ARTIFICIAL INTELLIGENCE BASED PERSONAL COMPUTER PARTS AND LAPTOPS RECOMMENDING ASSISTANT

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Specializing in Software Engineering

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Declaration

I declare that this is my own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

..... …...../…...../…….

Prof. Koliya Pulasinghe Date

(Signature of the supervisor)

..... …...../…...../…….

Ms. Hansi De Silva Date

(Signature of the Co-supervisor)

ABSTRACT

Most of the computer and laptop users find it difficult to search for the ideal hardware component for themselves. Because there is a number of manufacturers in this sector. Thereby there are a variety of versions and brands available. This has created a need of having an online assistant to help the laptop and PC users to find the ideal hardware component matching their requirement. Another aspect that has created the need for such an assistant is the practice of assembling PCs' by people according to their requirements. This is a common practice, especially in the gaming industry. Because almost all the games demand PC specification if it needs to be played. Considering the above aspects an online assistant to assist you in finding the hardware components is designed in this research. This research was initiated with the deployment of an online questionnaire and interviews with the local vendors (PC and Laptops). With the information gathered an online assistant is designed to suggest compatible parts matching the requirements. In order to find the ideal component customer feedback analysis along with price optimization is used. This platform will provide assistance in finding the compatible PC parts, generating PC plans matching customer's budget and analysis of customer feedback and display the results in a rating format. Laptop users are given the service to compare laptops and based on the computational power the BEST will be recommended. In order to generate compatible PC part plan and laptop recommendation, Expert Systems will be used. For customer feedback analysis Natural Language Toolkit is used along with Python Libraries. Price optimization algorithms will be utilized to generate PC part plans according to the budget. The final output of this research is a web-based application built using Java, JavaScript and Python with Mongo DB as its database. Users will encounter this platform by the name "TechRing"- we make the right choices for you.

Keywords: Web scraping, assembling, expert systems, neural network, price optimization, sentiment analysis, lexicon, opinion mining, comparison, power.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to our project supervisor Prof. Koliya Pulasinghe for his guidance, encouragement and useful critique at every milestone in our research. His willingness to give his time so generously is highly appreciated. His mentoring and continuous support helped our team immensely to be who we are now and complete our work successfully and professionally.

I would also like to thank our co-supervisor Ms.Hansi De Silva who assisted us in our research work. Her supervision on our performance greatly helped us to improve the research activities. She also generously shared her time for us to provide the proper guidance and advice to make this research a successful project.

Also, I would like to thank our former lecturer in charge, Mr. Jayanth Amarachchi for constantly providing the guidance and advice to carry out the research according to required standards. Also, special gratitude for our team for being there for one another and investing their time and effort on this project to achieve our research goals.

Finally, a special thank you, for my parents and friends, who were always beside me helping and encouraging on this journey. If not for them this would not have to be successful as it is today.

Thank you

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LIST OF ABBREVIATIONS

Abbreviation	**Explanation**
PC	Personal Computer
DOTA	Defense of the Ancients
AMD	Advanced Micro Devices
GHz	Gigahertz
GB	Giga Byte
RAM	Random Access Memory
CPU	Central Processing Unit
IT	Information Technology
POS	Part of Speech
MVC	Model View Controller
AWS	Amazon Web Service
API	Application Programming Interface
JSON	JavaScript Object Notation
GPU	Graphics Processing Unit
SDLC	Software Development Life Cycle

1 INTRODUCTION

Initially, computers were used as a tool for calculations, but now computers help people finish many aspects in life [1]. Therefore, computers do play vital role in almost every industry. Among all the industries one of the upcoming industries is the gaming industry. Initially computer games were designed as an entertainment kit. But this industry has achieved a greater success and it is considered as one of the most profitable industries today. Computers are the main backbone of this industry.

It is not a difficult task to find a computer today. But it is a challenging task to find a computer that would satisfy the specific requirements. Therefore, the computers available in the market fail to cater to those requirements. Thus, people tend to assemble their own PC's. But it takes various components to build a PC and with the specifications, components required differ. For example, computers used for editing photos and videos is different from the computers used by a cashier.

