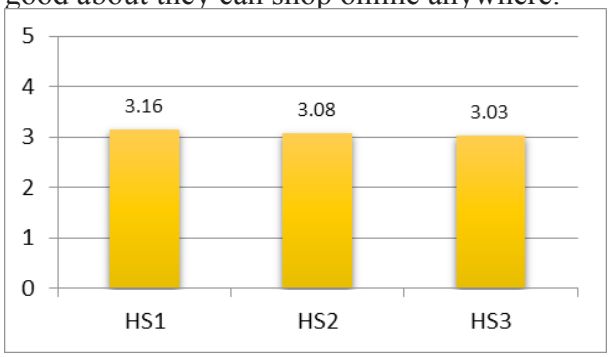

Figure 4.4: Hedonic Shopping items statistics

The result shows that almost consumers have above average attitude to the Hedonic Shopping of the E-commerce. The lowest is 3.03 correspond with variable HS3 – "To me, online shopping is an adventure"

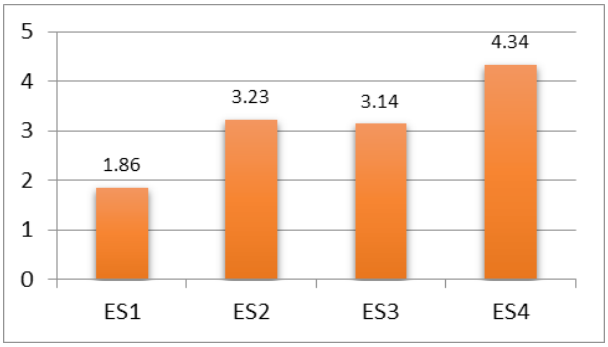

Figure 4.5: Ease of shopping items statistics

There is a difference among variables from ES1 to ES4. While variables ES2, ES3, ES4 have positive responses from respondents with mean 3.23, 3.14, 4.34 respectively, ES1 with a value of 1.86 shows that consumer does not appreciate the available information on sites, it might conclude that online shopping is quite not clear and understandable. Variables ES2 and ES3 which are "No hassles" and "I do not have to wait to be served" are rated from 3.23 to 3.14 reveal the satisfaction of online shopper from the process - relatively good means that it is easy to manipulate steps and take less time than being available at regular shops. About variable ES4, it is rate quite high with 4.34, it proves that many consumers believe that shopping online does not make consumers feel embarrassed if they do not purchase items, and vice versa it totally happens when they shop at a physical store.

4.2 Cronbach's alpha - Reliability Test

The survey's analysis shows that all components have the good Cronbach's Alpha coefficient (larger than 0.7). (Hair et al., 1998) [11]

Table 4.2: Cronbach's Alpha Result

No.	Com-po-nent	No. of Initial items	Cron-bach's Alpha	No. of De-leted items	De-leted items
1	SC	5	0.882	0	-
2	SS	4	0.875	0	-
3	HS	5	0.799	2	HS4, HS5
4	ES	4	0.877	0	-

4.3 Exploratory Factor Analysis

Table 4.3: Main coefficients of KMO test

Coefficient	Value
KMO	0.884
Sig. in Barlett Test	0.000
Eigenvalues	1.330
Extracted Variance	72.28%

After running EFA, the result also extracts to 4 components at Eigenvalues is 1.243 and Extracted Variance is 74.415%> 50%. KMO value is 0.878> 0.5; the Sig. value in Barlett Test is 0.000 < 0.050, so the exploratory factor analysis is suitable for investigating officially.

Besides, the Eigenvalues is 1.243>1 (Hair et al., 1998) [11] indicates the variability explained by each factor and that factor can represent for the whole group (Table 4 - 3). In addition, the extracted variance is 74.482%>50% means the model is standard for factor analysis.

	Component			
	1	2	3	4
SC1	,822			
SC4	,820			
SC3	,780			
SC2	,763			
SC5	,711			
ES4		,873		
ES2		,859		
ES3		,851		
ES1		,839		
SS4			,823	
SS1			,808	
SS2			,791	
SS3			,772	
HS1				,850
HS2				,783
HS3				,747

The EFA's result shows 16 observed variables is classified into 4 different groups, and the Factor Loadings of all variables are more than 0.5 which meets the conditions to investigate officially.

4.4 Confirmatory Factor Analysis

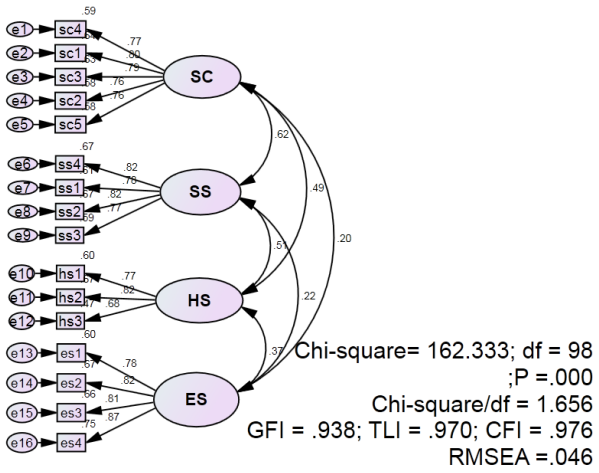

Figure 4.6: CFA result - Perceived Benefits (Standardized)

