TIPID: DECISION SUPPORT SYSTEM ON E-SHOPPING PRODUCTS THROUGH GRAPHICAL VISUALIZATION

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In Partial Fulfilment of the Requirements for the Degree
Bachelor of Science in Computer Science

Averos, Christian M.
Delicano, Jobea Ann F.

March 2018

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Recommended for Approval and Acceptance: Date:

_____ _____

Benilda Eleonor V. Comendador, DIT
Faculty-In-charge

Approved by the Thesis Defense Panel:

_____ _____

Benilda Eleonor V. Comendador, DIT

_____ _____

Marian G. Arada, MIT

Accepted for the Department of Computer Science

_____ _____

Melvin C. Roxas, MSGITS
Department Chairperson

Accepted for the College of Computer and Information Sciences

_____ _____

Gisela May A. Albano, PhD
Dean of the College

ABSTRACT

As new technologies arise, online food, apparel, and product delivery services came to spotlight. Along with the growth of online shopping websites comes with the growth of merchants offering different prices for the same product. When finding a befitting product to buy, users tend to buy cheaper similar products, however the process itself of searching for such cheaper alternatives can become tiresome as buyers would switch websites after websites and look for different sellers.

In order to lessen the time consumed searching for the optimal product for buyers with a fixed budget, the study aimed to develop a recommender system that searches and scrapes data on online shopping websites to provide lists of top 10 ranking products based on a combination of price and reviews, based on price, and based on reviews in a single page layout based on the user's search term input. The system used classification technique in data mining to identify the products a user wants to buy and Interleaved Ranking Algorithm list out the best products in the online market.

Through an experimental research method the system achieved 90.57% accuracy on acquiring relevant data, 72.80% on getting the best deals in terms of price ranking, and 58.40% in terms of reviews ranking. Therefore, having a 73.92% on the system's overall accuracy.

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Averos, Christian M.

Delicano, Jobea Ann F.

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LIST OF NOTATION

DM	Data Mining
OSW	Online Shopping Website

Chapter 1

THE PROBLEM AND ITS BACKGROUND

In the fast-paced modern world, where technology progresses rampantly, we try to keep up with today's trends as well as needs. With the rise of technology, clinging unto technology makes our lives easier, and some experts say that the internet can now be consider a need along with food and shelter (Pastore, 1998). Everything is being digitalized as for our communication and work-processes, and with the use of the internet and its rapid development, delivery systems are getting more and more popular alongside of online shopping websites (OSWs). With that being said, it has great effect on Filipinos, especially modern Filipina who buy products on the internet through OSWs.

Most people all over the Philippines have access to the internet and they are still growing in numbers but there's a problem, how can we diminish the hard work process of searching through many OSWs just to get the best deals? The researchers are used to seeing their mothers go through many stores just to get the optimal price that fits in their budget, sometimes, they even come to a point of bargaining or asking the store to lower the price if we're going to buy bulk of their products. Similarly, E-Shoppers would search for many online shopping websites like Amazon and Lazada to compare and analyze what is the best for their searched similar products, weighing in the reviews, quantity, and even quality just to make sure that they're making a good decision upon purchasing such product. Searching and rummaging through many OSWs is a tiresome job. The proposed solution helps the user to remove the users the problem of doing such a tiresome work by going through the process itself providing the user a single comparison interface page. Providing 3 ranked lists each sorted by highest rating, by cheapest prices, and by the combination of the former two forming the best deals, respectively.

Alongside of many frameworks for building mobile and web applications, acquired data must be represented in a formal and understandable way for users to grasp

in first glance the importance of this study. Visualizing dynamic data in a user-friendly interface can make users comprehend easily the content of the acquired unstructured data sets. Therefore, the researchers decided to develop a system to help with troubled online shoppers (OS).

Background of the Study

Most Filipino shoppers have a hard time jumping to another store into other store just to find the best deals of their wanted product, may it be a new pair of shoes, shining jeans, or maybe a newly released branded cap. As much as we can, we bargain, bargain, and bargain. Most modern Filipino women would go to mall after mall just to buy off on-sale product which is also true for old-fashion mothers who would prefer to bargain just to get deals from their market suppliers. In today's technological advantage, many shoppers prefer e-commerce as their mode of shopping (Kitonyi, 2017), primarily because internet is easy to access and buying is just a few clicks away.

Filipinos like to bargain, since the old times, Filipino mothers would go to the market with a fixed money and get much more worth of their money for. Just imagine the hard work of going through and bargaining to many stores just to lessen the pay for a similar product as well as avoiding similar low quality products. This is also true to online shoppers looking for looking for a specific product in an online store, they would search many online store just to get the best deal in their opinion. They would scan for reviews of the said product and sometimes to avoid getting scammed or getting less than what you expected. One of the most common problem in OSWs is that there are scammers always present (Bolido, 2014) even in the most trusted OSWs. As for saving, it is no wonder that getting the less payment is the best. Some men would pay double just to get the product they want as they deemed it worth it. Ratings and reviews comes into play as helpful elements in deciding on what to buy on the store.

Visualization is the representation of data in which is any technique for creating images, animations, and etc. to convey a message. Truly, life would be boring if there weren't many colors or shapes around. Both became one of the major tools in life for differentiating and comparing. In today's application of visualization, one of the tools it is used for, when it comes to websites and computer applications, is helping the users' on their experiences. It help them in the form of 'navigation', or even the colour and theme of the website to give more feeling of appropriate based on the contents.

With the visualization as the main part of knowing, and criticizing, and differentiating can be implemented in a decision-support system in which colours and shape helps in choosing one in the items in question. The researchers plan to build a system that caters in the selection of similar products in which the user has to decide to buy or not. Getting the data only from the trusted OSW to minimize cyber market scamming and increasing the satisfaction rate of the users in selecting. Filtering only the 'best' deals in terms of reviews, quantity, and popularity to get the most-likely product to be picked by the user.

Statement of the Problem

This study aimed to develop a system that gets the best deal from various online shopping websites based on user’s search terms and apply a visualization technique to display the best deals. Specifically, this addressed the following sub-problems:

1. Using web crawler and scraper, what is the accuracy of the developed system in getting the relevant data from online shopping websites?
2. What is the performance of the developed system in utilizing Interleaved Ranking algorithm to identify the best deals in terms of:
   2.1. Price?
   2.2. Average Rating and Number of Customer Reviews?