To measure the fit of the model with market's information, this study uses the indicators Chi-square, GFI (Good of fitness index), CFI (comparative fit index), TLI (Tucker and Lewis index) and RMSEA (root mean square error approximation). The CFA's result shows in Figure 4 - 1. This model has 98 degree of freedom, Chi-square = 162.333 with p-value = 0.00. The other criteria indicate that this model is fit with the market's data: CFI = .976, TLI = .970, GFI = .938, RMSEA = .046. The correlation coefficient between the components and the standard deviation (Figure 4.1) shows that these coefficients are all less than 1 (statistically significant). Therefore, all the components Shopping Convenience, Shopping Selection, Hedonic Shopping, and Ease of Shopping reach the distinct values (Estimate < 1)

4.5 Structural Equation Model (SEM)

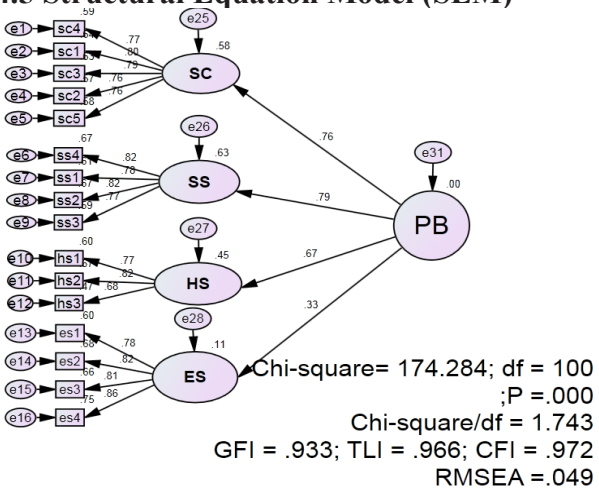

Figure 4.7: SEM result - Theoretical Model (Standardized)

SEM model describes that Perceived Benefits variable is observed by 4 components: Shopping Convenience, Shopping Selection, Ease of Shopping and Hedonic Shopping.

Table 4.4: Result of main parameters (standardized)

Relationship			Estimate
SS	←	PB	.791
SC	←	PB	.762
HS	←	PB	.668
ES	←	PB	.332

Shopping Selection is the component that most contribute to create Perceived Benefits for consumers when shopping online, which followed by Shopping Convenience.

4.6 Independent t-test

Regarding the significant differences in means of Hedonic Shopping among group ages, there were some previous studies also related to the same matter. Koivisto et al., (2014) [12] also pointed the demographic differences in Perceived Benefits. Besides, Ford et al., (2012) [7] are more specific to age differences in satisfaction and perceived benefits. Therefore, the outcome of this study is also in accordant with previous research in different country.

This independent-samples t-test assesses whether the means of group ages (over 25 and less than 25) significantly differ on a Perceived Benefits components.

Table 4.5: T-test result of of Perceived Benefits component between group ages.

Test variables	Sig. of Levene Test	Sig. of T-Test		Result
Shopping Convenience	0.955	Equal variances assumed	0.29	Accept
Shopping Selection	0.213	Equal variances assumed	0.28	Accept
Hedonic Shopping	0.787	Equal variances assumed	0.04	Reject
Ease of Shopping	0.977	Equal variances assumed	0.78	Accept

The result in Table 4.5 shows that the sig. value of Levene's Test is over than 0.05. Then, the sig. value in line "equal variances assumed" is valid and is used to test hypothesis. Next, the t-test's sig value is 0.043 < 0.05, so it means that the null hypothesis is rejected and there is significant difference in mean between group ages on hedonic shopping.

Table 4.6: Difference in mean between group ages on Hedonic Shopping

Component	Age	N	Mean
Hedonic Shopping	< 25	117	3,2365
	> 25	193	3,0069

According to table 4.5, the result indicates the difference in mean between group ages on Hedonic Shopping. The mean of group age smaller than 25 is rather higher than group of elder than 25 in Hedonic Shopping component (3.2365 and 3.0069 respectively)

5. IMPLICATION AND CONCLUSION

5.1. Implication

- **Shopping Convenience**

By the mean is 3.24, SC5 which is "Comparison through online shopping is made easier for me" has the lowest score from consumer evaluate. Therefore, E-commerce companies should improve the information of their product to help consumer easy to compare the product. With SC3 - "Shopping online can be done when the stores are closed", it points that consumers appreciate online service partially due to their ubiquity. Moreover, other items also indicate almost convenient reasons that induce consumers to purchase online.

Based on the outcome, there are many consumers feel "Online shopping saves my time". This will be a consult for companies to make their service faster to save time for the consumer. In addition, with the company has not joined into E-commerce market yet this can be a good result for them to think about E-commerce.

- **Shopping Selection**

E-commerce companies should increase more product from variety brand into their website, that can encourage consumer enter and buy a product because they can choose a product from many brands inside one website.

Offer shipping service nationwide or worldwide to increase the product approach ability for consumer everywhere, the consumer just only has to stay at home and order product from a long distance place, this is also another advantage of shopping selection.

- **Hedonic Shopping**

Base on researcher analysis, the E-commerce in need to bring more enjoyment feeling to the consumer. E-commerce store should create some interesting points in the website periodically in order to raise the excitement when consumers access to the website. Creating some events to stimulate consumers to shop online on e-commerce websites is a good way to enhance the shopping experience to consumers such as offer promotions, voucher, and coupon. In addition, focusing on the process of shopping, the user's interface also affects consumer's feeling.

When shopping online, the consumer feels free to choose products like their living in their own world. E-business should focus on this experience of consumers to improve buying process experience because it could help enterprises increase more revenue.

Pay attention to the product quality is a way to gain the satisfaction of consumer and make them return the website.

- **Ease of Shopping**

It might seem obvious that if the process is easy to do, the consumer will spend more money and time to shop online rather than shop-in-store. Therefore, e-commerce business should pay more attention to ensure that online shopping is a pleasant experience.

First of all, create a clear and easy to manipulate interface, e-retailer should pay more attention to the shopping process to make it simple and try to reduce unnecessary steps as few as possible, it might be based on the number of clicks when consumer making a purchase. For instance, based on realistic experiences when making a purchase on websites like Nike (7 clicks), Zara (11 clicks) and Amazon (10 clicks), authors can see the advantage as well as disadvantage of these website buying process. Therefore, research group recommends that online shopping websites should consider building a purchasing process require 9 clicks in total, as follows:

Click 1: Log in or create a new account
Click 2: Homepage showing mega menu to product categories
Click 3: Product category page
Click 4: Product detail page
Click 5: Add to cart
Click 6: See shopping bag
Click 7: Enter contact detail and shipping method
Click 8: Choose a payment method and enter credit card detail.
Click 9: Confirmation and finalize the order.

Consumer choose online shopping because it does not take too much time rather than traditional shopping, they do not have to wait to be served but there are some problems when buying online that e-vendor should avoid keeping consumer stay longer on the website but do not feel impatient. The e-business should:

- Provide a short description to introduce the company and the product it sells, it makes consumer understand the business quickly, and they don't have to search to find out what is this company about and create the feeling of a professional business.
- Make sure that the website loads quickly both in computer and mobile devices because there are many competitors in the same product line, if the website loads too slowly, consumers tend to go somewhere else, they won't wait.
- Do not try to bombard consumer with pop-ups and do not show it too slow, according to the article "25 reasons why I'll leave your website in 10 seconds" (Econsultancy, 2017) [5] it is better when showing about 30 to 60 seconds, consumer is not calm to wait to see all of the unnecessary information if it do not bring them any benefit.
- For what consumer wants to see is the content, not advertising, so the content should be clear, sufficient, reliable and attractive, with only a click on the desktop or a swipe on tablet or smartphone, customer can get the necessary information.
- The immediate registration requirement is also very annoying; it will make consumers leave soon.
- Including customer review, it is more

trustworthy than any information, it not only makes consumers have a chance to show their opinion with supplier, the supplier also can fix the error if there is any complaint, but also make other consumers have an objective view from other feedbacks.

5.2 Discussion

This study's result pointed out that Shopping Convenience (SC) is the highest perceived benefit ; it helps consumers can buy wherever and whenever they want. The findings are also accordance with the expectations as well as the previous research in the foreign market. According to Forsythe et al. (2006) research's result, the convenience is also the first and the main component contributing to Perceived Benefits creation. Besides, Li et al., (2006) [13] also find out that convenience benefit is one of top 3 benefits associated with online buying behaviors. Similarly, Tsai et al., (2011) [16] postulate convenience benefit has significant positive influence on consumers' attitude toward group buying.Also, convenience is the only one of the strongest motives examined by past catalog shopping research (Gillett, 1970) [10]. In Vietnam, the reason that the majority of e-consumers choose shopping online is the convenience. In a developing and tropical country such as Vietnam, the traffic jam and the weather always affect the consumers' mind when they choose to go out and buy something. Therefore, it is obviously seen that convenience is the main element that stimulates consumers shopping online not only in the world, but also in Vietnam.

5.3 Conclusion

The research was implemented in Vietnamese market to complement the measurement system in E-commerce case study in Ho Chi Minh city. A two-fold methodology has; therefore, been employed, involving a review of the literature on e-marketing and the interview with an expert. This research has found out 4 components that contribute to Perceived Benefits, these are: Shopping Convenience, Shopping Selection, Hedonic Shopping and Ease of Shopping. Identifying factor where the brand shows competitive advantage will also help e-business owners make decisions about performance (i.e. competitive edge can be leveraged through the improvement of e-commerce website).

Due to the limitation of time during conducting research and money for research's cost, this study just only is implemented in the limited time and geography. If research is replicated in other countries with more time taking, the research team can compare and develop a scale system for more components that make up the Perceived Benefits in E-commerce. This is clearly a direction for future research.

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Awards & Photos Appendix

Evaluation criteria

The score of the review committee accounted for 60%

Audience at the auditorium vote account for 40%: Audience at the auditorium vote according to the criteria: Application of the subject in practice; Presentation ability of the group.