3. What is the overall accuracy performance of the developed system?

Theoretical/Conceptual Framework

Theoretical Framework

Figure 1. System Theory Framework

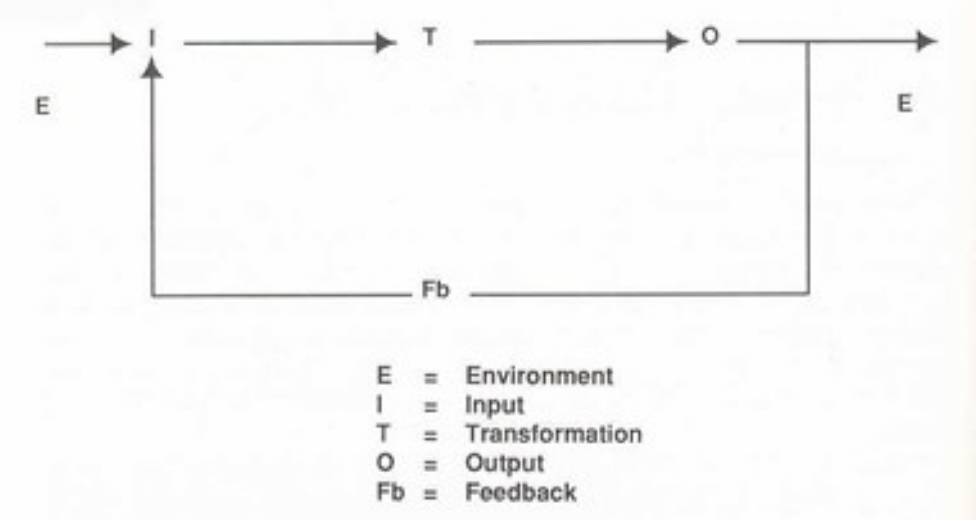


Figure 1 shows the theoretical framework of the system. System Theory is introduced by Ludwig von Bertalanffy. This theory points main four things that build up a system: objects, attributes, object-relationship and environment.

Conceptual framework

Table 1 shows the conceptual framework of the system where the user's search terms are the input data. The processes are getting the data from OSW and filtering out redundant data. The output data are the collection of best deals.

Table 1: Conceptual Framework of the System

INPUT	PROCESS	OUTPUT
User search term	Getting data from site Filtering out redundant data Analysis of the data set	Graphical Representation of the listed Best Deals

Significance of the Study

The system will benefit the following people:

Online Shoppers. This study would benefit shoppers who wants to lessen their time on selecting the best deal.

Store Owners. This will benefit them by being able to search how they would price their own products.

Future Researchers. This study will be a help as a guiding reference in making a system related to e-commerce.

Scope and Limitation of the Study

This study focused on the accuracy of the finding the best deals of electronic products and accessories selected by the user at the top online shopping websites. The system mines data from popular retailer online shopping websites and does not include second hand online shopping websites, specifically:

1. Lazada (lazada.com.ph)
2. Shopee (shopee.ph)
3. Amazon (amazon.com)

The scope in assessing the best deals is based on the relevancy, availability, price excluding the shipping fee, and numerical reviews regarding the product. The product prices are displayed in Philippine Peso.

The system is not affiliated in selling products and only acts as a recommender system for finding the best deals.

Definition of Terms

Data Mining. It is the process of extracting information from a large sets of data.

Online shoppers. Product consumers that uses Online Shopping Websites as their medium for purchasing.

Online Shopping Websites. Form of e-commerce that allows users to purchase commodities over the internet with the help of a web browser.

Scammers. People who extorts or uses dirty tactics to gain information, power or money.

Chapter 2

REVIEW OF LITERATURE AND STUDIES

This chapter discusses papers related to the study including Data Mining: its techniques, tools and application; visualization techniques; and shopping: physical shopping and its problems, OSWs and its problem and application of data mining in OSWs.

Related Literature and Studies

Data Mining

In the ever expanding data collection and data storage, Data Mining (DM) has been a logical process used to search useful information through piles of data. (Ramageri, 2010) Since data sets has become more complex and larger than it was, DM was improved by different algorithms discovered and developed in the field of computer science. DM is an important task in knowledge discovery in databases (KDD). (Li & Beaubouef, 2010) KDD consists procedures including (Smita & Sharma, 2014):

selection of data from varying sources;

preprocessing or data reduction;

transformation of data;

identifying the desired result; and

interpretation and analysis to give relevant information.

There are several DM techniques developed and applied in KDD (Bhatnagar et al., 2012):

Association. In association, a pattern is discovered based on a relationship of a particular item on other items in the same transaction. For example, the association technique is used in reservation systems analysis to identify in which area customers frequently make reservations.

Classification. Classification method makes use of mathematical techniques such as decision trees, linear programming, neural network and statistics. Basically classification is used to categorize each item in a set of data into one of predefined set of classes or groups.

Clustering. Clustering is a data mining technique that makes meaningful or useful cluster of objects that have similar characteristic using automatic technique. Different from classification, clustering technique also defines the classes and put objects in them, while in classification objects are assigned into predefined classes.

Prediction. It is one of a data mining techniques that discover relationship between independent variables and relationship between dependent and independent variables.

Sequential Patterns. Sequential patterns analysis is one of data mining technique that seeks to discover similar patterns in data transaction over a business period. The uncover patterns are used for further business analysis to recognize relationships among data.

Discrimination. Data discrimination produces what are called discriminant rules and is basically the comparison of the general features of objects between two classes referred to as the target class and the contrasting class.

DM is currently used in wide range of industries that holds a large amount of data and is commonly combining it in other tools that can enhance the power of DM in various fields. (Ramageri, 2010) Some of these fields include the field of biological science to analyze sequential pattern in genes and identify various diseases related to it. Finance industries use DM for price prediction, stock forecasting, identify frauds and money laundering. (Li & Beaubouef, 2010) Sales industry also use DM as in different ways (Al Essa & Bach, 2014):

Information broker for customer buying habits, from transaction histories to loyalty card usage. Because of this, supermarkets can predict customer behavior and act upon it for customer satisfaction and better sales;

Recommendation-based business that tracks customer's bought items and offer customer new items that they might also like;

Keeping good customers that boosts sales and avoiding fraudulent, bad customers;

Decision support system for both business holders and/or customers (Smita & Sharma, 2014); and

Other applications that can build customer relationship.

Web Crawler

Before acquiring data to be displayed, websites should be visited first. Web crawlers are used to automate website visits from time to time and partnered with a scraper in order to get needed data. Data mining techniques like classification is used in order to crawl to needed webpages to avoid wasting resources and to lessen noise from the data that will be obtained. (Mitra & Tan, 2010)

Web Scraper

Web scraper functions as a tool for obtaining the specific data needed from the website. Different data mining techniques are applied to get the data in a systematic way by grouping the data to discover hidden aspects of the data. Classification technique is used to scrape data given that there is a predefined class given as a basis (Dai et al., 2015).

Data Analysis Techniques

Bayesian Estimation

In order to avoid from bad product or service, consumers rely on product reviews by other consumers. Consumers automatically prejudge products on a five-star rating. This method is powerful and easy to understand but it can be mishandled when ranked since five-star ratings depends not only on the average number of stars but the average number of reviews. Take for example Product A with an average rating of 5 and a single review, and Product B with an average rating of 4 but has a hundred reviews. Not all cons Bayesian Estimation is an empirical metric that considers both average and number of reviews. This is done by using a probability distribution for each reviews given by a consumer on a specific product. By making a threshold parameter and taking a minimum number of ratings as a confidence for the threshold, a product is weighed according to the reviews it has received while still taking into consideration the true average of the product. Bayesian estimation is used in review sites such as IMDb.

Interleaved Ranking Algorithm

In product information retrieval where there are different factors to consider such as price and reviews, they, of course, are ranked differently depending how it is filtered. In order to make data retrieval efficient, the approach is to compare both rankings and display a single ranked list to the user. Both ranking are interpreted in an unbiased way and presented to the user to be more interpretable. One way of interleaving is by Team Draft wherein in adapts the analogy of selecting teams in a sports match. This way, both ranks are considered equally appending each item on the interleaved list in an alternate manner.