Total score: 100 points

The level of practical application of the group topic, the ability to present the group:

- Very good (100 points)
- Good (90 points)
- Normal (80 points)
- Low (70 points)

Conference Awards

First Prize: Automatic Alternative Image Recognition To Voice - Phan Trung Thanh, Nguyen, Vu Hoang Son, Vo Ha Quan

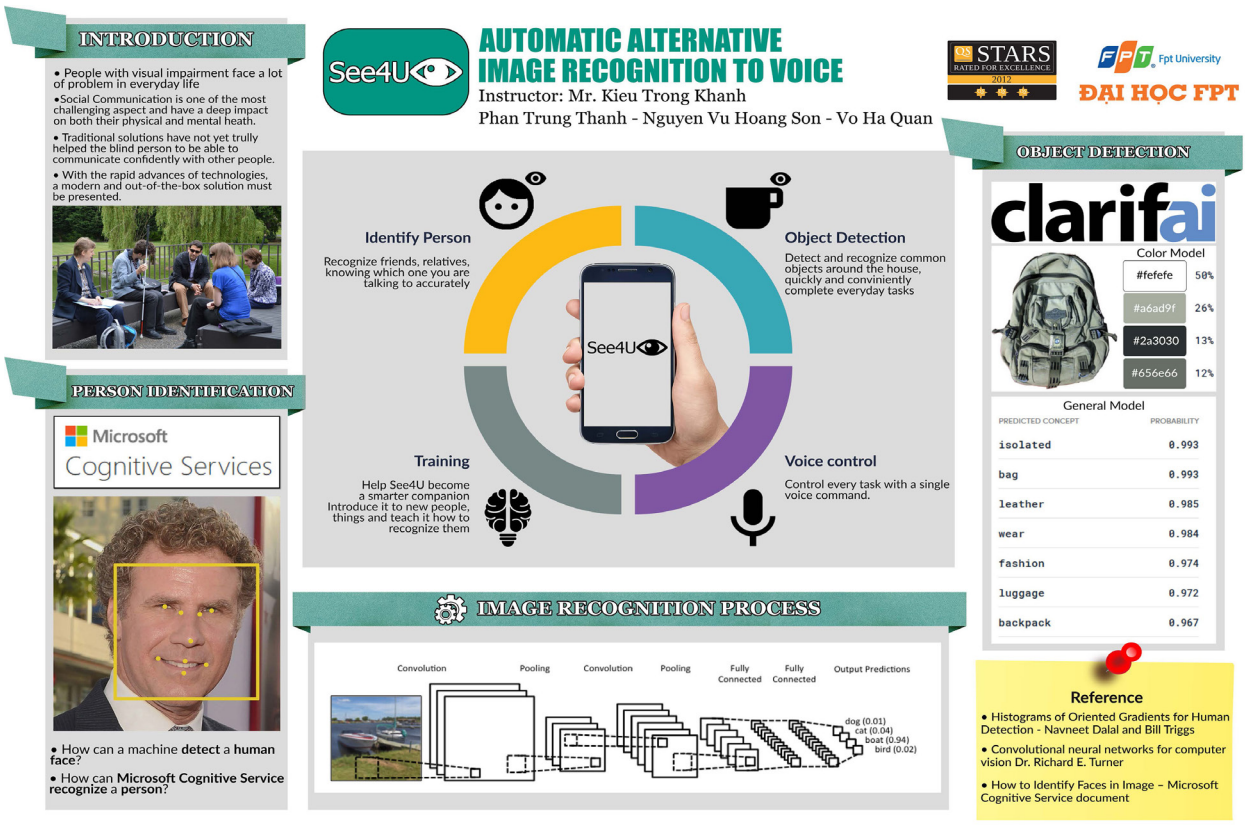
Second Prize: Engineer a Remote Code Execution System :A sandboxing approach using Docker's container technology - Le Ta Dang Khoa

Third Prize: Customer Behavior in focus: A case study of Tiki Vietnam - Le Hoang Vinh, Bùi Nguyet Hieu, Nguyen Hoan Vu, Nguyen Thi Thanh Thuy

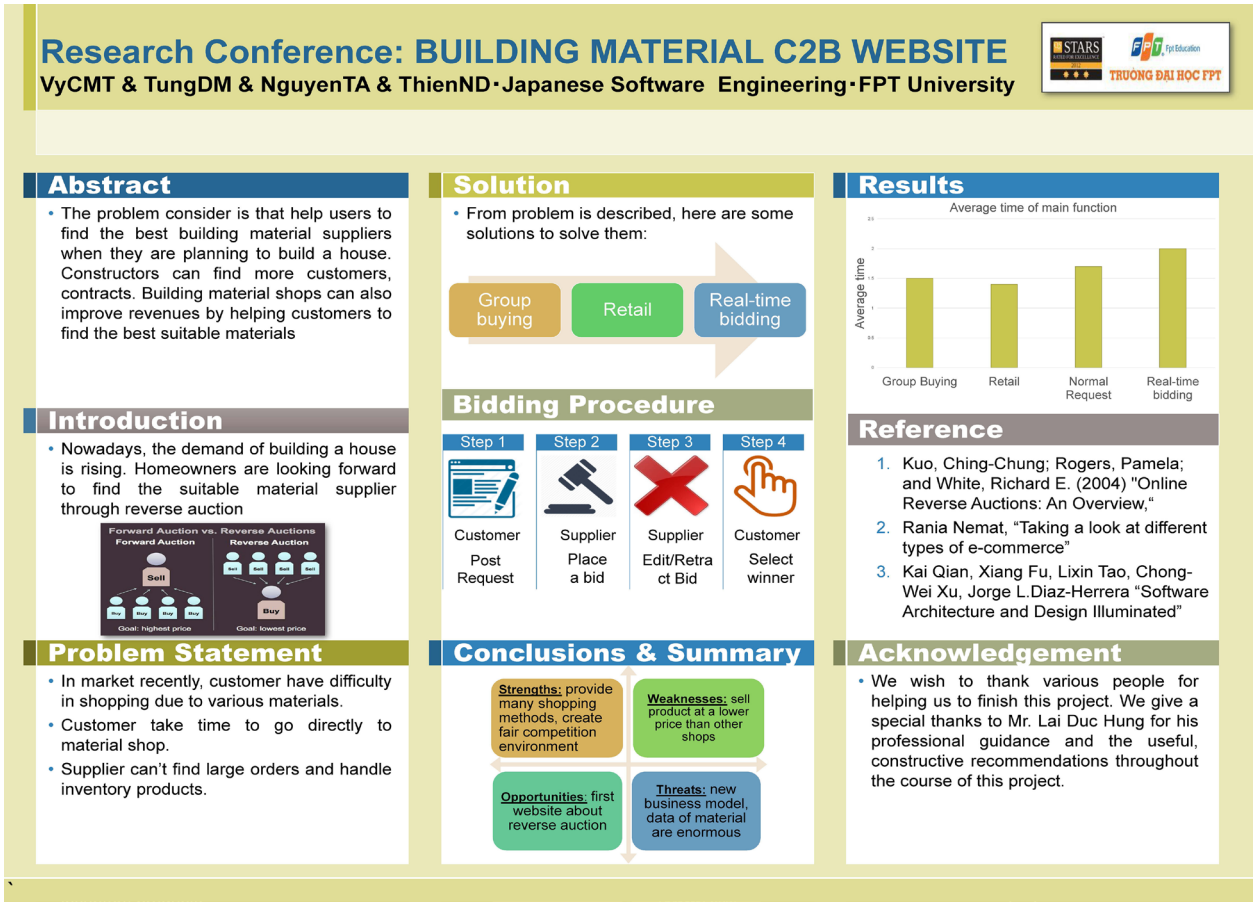
Consolation Prize:

- A Study on Perceived Benefits in E-commerce: Case study - Nguyen Nhat Truong, Nguyen Thi Anh Thi, Huynh Ngoc Khanh Linh

- Building Material C2b Website - Cao Minh Thuy Vy, Dang Minh Tung, Tran Anh Nguyen, Nguyen Dinh Thien



Subject's poster "Automatic Alternative Image Recognition To Voice"



Subject's poster "Building Material C2b Website"

Engineer a Remote Code Execution System

Le Ta Dang Khoa, Student
School of Engineering, FPT University, Vietnam

ABSTRACT

In this paper, we address the problem of building a Remote Code Execution System (RCES).

An RCES is a web service that empowers any clients with the ability to execute user's code safely, even if the code is malicious. This is the key technology behind all sites which support in-browser code execution, such as CodeCademy.

Although there are some RCES APIs for developers to consume, none of them allows clients to build and run a full project instead of a single code file, so we decided to build an in-house RCES for our Capstone project.

The key idea is to use Docker's container technology for sandboxing, then integrate it with file management to allow full project code execution.

Acknowledgements

Mr. Nguyen Huy Hung
Capstone Project Instructor

Mr. Tran Quang Khoi Nguyen
Capstone Project Teammate

INTRODUCTION

There are 3 main problems in this project:

1. **Language Scalability**: The system's ability to support a new programming language, library, framework, etc.
2. **System Protection**: The system's ability to stay safe from malicious code submitted by the user.
3. **Project Execution**: The system's ability to build-and-run a full code project, not just a single code file.

Instead of building everything from scratch, we looked for open source projects of existed RCES and modify them. The project we used is **CompileBox**.

PROBLEM & SOLUTION PLAN

Restating the mentioned problems:
Problem 1. For a given code engine, mimic the way a proper IDE build and run its code.
Problem 2. Execute the submitted code in an isolated environment so that every destruction only happen inside that

Here is the solution plan:
Step 1. Study Docker's API to re-architect CompileBox.
Step 2. Study the way IDE executes code projects to re-write the Bash scripts.
Step 3. Build a file management service that appropriately prepares workspaces for each execution request

SYSTEM PROTECTION

At its core, the Docker engine has the following properties.

Property 1. Using Namespaces to provide containers with their own view of the underlying Linux system, limiting what a container can see and access.
Property 2. Using Control Groups to ensure containers only use the resources they need.

We use **property 1** to assign a non-root user to every instantiated container, limiting the attacking surface for malicious users.
We use **property 2** for configuring the resources available to each container, so that every attempt to stress the system's resources are killed.

Table 1. List of Possible Attacks, our Solutions and their Results

Attacks	Solutions	Results
Gain root permission	Non-root privileges	Passed.
Infinite Loop	Set Docker's time-out	Passed.
CPU Stress	25% CPU time	Passed.
Memory Stress	64MB	Passed.
Download Viruses	No Internet connection	Passed.
Spamming Hard Disk	I/O speed at 1MB/sec	Passed.

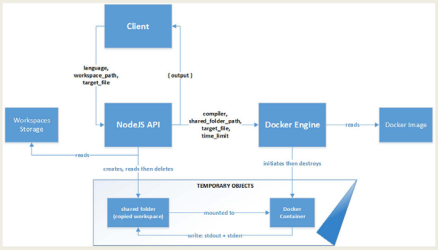


Figure 1. ThinkCode's RCES mechanism

LANGUAGE SCALABILITY

We can scale the system to new code engine with these 3 simple steps:

1. In Dockerfile, write Bash commands that install the new code engine.
2. Use that Dockerfile to build a new Docker's image.
3. Add a new Bash script to mimic how IDE runs that coding engine.