Data Visualization

Visualization provide users a comprehensive understanding about a data. It gives form to raw data making it coherent to the users. Using computer graphic effects, data sets can be visualized to display patterns, relationship and trends in a more advanced way. This gives users an ease to apprehend information by the use of visual reasoning rather than numerical reasoning. (Zhao, 2002) Presentation of data may involve the manipulation of graphical entities and attributes. A good data visualization must consider the effectiveness or ease of interpretation, accuracy or correct quantitative evaluation, efficiency or data redundancy removal, aesthetic or must be pleasant to the user's eye and adaptable or adjustable to serve multiple needs. According to Ward, common techniques on data visualization are following: charts, graphs, plots, maps, images, 3D surfaces and animation. Parsaye and Chignell listed the common steps followed in data visualization:

1) Numerical transformation of data by modifying the distribution

2) Data analysis to interpret data that will be used in graphical interpretation

3) Graphical interpretation by plotting the analyzed data onto graphs

4) User interaction by adding options for users to dynamically adjust mapping, zooming, panning, highlighting, et cetera.

Shopping

Shopping is the activity of trading goods and products for other goods and products. (Robertson, 2012) Simply put, exchanging a product for a more benefiting one, this can be; food, tools, money, ad etc. depending on your needs. In the early age of man, the art of exchanging goods took place in which leads to easier lives of the customers for they don't even have to hunt or gather food themselves in which fasten the growth of many communities. According to Oxford, markets or shopping malls have been the main place

of trading, but they're often in urban areas or in the middle of the city which can be, depending where you live or just lazy, can be hard to go to. (Bund)

As technology develop and as our understanding of computers and the internet as well as the remaining difficulty of going to the market place, landlines, the internet and trading companies gave birth to ticket booking and food delivery services, and online shopping websites (OSWs). Pizzas, clothes, and pizza, can be delivered in front of your doorstep in a matter of minutes by the usage of the internet by visiting such OSWs. But be wary of scammers especially in the e-shopping category as they run rampant waiting for a user to be conned.

As the danger of scammers are not enough, one of the most commonly problem encountered by many users is the tedious work of manually comparing and searching of a particular type of product in many OSWs. Users have to go to multiple OSW just to type in the same keywords and is faced with many similar product in that OSW plus many more with the other OSWs. Reviewing the 'reviews', as well as looking in to the quantity, and the quality of the searched product come hand in hand which makes it hard for the comparison process thus making a decisive and long decision.

Fortunately, 'Comparison of ecommerce products using web mining authors', have started a way for tackling this issue way easier with the use of Data mining. Studying the HTML code structure of international OSWs such as Lazada and Amazon, and using web-crawling spider to scrape out unstructured data and organizing them to a meaningful data. They let the user input search terms that will display the comparing pair deals, successfully lessening the user's time for looking in different browser tabs. Displaying it in a single-view page for users to view and pick what they desire. However, displaying and adding a table of comparison for such products still doesn't solve the problem of finding the best deals an OSW can offer. Finding the best deals have to account the reviews of other users, quality, quantity, and availability of the product. (Mo, Z., Li, Y.-F. and Fan, P., 2015)

Synthesis of the Study

There have been many studies that concerns in the field of data mining and visualization. One of the main researches that drives the researchers is the 'Comparison of E-commerce products in using web mining' research done in Savitribai Phule Pune University in where the users inputs two or more products to compare in a single page website. However, the main problem of Shah, et al.'s work is that the users are required to manually search and add the products for it to compare. Undisputedly, price is one of the considerations when people are trying to save money when buying a product. So is ratings and reviews as for considering the duration of use or the quality of the product. It's true that people looked up to reviews to see if it's worth it or not. In this study, the researchers attempt to gather data from the leading OSWs automatically responding the search terms or input of the users. The researchers limited to OSWs with branches in the Philippines to remove or reduce the cost of high delivery fee for products from foreign countries. Using the input of the user, the system then will collect products related to the input from the OSWs and finally, displayed according to their ranking. A total of 50 unique search terms are used for the regression test due to the shortage of electronic device categories with non-specific brand or merchant to provide fair competition to online merchants. As a decision support system, the system focuses on visualizing the products in a way that help convey the difference among the products as well as magnify the pros and cons.

For the gathering data relevant to the desired product of the user, the researchers used web scraper for acquiring the frequent relevant item sets. The prune data in will be stored in the a database to remove repeating data or noise data then subjected to an algorithm called Interleaved ranking algorithm with Bayesian estimation to find the best deals to be visualize in a single view page. For the visualization, the users can view graphs and statistics which can help in deciding on what to buy.

CHAPTER 3

Research Methodology

This chapter defines the research methods used to conduct the study. It involves the research method that will be used, paradigm, system architecture and the data gathering procedure.

Research Design

The research design of this study used the Experimental research design. The aim of the experiment is to determine if the system is a reliable and accurate approach in the delivery of gathered best deals in the selected OSWs. With the use of this design, the researchers have reached and come up with the answers to the questions stated in the statement of the problem.

In determining the overall performance of the system in gathering the best deals, the researchers lead an experiment. The respondents, described in the Research instrument in Instrumentation, compare the system's actual output and the expected result by the researchers to measure the system's performance in accuracy, reliability, and consistency in getting the best deals.

Sources of Data

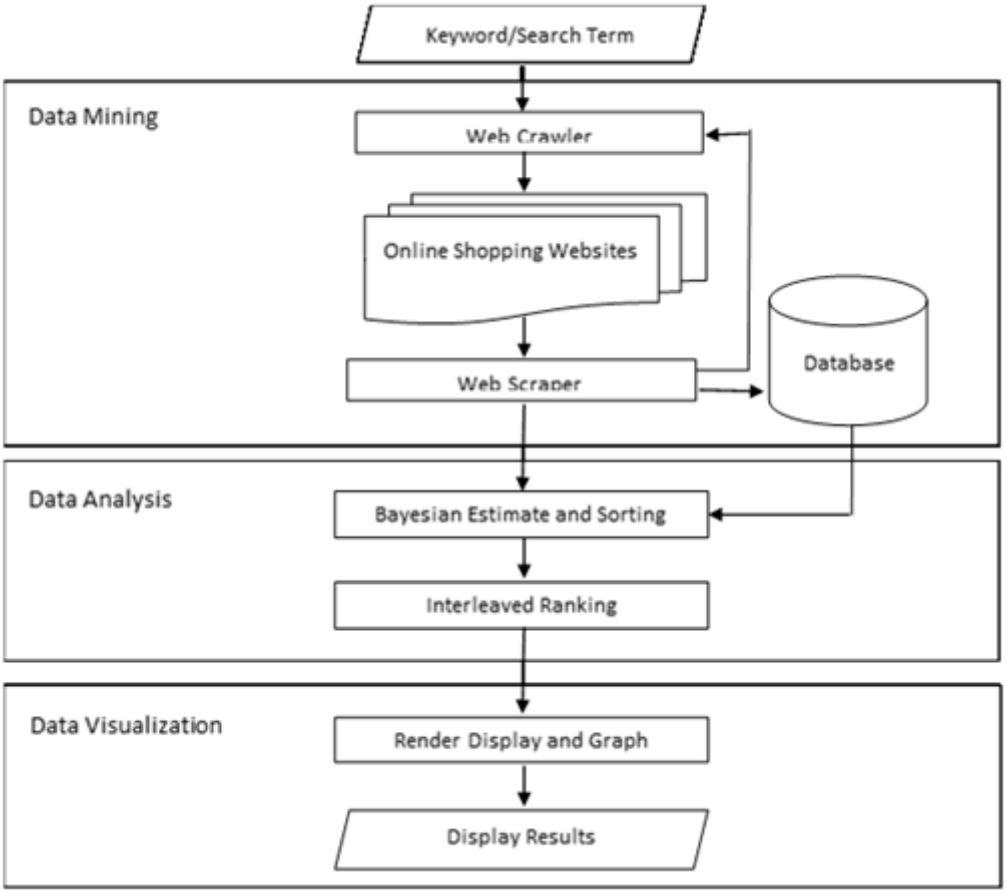
The respondents were both the researchers and searching online shoppers. The respondents used search terms to train the system and is given a set of possible best deals. The respondents then evaluated the accuracy and reliability of the system.