The following Bash script is used to runs the compiled Java's .class files.

```
# 1. Get targeted-file's fullname
fullpath=$1
IFS='/' read -r -a fullpath_array <<< "$fullpath"
fullname=${fullpath_array[-1]}

# 2. Build the targeted-file's classname
IFS='.' read -r -a fullname_array <<< "$fullname"
fullpath_array[-1]=${fullname_array[0]}
classname=${IFS=. ; echo "${fullpath_array[*]}"}

# 3. Go to usercode and run compiled java-file
cd /usercode
java $classname
```

CONCLUSIONS

In this paper, we have demonstrate our approach to engineer an RCES, accomplishing all 3 objectives, namely **Language Scalability**, **System Protection** and **Project Execution**.

On extending the project, we planned to implement a grading system. Since grading a code project is simply running the test files, this is completely possible as we've already achieved full project code execution.

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3. https://medium.freecodecamp.com/a-beginner-friendly-introduction-to-containers-vms-and-docker-79a9e3e119b
4. https://blog.remoteinterview.io/how-we-used-docker-to-compile-and-run-untrusted-code-2fafbffe2ad5

Subject's poster "Engineer a Remote Code Execution System"

STARS RATED FOR EXCELLENCE 2012

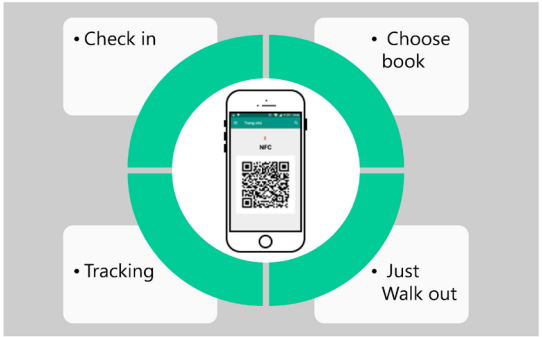
Fpt University
TRƯỜNG ĐẠI HỌC FPT

JUST WALK OUT LIBRARY

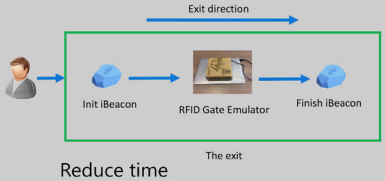
Instructor: Mr. Kiều Trọng Khánh
Võ Hồng Hà – Nguyễn Tuấn Anh – Đặng Nhật Thiên

CURRENT ISSUES

Too much time
Too much paper
Too much people
Complexity & Overload



OUR SOLUTION



Reduce time
Reduce paper
Reduce people
Easy and Convenient

NFC

✓ Suitable for our approach
✓ Becoming popular
✓ Trend of the future

QR CODE

✓ Suitable for our approach
✓ Some old phones don't support NFC
✓ Very popular

BEACON

It transmits Bluetooth low-energy signal that an application can listen and respond accordingly when the phone comes in range.

RFID

RFID uses electromagnetic fields to automatically identify track tags attached to objects.

REFERENCE

http://developer.estimote.com/ibeacon/

http://www.rfid-library.com/eng_index.html

http://nearfieldcommunication.org

Subject's poster "Just Walk Out Library"

Shopping Clothes with Pictures

FPT University
Instructor: Kieu Trong Khanh
Vu Huy Quan – Nguyen Minh Khoi – Ta Duc Loc

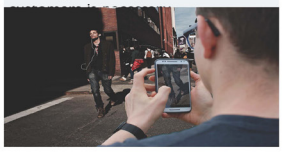
Introduction

With the rise of technologies, **Shopping clothes online** has become very popular.

However, it is not much different from traditional shopping.

People want to buy clothes but they do not want to go through all the complicated steps: **figuring out the category, type, properties of the clothes and where they are sold.**

As a result, **programmatically solving these questions** for



Questions

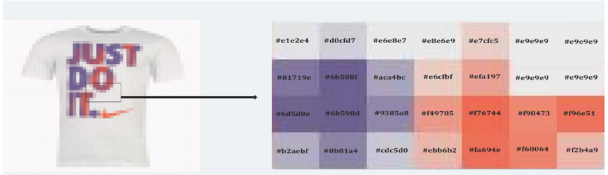
How does **image recognition** work?

- What is **estimate function** ?
- What is **neural network** ?
- What is **convolution and max-pooling** ?

How to turn an **image into numerical data** type?

How a **image can be broken down** to find all the **main properties** of it ?

Image into numerical data



An image is created by thousands of pixels, each pixel holds a hex code that present color code of it.

Overlap cut

Max-pooling

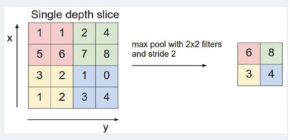
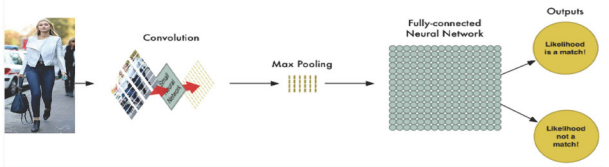


Image recognition process

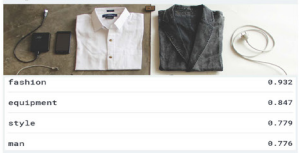


Result

- On the **category test**, through 561 subjects, the success rate is **93%**
- On the **properties test**, through 561 subjects, the success rate is **81%**

Conclusion

- Using **convolution neural network** can retrieve the **main properties** of an image.
- Each image inputted into the algorithms can produce **multiple predictions with its**



- Recognition accuracy can be improved by inputting a **large amount of data** to process.
- Image **should not have low quality**.

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Subject's poster "Shopping Clothes with Pictures"

A Study On Perceived Risk In E-Commerce:

Case study on Hochiminh City

Nguyen Thi Thu Huong, Do Duc Thanh Duy, Tran The Long, Do Hoang Tuan, Bui Thanh Khoa
FPT University, Ho Chi Minh City, Vietnam

TRUONG ĐẠI HỌC FPT

QUESTION

- What are components of Consumers' Perceived Risk in E-Commerce?
- Is there any difference between male and female in Perceived Risk?

BACKGROUND

In Vietnam, E-Commerce is considered as new exchange market. According to VECITA (2015) [8], E-Commerce is developing rapidly through telecommunications systems, booming to about 1/3 of Vietnam Internet users.

However, E-Commerce does not reach its potential yet due to some barriers. One of the most noticeable reasons is their Perceived Risks (Liebermann and Stashevsky, 2002 [5] ; Snoj, Korda and Mumel, 2004 [7]; Mitchell, 1999 [6]).

RELATED RESEARCH

Featherman and Pavlou (2003) [2] unite the Psychological and social risk facets of Perceived Risk into one Psychosocial facet as defined by Cunningham (1967)[1].

Moreover, there are two sections of Perceived Risk in the process of online shopping, Perceived Risks associated with Product/service and Perceived Risks happening during online Transaction (Lee, Park and Ahn, 2001) [4].

According to Garbarino and Strahilevitz (2004) [3], there is gender difference in how men and women perceive risks associated with online shopping.

FIGURE 1

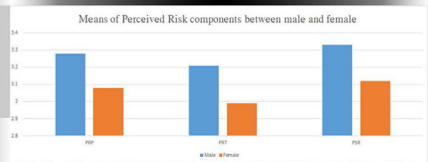
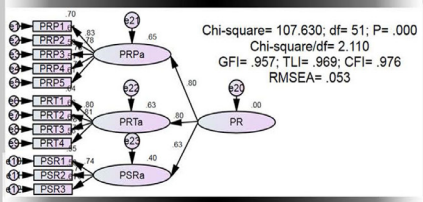


FIGURE 2



ANALYZING

The Cronbach's alpha score for adoption intention suggests that both observed variables of the Perceived Risk scales are kept stably for EFA.

Based on the EFA test, 12 observed variables are reduce and separated into 3 components.

The results demonstrate that the Perceived Risk includes three main components. The most influential: Perceived Risk associated with Product/Service (PRP) and Perceived Risk happening during Transaction (PRT).

Finally, there are the diffirence between male and female in Perceived Risk components.

CONCLUSION

Perceived Risk in E-commerce includes:

- Perceived Risk associated with Product/Service.
- Perceived Risk happening during Transaction.
- Psychosocial Risk.

Moreover, gender affects Risk Perception in E-Commerce.

IMPLICATIONS

- Making visual instruction on online buying process.
- Providing many payment methods.
- Applying quickly order tool.
- Fast Delivery Services.
- Money back guarantees and prominently displayed consumer satisfaction guarantees.
- Simple statements and graphics stating that transactions are guaranteed.
- Privacy policy such as "we will never sell your personal information period".

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Subject's poster "A Study on Perceived Risk in E-Commerce"

TRƯỜNG ĐẠI HỌC FPT

Customer Behavior in Focus: A Case Study of Tiki Viet Nam

Supervisor: Nguyen Quoc Bao | Le Hoang Vinh Bui Nguyet Hieu Nguyen Hoan Vu Nguyen Thi Thanh Thuy

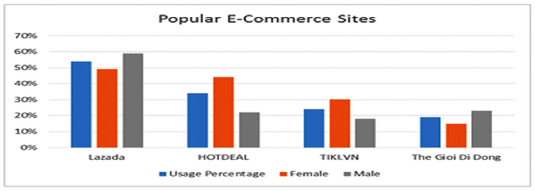
Objective

o Identify key factors which affect online repurchase intentions.
o Understand the relationships between these factors and online repurchase intentions.

Problem Statement

o Difference in quality and features between real products and advertisements (59%)
o Easier and faster traditional shopping (45%)
o Low trust (41%)
o The lack of information (38%)
o Difficulty in methods of payment (37%)

Background

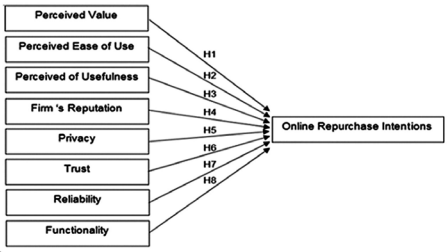


Tiki Viet Nam:
o Established in March 2010 by Mr. Tran Ngoc Thai Son.
o "Tiki" = "Tiet kiem" (save) and "Tim kiem" (seek).
o Core values: Ease of search, Affordability, and Trust-worthiness.