Instrumentation

Software/Hardware Tools

System Architecture

Figure 2. System Architecture



Data Mining. The product keyword will be used in order to get the specific items from OSWs. Using the Web Crawler to go to each OSWs, the Web Scraper will then mine relevant data and stored them in database.

Data Analysis. After the Web Scraper is done storing the relevant items in the database, the items will be duplicated in an exact duplicate set of two namely set A and set B After computing the Bayesian estimate according to the ratings and reviews. Set A will be sorted starting with the lowest price and set B will be sorted

according to the Bayesian estimate of the reviews. The two sets will undergo through interleaved ranking to get the ranked set.

Data Visualization. After acquiring the ranked set through interleaving, top 10 items will be displayed as the Best Deals item set. The top 10 in Set A and Set B, which were ranked by price and reviews will be displayed and called as the 'candidate' set. The scatter plot figure of Matplot library will be used to plot and display the item values onto a graph that will compare and show the difference between the ranked products.

Development Details

The researcher's will use the following tools in order to develop the system:

Python. A multi-paradigm programming language with high-level data structures and highly readable syntax that can be used on most platforms. This language will be used to create the backend for the system.

Django Framework. A server-side web framework written in Python which will be used to create the user-interface for the system.

BeautifulSoup. A web crawling framework written in Python. This will be used to crawl and extract data from various data sources.

Selenium Webdriver. Webdriver that will be used to run the web crawlers on browser.

Research Instrument

Experiment paper will be used to measure and record results while testing the system.

Data Generation

The following are the procedures in gathering data used by the researchers for the study:

Software Related Data

Maximum of (20) product data sets per OSW each for a maximum of sixty (60) products data sets were gathered will be stored in a database. The data acquired from the three (3) OSWs are then further reduced and extracted only the best out of all the data. The data sets of ten (10) 'Best deals' are sorted according to the respondent's preference and finally displayed.

Survey & Testing Data

A regression test of fifty (50) unique search terms related to electronic devices were used as testing data sets. The search terms were used in order to extract item set from OSWs. Accuracy of the relevant data in extracted item set were evaluated by tallying the number of items related to the search term given. The extracted item set was ranked by price and another similar extracted item set will be ranked by reviews. The top 10 in both ranked sets were classified as the candidate items for the best deals. The two ranked item sets underwent interleaved ranking and the top 10 were the best deals. The accuracy was acquired by counting the candidate items present in the best deals and using the recall formula. The total accuracy of the system was computed by getting the average of the accuracy of the relevant items, accuracy of best deal by price and accuracy of by reviews.

Data Analysis

In order to solve for the first problem, accuracy of the scraped set by the Web Scraper was computed by the following formula:

$$x = \frac{n}{N} \times 100$$

where: x = accuracy

n = number of relevant item in set

N = total number of item in set

The formula of Bayesian Estimation in the second problem was used for evaluation of the ranking in the 'scraped' data sets:

$$x = \frac{C * m + R * v}{C + v}$$

where: x = Bayesian estimate

. R = mean over the ratings for the items.

C = confidence

v = number of reviews

m = threshold parameter

The formula of Recall was used on solving second problem to get the accuracy:

$$x = \frac{cb}{cb + nb} \times 100$$

where: x = Accuracy

cb = no. of candidate (price/review) - best deal item

nb = no. of non-candidate (price/review) – best deal item

To solve the third problem, mean formula was used:

$$x = \frac{a.of\ relevant\ items + a.of\ best\ deal\ by\ price + a.of\ best\ deal\ by\ reviews}{3}$$

where: x = total accuracy of the system

Chapter 4

RESULTS AND DISCUSSION

The purpose of the study is to provide recommendable best product deals from the Internet based on its price and reviews according to the user's search term input. The analysis of the test results gives an idea on the accuracy of the system can show list of the products that will give the user an idea on what product is the best to buy. Fifty (50) technology-related search terms were used to test the system and answer the problem stated in the first chapter.

The discussion below is presented to answer the following question/s:

1. Using web crawler and scraper, what is the accuracy of the developed system in getting the relevant data from online shopping websites?

Table 2: Performance of the developed system in using web crawler and spider with 0% to 75% accuracy

#	Search Terms	Number of Relevant Items	Total Number Of Items	Accuracy of getting relevant items
1	Usb Steering Wheel	7	40	17.50%
2	4gb RAM	19	40	47.50%
3	Videocard	23	40	57.50%
4	Cooling Pads	29	43	67.44%
5	Laser Printer	28	40	70.00%
6	Wireless Keyboard	43	59	72.88%

Table 2 shows the accuracy of each search terms ranging from 0% to 75%. USB steering wheel got the lowest accuracy of 17.5%. Most of the products showed were not directly related to USB steering wheels for gaming, but a music player with a USB port attachable to the steering wheel. 4GB RAM got second

lowest accuracy since majority of the products showed were smartphone units with 4GB RAM specifications. Four (4) items got an accuracy ranging from 50% to 70%.

Table 3: Performance of the developed system in using web crawler and spider with 76% to 99% accuracy

#		# of Relevant Items	Total Number Of Items	Accuracy of getting relevant items
7	Polaroid Camera	45	58	77.59%
8	4g Pocket Wifi	36	45	80.00%
9	Projector	49	60	81.67%
10	Surround Sound Microphone	33	40	82.50%
11	Breadboard	35	41	85.37%
12	Digital Camera	45	52	86.54%
13	Wireless Controller	46	52	88.46%
14	Washing Machine	40	45	88.89%
15	Ps3 Controller	36	40	90.00%
16	Android Charger	37	40	92.50%
17	Midi Keyboard	37	40	92.50%
18	Motherboard	37	40	92.50%
19	Gaming Mouse	56	60	93.33%
20	Battery Charger	56	60	93.33%
21	Hdmi Adapter	55	58	94.83%
22	Wireless Microphone	44	46	95.65%
23	1tb External Hard Drive	58	60	96.67%
24	4k Tv	35	36	97.22%
25	Drawing Tablet	40	41	97.56%
26	Dvd Player	42	43	97.67%
27	Led Monitor	43	44	97.73%
28	Bluetooth Speaker	59	60	98.33%
29	Gaming Keyboard	59	60	98.33%
30	Wireless Mouse	59	60	98.33%
31	Web Cam	59	60	98.33%

Table 3 shows twenty-five (25) search terms with accuracy ranging from 76% to 99%.

Table 4: Performance of the developed system in using web crawler and spider with 100% accuracy

#	Search Terms	# of Relevant Items	Total Number Of Items	Accuracy of getting relevant items
32	Led Keyboard	42	42	100.00%
33	Led Mouse	42	42	100.00%
34	Silent Mouse	53	53	100.00%
35	Bluetooth Earphone	60	60	100.00%
36	Gaming Headset	57	57	100.00%
37	Silent Keyboard	40	40	100.00%
38	10000mah Power Bank	60	60	100.00%
39	Iphone 7 Case	48	48	100.00%
40	Vga Adapter	56	56	100.00%
41	Usb 3.0 Cable	52	52	100.00%
42	Avr (Automatic Voltage Regulator)	41	41	100.00%
43	32gb Flash Drive	60	60	100.00%
44	Dash Cam	60	60	100.00%
45	32gb Memory Card	60	60	100.00%
46	Pointer Clicker	40	40	100.00%
47	Vr Headset	40	40	100.00%
48	Router	60	60	100.00%
49	Scientific Calculator	48	48	100.00%
50	Drone	40	40	100.00%
			TOTAL: 90.57%	

Table 4 shows search terms that got a perfect accuracy and the total accuracy of the System in getting the relevant items. Nineteen (19) search terms got a 100% accuracy. The search terms which got a high accuracy displayed product which were directly related to the user's expectations. The total accuracy of the system in getting the relevant items is 90.57%.

2. What is the performance of the developed system in utilizing Interleaved Ranking algorithm to identify the best deals in terms of:

   2.1. Price?

2.2. Average Rating and Number of Customer Reviews?

Table 5: Performance of the developed system in identifying the best deals in terms of price with 0% to 75% accuracy

#	Search Terms	Number of Candidate Products in Best Deals list based on price rankings	Number of Non-Candidate products in Best Deals list based on price rankings	Accuracy of getting the best deals based on price rankings
1	USB Steering Wheel	2	8	20%
2	4g Pocket Wifi	5	5	50%
3	Digital Camera	6	4	60%
4	Midi Keyboard	6	4	60%
5	Hdmi Adapter	6	4	60%
6	Cooling Pads	6	4	60%
7	Polaroid Camera	6	4	60%
8	Dash Cam	6	4	60%
9	Laser Printer	6	4	60%
10	Wireless Microphone	6	4	60%
11	Projector	6	4	60%
12	Dvd Player	6	4	60%
13	Router	6	4	60%
14	Scientific Calculator	6	4	60%
15	Battery Charger	6	4	60%
16	Drawing Tablet	7	3	70%
17	Led Keyboard	7	3	70%
18	Silent Mouse	7	3	70%
19	Gaming Headset	7	3	70%
20	Ps3 Controller	7	3	70%
21	Wireless Keyboard	7	3	70%
22	Iphone 7 Case	7	3	70%
23	Usb 3.0 Cable	7	3	70%
24	Web Cam	7	3	70%
25	Breadboard	7	3	70%
26	Washing Machine	7	3	70%
27	Drone	7	3	70%
28	4gb RAM	7	3	70%
29	Videocard	7	3	70%

Table 5 shows accuracy in getting the ranked best deals based on price rankings ranging 50% to 75%. USB steering wheel gets the lowest accuracy of

20%. One (1) item—4G Pocket Wifi—gets an accuracy of 50%. Twenty-seven (27) search terms got an accuracy ranging 60% to 70%. USB Steering Wheel, which got the lowest accuracy, showed products with low prices yet low customer reviews.

Table 6: Performance of the developed system in identifying the best deals in terms of price with 76% to 100% accuracy

#	Search Terms	# of Candidate Products in Best Deals list based on price rankings	# of Non-Candidate products in Best Deals list based on price rankings	Accuracy of getting the best deals based on price rankings
30	Bluetooth Speaker	8	2	80%
31	Gaming Keyboard	8	2	80%
32	Led Mouse	8	2	80%
33	Bluetooth Earphone	8	2	80%
34	Wireless Controller	8	2	80%
35	Silent Keyboard	8	2	80%
36	Wireless Mouse	8	2	80%
37	1tb External Hard Drive	8	2	80%
38	Avr (Automatic Voltage Regulator)	8	2	80%
39	32gb Flash Drive	8	2	80%
40	4k Tv	8	2	80%
41	32gb Memory Card	8	2	80%
42	Pointer Clicker	8	2	80%
43	Surround Sound Microphone	8	2	80%
44	Vr Headset	8	2	80%
45	Motherboard	8	2	80%
46	10000mah Power Bank	9	1	90%
47	Vga Adapter	9	1	90%
48	Led Monitor	9	1	90%
49	Gaming Mouse	10	0	100%
50	Android Charger	10	0	100%
			TOTAL: 72.8%	

Table 6 shows the list of search terms with accuracy ranging from 80% to 100% and the total accuracy of getting the ranked best deals based on the price

rankings. Twenty (19) search terms got an accuracy ranging from 80% to 90%. Two (2) products—gaming mouse and android charger—gets the perfect accuracy. These two search terms displayed products with low prices and high customer reviews. The total accuracy of getting ranked best deals based on price rankings is 72.8%.

Table 7: Performance of the developed system in identifying the best deals in terms of customer reviews with 0% to 50% accuracy

#	Search Terms	# of Candidate Products in Best Deals list based on customer review rankings	# of Non-Candidate products in Best Deals list based on customer review rankings	Accuracy of getting the best deals based on customer review rankings
1	Drawing Tablet	3	7	30%
2	4g Pocket Wifi	4	6	40%
3	USB 3.0 Cable	4	6	40%
4	Web Cam	4	6	40%
5	Breadboard	4	6	40%
6	Gaming Keyboard	4	6	40%
7	32gb Memory Card	4	6	40%
8	Led Monitor	4	6	40%
9	Laser Printer	5	5	50%
10	Projector	5	5	50%
11	Battery Charger	5	5	50%
12	Led Keyboard	5	5	50%
13	Silent Mouse	5	5	50%
14	Gaming Headset	5	5	50%
15	Ps3 Controller	5	5	50%
16	Iphone 7 Case	5	5	50%
17	4gb RAM	5	5	50%
18	Silent Keyboard	5	5	50%
19	Pointer Clicker	5	5	50%
20	Surround Sound Microphone	5	5	50%
21	Usb Steering Wheel	5	5	50%
22	Vga Adapter	5	5	50%

Table 7 shows accuracy in getting the ranked best deals based on customer review rankings ranging 30% to 50%. Drawing tablet gets the lowest

accuracy of 30%. The products displayed had high customer reviews yet high prices. Twenty-one (21) search terms got an accuracy ranging 40% to 50%.