Result

Factors	Hypothesis testing
Perceived Value	Reject
Perceived Ease of Use	Accept
Perceived Usefulness	Accept
Firm's Reputation	Accept
Privacy	Reject
Trust	Accept
Functionality	Accept

Research Framework



Literature Review

Factors	Definition
Perceived Value	The surplus between customer's perceived benefits and customer's perceived costs - Day (1990)
Perceived Ease of Use	The degree to which a person believes that using a particular system would be free from effort – Davis (1989)
Perceived Usefulness	The extent to which a customer believes that the using technology will enhance his performance of an activity - Davis (1989)
Firm's Reputation	Customers' perception on how responsible the firm is with their customer and honestly take care of their welfare - Hess (2008)
Privacy	Security and guards of customers' information online shopping in site - Ward and Lee (2000)
Trust	A specific beliefs set that mentions about the integrity, capability and benevolence of another party - Chiu et al. (2009)
Reliability	The working consistence of a particular site that operates as expected - Goode and Harris (2007)
Functionality	The extent to which a website is built to provide the sufficient information about the product or service - Law and Bai (2008)

Limitation

o The terms "consumer" and "customer" are often used interchangeably.
o In essence, consumers use products while customers buy them.
o A consumer may also be a customer and a customer can also be a consumer.
Therefore, the customer behavior study is also the limitation of the consumer behavior research.

Conclusion

o There are 6 factors affecting on Online Repurchase Intentions.
o Differences in different individuals' perception will lead to the Perceived Value's hypothesis rejection.
o Privacy hypothesis is rejected because of the Vietnamese low information safety awareness.
o There is no difference in Online Repurchase Intentions among different demographic groups.

Subject's poster "Customer Behavior in focus: A case study of Tiki Vietnam"

A Study On Perceived Benefit In E-Commerce
Case Study On Hochiminh City

Truong Nguyen - Linh Huynh - Thi Nguyen - Khoa Bui

FPT University

Abstract

This research aims to explore the components of Perceived Benefits when shopping online, construct and test their measurement scales. The two main components that make up the Perceived Benefits are Shopping Convenience and Shopping Selection. In short, it helps marketing executives better understand the components of Perceived Benefits and suggests some managerial implications to design and orient program as well as improves site features for better performances.

Introduction

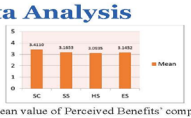
Nowadays, E-commerce has developed strongly, played the main role in the development of economy, and brought many benefits to daily life in the world. In Vietnam, it is nearly 62% of online users said that they already bought online by the average expenditure per capita approximately 160 USD. In addition to, the total sales revenue from an online B2B retailer in 2015 is roundly 4.07 billion USD (VECITA, 2016).

Vietnam population in 2015 (million)	Internet user ratio	Internet user use online shopping service ratio	Forecast individual online shopping value in 2015	Forecast B2C e-commerce profit in 2015
91.3	45%	62%	160 USD	4.07 billion USD

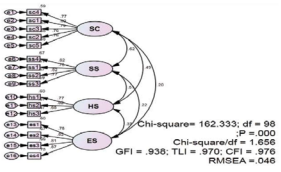
Analysis Methods

- Descriptive statistic
- Cronbach's alpha - reliability test
- Exploratory Factor Analysis
- Confirmatory Factor Analysis
- Structural Equation Model (SEM)
- Independent t-test

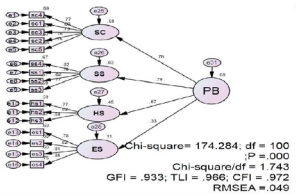
Data Analysis



The mean value of Perceived Benefits' components



CFA result - Perceived Benefits (Standardized)



SEM result - Theoretical Model (Standardized)

Relationship			Estimate
SS	<-	PB	.791
SC	<-	PB	.762
HS	<-	PB	.668
ES	<-	PB	.332

Result of main parameters (standardized)

Findings

- Perceived Benefits variable is observed by 4 components: Shopping Convenience, Shopping Selection, Hedonic Shopping, and Ease of Shopping.
- Shopping Selection is the component that most contribute to create Perceived Benefits, which followed by Shopping Convenience.
- There is a significant difference in mean between group ages on Hedonic Shopping.

Conclusion & Implication

- Conclusion:
Shopping Convenience and Shopping Selection are the 2 highest perceived benefit ; it helps consumers can buy whatever, wherever and whenever they want.
The findings are also accordance with the expectations as well as the previous research in the foreign market. It is obviously seen that convenience is the main element that stiulates consumers shopping, online not only in the world, but also in Vietnam.

- Implication:
Improving service faster to save time.
Diversifying variety brands into the websites.
Offering shipping service nationwide or worldwide to increase the product approach.
Refreshing the website periodically to raise the excitement.
Focusing especially on the experience of young consumers to improve buying process experience

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Subject's poster "A Study on Perceived Benefits in E-commerce"

Posters were displayed at the 1st FPTU Student Research Conference

Mr. Lam Huu Khanh Phuong was presenting Keynote 2: "Kanban Methodology in multi small projects context"

Dr. Tran Ngoc Tuan, Vice Rector of HCMC FPT University was speaking to start the conference

The evaluation committee were listening and discussing about the presentations of teams

Mr. Kieu Trong Khanh was presenting Keynote 1: "Software StartUp Project Contest"

Team 3 was presenting subject of "Automatic Alternative Image Recognition To Voice"

Team 1 was presenting subject of “Customer Behavior in focus: A case study of Tiki Vietnam”

Mr. Than Van Su was giving some remarks after all teams had finished presentations

Team 5 was presenting subject of “Building Material C2b Website”

Dr. Tran Ngoc Tuan, Vice Rector of HCMC FPT University awarded certificates and congratulated to the winning teams

FPTU

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