Table 8: Performance of the developed system in identifying the best deals in terms of customer reviews with 60% to 100% accuracy

#	Search Terms	# of Candidate Products in Best Deals list based on customer review rankings	# of Non-Candidate products in Best Deals list based on customer review rankings	Accuracy of getting the best deals based on customer review rankings
23	Hdmi Adapter	6	4	60%
24	Cooling Pads	6	4	60%
25	Polaroid Camera	6	4	60%
26	Dash Cam	6	4	60%
27	Wireless Microphone	6	4	60%
28	Dvd Player	6	4	60%
29	Led Mouse	6	4	60%
30	Bluetooth Earphone	6	4	60%
31	Wireless Controller	6	4	60%
32	Wireless Mouse	6	4	60%
33	1tb External Hard Drive	6	4	60%
34	Avr (Automatic Voltage Regulator)	6	4	60%
35	Vr Headset	6	4	60%
36	Gaming Mouse	6	4	60%
37	Digital Camera	7	3	70%
38	Midi Keyboard	7	3	70%
39	Wireless Keyboard	7	3	70%
40	Washing Machine	7	3	70%
41	Drone	7	3	70%
42	Bluetooth Speaker	7	3	70%
43	32gb Flash Drive	7	3	70%
44	4k Tv	7	3	70%
45	Motherboard	10	3	70%
46	Router	8	2	80%
47	Scientific Calculator	8	2	80%
48	10000mah Power Bank	8	2	80%
49	Videocard	10	0	100%
50	Android Charger	10	0	100%
			TOTAL:	58.4%

Table 8 shows the accuracy of getting the ranked best deals based on the average rating and number of costumer reviews ranging from 60% to 100% and the total accuracy of getting the ranked best deals based on the average rating and number of customer reviews. Twenty-three (23) search term got an accuracy ranging from 60% to 70%. Three (3) search terms got an accuracy of 80%. Two (2) search terms—videocard and android charger—got a perfect accuracy. The search terms which got a high accuracy displayed products with high customer reviews and low prices. The total accuracy of getting the ranked best deals based on the average rating and number of costumer reviews is 58.4%.

3. What is the overall accuracy performance of the developed system?

Table 9: Total accuracy of the system

Accuracy of getting relevant items	Accuracy of getting the best deals in terms of:		Overall Accuracy
	Price	Customer Reviews	
90.57%	72.80%	58.40%	73.92%

Based on the Table 9, by getting the average of total accuracy of getting relevant items, total accuracy of getting the best deals based on price, and total accuracy of getting the best deals based on reviews, we can get the overall accuracy of the system. A total of 73.82% accuracy was achieved by the System.

Chapter 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary, conclusion, and the recommendations of the study. It is also discussed the findings and results made from the information gathered in experimenting the accuracy of the System in giving the best deals.

Summary of the Findings

The study aimed to develop a system that provide recommendable best deal products among the online shopping websites. The research method in this study is through experimental design.

The first problem stated in Chapter 1 asked the accuracy of getting the relevant items using the mean formula. The results shows that the accuracy for getting the relevant items is 90.57%.

The second problem statement asked for the accuracy of getting the best deals in terms of price and reviews. The results found that the accuracy of getting the best deals according to price and review ranking is 72.80% and 58.40%, respectively.

The third problem statement asked for the overall accuracy of the System in providing relevant best deals items according to price and review ranking. The System receives 73.92%

Conclusions

Through the testing and analysis of the results, the researchers have concluded the following:

1. The researchers found that accuracy of getting the relevant data in online shopping websites heavily weighs on the ambiguity of the search term. “4GB ram” search term test got the lowest accuracy of getting the relevant data since

the term can be used to specify a desktop computer hardware or a specifications of a smartphone unit. VR Headset got a 100% accuracy of getting the relevant data due to lack of ambiguity. Therefore, the lower the ambiguity of the search term, higher the accuracy of getting the relevant data.

2. The total accuracy of getting the best deals in terms of price is higher than in terms of reviews due to the products in the price ranking having a good review rates and review rankings having listing highly reviewed yet expensive products. The highly reviewed expensive products will rank low in the price rankings and the products with good reviews which ranked high in the price rankings will be ranked on a middle rather than low. During the merging of two rankings, the products which topped the price ranking would get ranked high in the best deals rank. The researchers therefore concluded that most products with low price and good reviews are more likely to be included in top 10 best deals rather than highly reviewed yet expensive products.
3. The overall accuracy of the System is moderately high. The researchers found that there are factors which affects the overall accuracy of the System. The factors that affects the accuracy of the system is the ambiguity of the search term, and the price and review of the products.

Recommendations

The researchers suggest the following improvements to the system to further enhance the results which answers the statement of the problem.

1. To get higher accuracy on getting relevant data, it is advised to use filtering options to get a more specific and relevant output.

2. To get higher accuracy on best deals based on customer review rankings, other methods and algorithms to merge price rankings and customer review rankings should be considered.
3. In order to achieve higher results on the overall accuracy of the system, application of filtering options and improvement of algorithm to merge price rankings and customer review rankings.

Other recommendations for the overall performance and improvement of the system includes the following:

1. Add more online shopping websites for wider selection of products.
2. Use a different data mining approach to improve speed of data extraction from online shopping websites.
3. Improvement of the User Interface and User Experience of the system.
4. Testing the system on different time intervals to check the differences and variations of results' effectiveness on the accuracy of time.

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APPENDICES

Appendix A:

SAMPLE EXPERIMENT PAPER

Table 10: Sample experiment paper for getting the accuracy of the relevant items

#	Search Terms	# of Relevant Items	Total Number Of Items	Accuracy of getting relevant items
1	Drawing Tablet			
2	Bluetooth Speaker			
3	Gaming Mouse			
4	Led Keyboard			
5	Gaming Keyboard			
6	Led Mouse			
7	Silent Mouse			
8	Bluetooth Earphone			
9	Gaming Headset			
10	Digital Camera			
11	Wireless Controller			
12	Ps3 Controller			
13	Silent Keyboard			
14	Wireless Keyboard			
15	Wireless Mouse			
16	Android Charger			
17	10000mah Power Bank			
18	Midi Keyboard			
19	Iphone 7 Case			
20	1tb External Hard Drive			
21	Hdmi Adapter			
22	Vga Adapter			
23	Usb 3.0 Cable			
24	Cooling Pads			
25	Avr (Automatic Voltage Regulator)			
26	32gb Flash Drive			
27	Led Monitor			
28	4k Tv			

29	Polaroid Camera			
30	Dash Cam			
31	Laser Printer			
32	32gb Memory Card			
33	Wireless Microphone			
34	Web Cam			
35	Projector			
36	Pointer Clicker			
37	Dvd Player			
38	Surround Sound Microphone			
39	Vr Headset			
40	4g Pocket Wifi			
41	Router			
42	Scientific Calculator			
43	Breadboard			
44	Washing Machine			
45	Usb Steering Wheel			
46	Drone			
47	Battery Charger			
48	4gb RAM			
49	Motherboard			
50	Videocard			
				Total:

Table 11: Sample experiment paper on getting the best deals based on price rankings and customer review rankings

#	**Search Terms**	**# of Candidate Products in Best Deals list**		**# of Non-Candidate products in Best Deals list**		**Accuracy of getting the best deals based on:**	
		Price	**Reviews**	**Price**	**Reviews**	**Price**	**Reviews**
1	Drawing Tablet						
2	Bluetooth Speaker						
3	Gaming Mouse						
4	Led Keyboard						
5	Gaming Keyboard						
6	Led Mouse						

7	Silent Mouse						
8	Bluetooth Earphone						
9	Gaming Headset						
10	Digital Camera						
11	Wireless Controller						
12	Ps3 Controller						
13	Silent Keyboard						
14	Wireless Keyboard						
15	Wireless Mouse						
16	Android Charger						
17	10000mah Power Bank						
18	Midi Keyboard						
19	Iphone 7 Case						
20	1tb External Hard Drive						
21	Hdmi Adapter						
22	Vga Adapter						
23	Usb 3.0 Cable						
24	Cooling Pads						
25	Avr (Automatic Voltage Regulator)						
26	32gb Flash Drive						
27	Led Monitor						
28	4k Tv						
29	Polaroid Camera						
30	Dash Cam						
31	Laser Printer						
32	32gb Memory Card						

33	Wireless Microphone						
34	Web Cam						
35	Projector						
36	Pointer Clicker						
37	Dvd Player						
38	Surround Sound Microphone						
39	Vr Headset						
40	4g Pocket Wifi						
41	Router						
42	Scientific Calculator						
43	Breadboard						
44	Washing Machine						
45	Usb Steering Wheel						
46	Drone						
47	Battery Charger						
48	4gb RAM						
49	Motherboard						
50	Videocard						
						Total:	**Total:**

Table 12: Sample experiment paper for total accuracy of the system

Total Accuracy of getting relevant items	Total Accuracy of getting the best deals based on:		Overall Accuracy of the System
	Price	Reviews	

Appendix B:

IMPLEMENTATION REPORT

Introduction

When searching for the optimal product when buying online, buyers with a fixed budget tend to switch websites after websites. TIPid, a Decision support system on E-Shopping Products through Graphical Visualization, searches online shopping websites and gathers data based on the user's search term input to provide list rankings of the best deals to which the users can check and buy. The list rankings consist of products list ranked based on price and reviews, products list ranked based on price, and products list ranked based on reviews.

Problem Statement

The purpose of the study is to develop a decision support system that accurately provides best deals on the E-Shopping market in relevance to the user's search term input. Specifically, the study aims to answer the following questions:

1. Using web scraper and spider, what is the accuracy of getting the relevant data from online shopping websites using percentage formula?

2. What is the accuracy of the applying Interleaved Ranking using Recall formula in getting the ranked best deals based on:

    a. The ranking by Price?

    b. The ranking by Average Rating and Number of Customer Reviews?

3. What is the total accuracy of using the developed system using the mean formula?

Time Frame

	February			March	
	2nd week	3rd week	4th week	1st week	2nd week
Gathering of Testing Data					
Testing					
Evaluation of Results					
Chapter 4					
Chapter 5					

Implementation Procedures

Before the implementation procedures, the researchers' first list out the search term input data to be used to test the system. The search term input data were all technology-related devices for the devices have a wide range of prices, manufacturers, and sellers available on the E-Shopping market. A total of 50 search term inputs have been gathered. The objective of the implementation is to evaluate the accuracy of getting the relevant data from online shopping websites, accuracy of getting the ranked best deals based on the ranking by price and the ranking by average rating and number of customer reviews, and the overall accuracy of the system.

Issues and Concerns

There are two issues encountered by the researchers. The first issue encountered is the limited searching time per day of the system as the online shopping websites detects and prevents the system to further acquiring data branding the system as a bot. The second issue encountered is the slow extraction of data as the system have to wait for the pages to fully load to finally scrape the data to fully load to scrape the data.

Implementation Photos

Appendix C:

SCREENSHOTS OF THE SYSTEM

Figure 3. Screenshot of TIPid Homepage

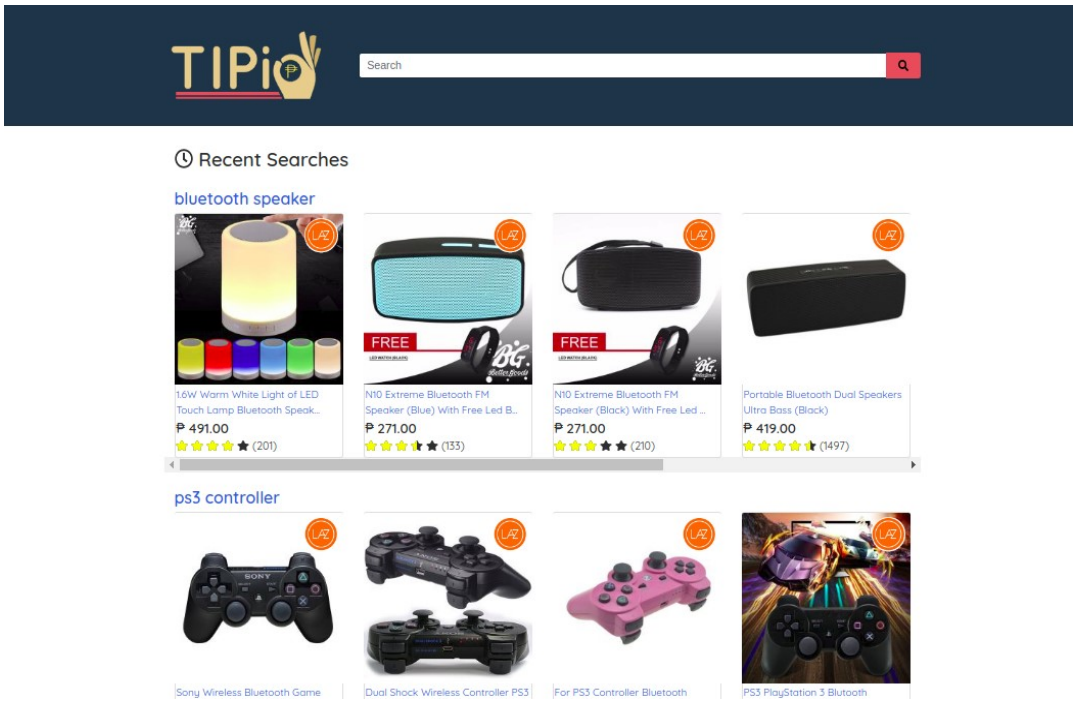


Figure 4. Top 10 Best Deals Section in Search Results Page

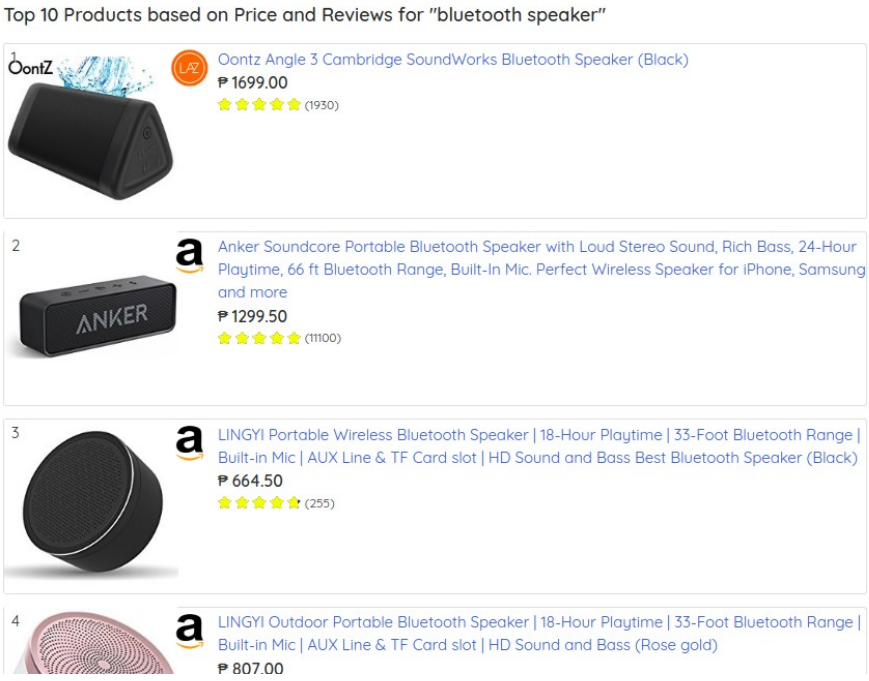


Figure 5. Top 10 Products based on Price Section

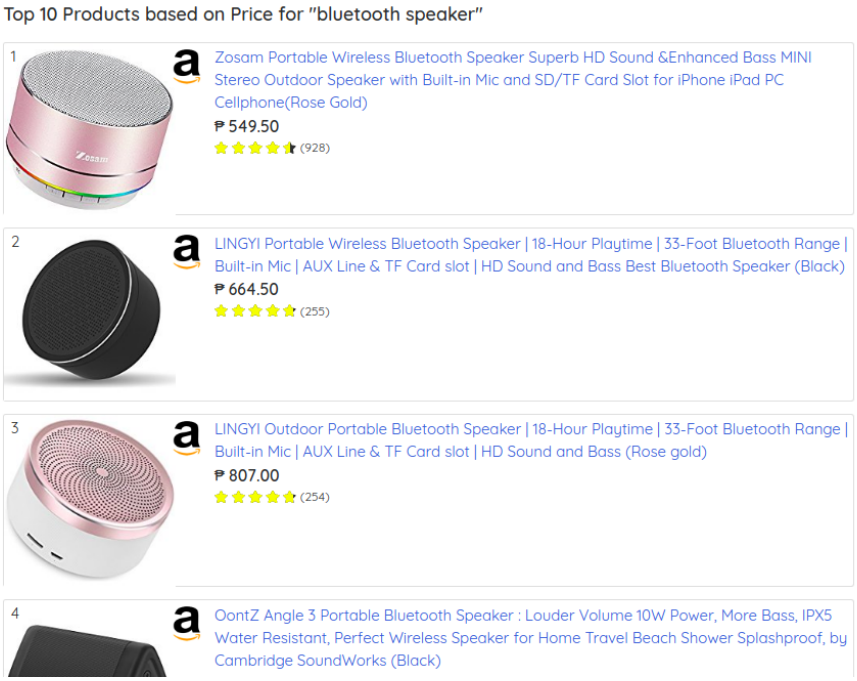
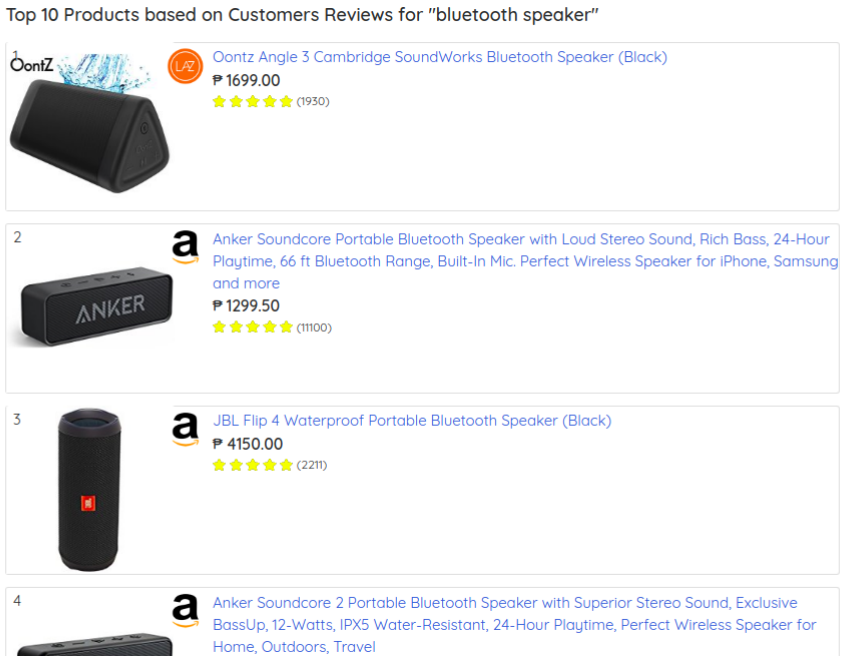


Figure 6. Top 10 Products based on Customer Reviews Section



Appendix D:

RESUME OF THE RESEARCHERS

CHRISTIAN AVEROS

5 South 17 Fr. Martinez St. Barangay Obrero, Quezon City
christianaveros@gmail.com

PERSONAL INFORMATION

Date of Birth: January 27, 1998
Civil Status: Single
Place of Birth: Quezon City
Sex: Male
Languages Spoken: English, Filipino (Tagalog)

EDUCATIONAL ATTAINMENT

Polytechnic University of the Philippines — *2014 – Present*
Bachelor of Science in Computer Science
Major in Computer Graphics and Visualization
Sta. Mesa, Manila

Manuel A. Roxas High School — 2010 -- 2014
With specialization in Metal Welding
Roxas, Quezon City

SKILLS

Microsoft Office: Word, Power Point
Programming/Scripting Languages: C, C#, SQL, Java, HTML, PHP, CSS, JavaScript, CSS, Game Maker Language (GML)
Multimedia: Adobe Photoshop, Adobe Flash, Photography, Basic Videography, Basic Animation

HONORS/AWARDS

Top 10 Finalist DevCon Devise: A Student App Development Competition
PLDT TelTEC InnoLab, 721 Boni Ave. Mandaluyong City (2017)

Top Participant Bluemix Challenge: #Apps4SocialGood Edition Competition
IBM Philippines (BGC Office) 28/F, One World Place, 32nd St., BGC, Taguig City (2016)

WORK EXPERIENCE

Save22, Inc.
Unit 1501, Centerpoint Bldg., Julia Vargas Ave., cor. Garnet Rd., Ortigas Center, Pasig City
I.T/Engineering Department - Intern

Jobea Ann F. Delicano

10 Khalid St. Kingsville subd. Antipolo City, Rizal
09558553254 / jobea.delicano@gmail.com

PERSONAL INFORMATION

Date of Birth: June 21, 1998 Sex: Female
Place of Birth: Pasig City Citizenship: Filipino
Languages Spoken: English and Filipino

EDUCATIONAL ATTAINMENT

2014 – Present	Polytechnic University of the Philippines College of Computer and Information Sciences Bachelor of Science in Computer Science Major in Computer Graphics and Visualization Sta. Mesa, Manila
2011 – 2014	Roosevelt College Cainta Sumulong Highway, Cainta, Rizal

SKILLS

Microsoft Office: Word, Excel, Powerpoint, Publisher
Multimedia: Adobe Photoshop, Adobe Flash, Hitfilm Express
Programming: Python (Django, BeautifulSoup), JavaScript (React, ReactNative, NodeJS), PHP, C, C#, Java, SQL, HTML, CSS

WORK EXPERIENCE

Save22, Inc.
Unit 1501, Centerpoint Bldg., Julia Vargas Ave., cor. Garnet Rd., Ortigas Center, Pasig City
I.T/Engineering Department - Intern