As mentioned in the beginning majority of PC's are assembled for gaming purposes. Because most of the games available nowadays have different specifications. For example, the game DOTA requires Processor: Dual core from Intel or AMD at 2.8 GHz, Memory: 4 GB RAM,

Storage: 15 GB available space. Therefore, when they assemble a PC according to a game system requirement they need to look into those aspects and decide on assembling procedure.

People find it difficult to match the PC parts with each other when assembling because the PC parts have compatibility issues with one another. When it comes to compatibility, motherboard plays a major role since it has to work with components like RAM, CPU and more. Mainly it is necessary to check the socket compatibility with the processor.

Assembling a PC is a task with high complexity [2]. Information Technology experts might be capable of identifying the compatibilities and the required remedies. But it is not the same with an average person. We cannot ignore the fact, not only IT experts use computers average people starting from school level also use computers. Thus, they also prefer assembling their own PC's. Through a

background analysis we found out that this Non – IT PC assemblers find it difficult to match the compatibility and proceed the assembling. They use the help of internet, YouTube tutorials, gaming web sites to find the parts.
When purchasing a product, it is better to have options to select with. There are sites from vendors and e-commerce sites displaying the available PC parts. Some site provides both the ecommerce and vendor site together in one as well. Most of the local vendors do not reach to the online market. They believe that having the physical existence is enough for them to reach the market. This might be true couple of decades back but now it is must to have online access to the customers. Thus the need of having a common platform for products from local vendors, ecommerce sites and non-website holders is important. Because this type of platform will help them to choose the best product for the best price.

Laptops are also widely used in the industry. Today there are variety of laptops available. Different brands, models, versions and more. Depending on the requirements the laptop that is needed differ [3]. Due to the variety of options to select with cause confusions to a customer. Because they might have doubt as to which laptop is better. There are sites that provide the function where they can compare two laptops but none of the sites recommends a laptop. This makes the users to do a background checking on the laptops before purchasing. Sometimes people who does not have a reliable source of information will go to a shop and purchase a laptop that is recommended by the shop owners.

Before purchasing a part, customers prefer looking into the customer reviews. There are many open sources available where people have expressed their experiences with the products. One of the sources is Facebook. People who have the access to those sources will go through the comments and have an idea about the product. But it is not easy to go through thousands of comments and get an idea. Most of the time people will go through first couple of comments.

Below diagrams show the data we gathered using an online survey we conducted. Our main motive through the survey was to identify our target audience, the size of

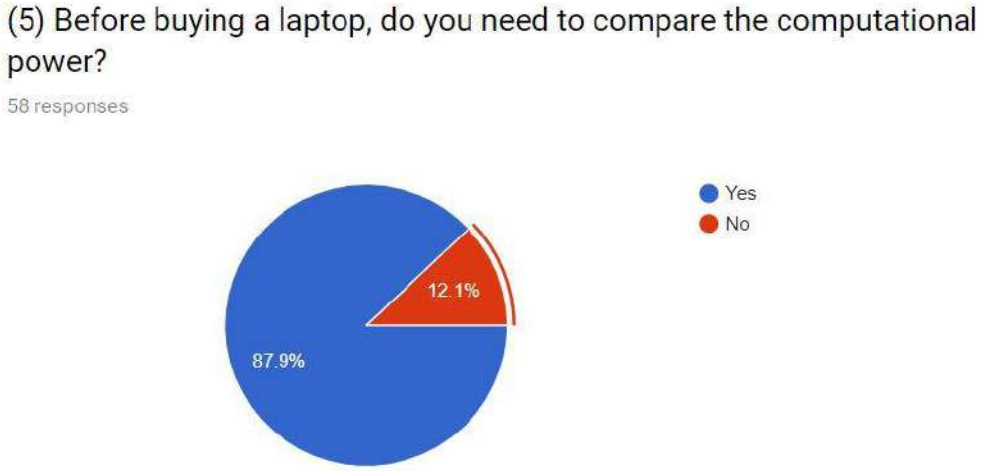

Figure 1. 2 Survey Result Percentage

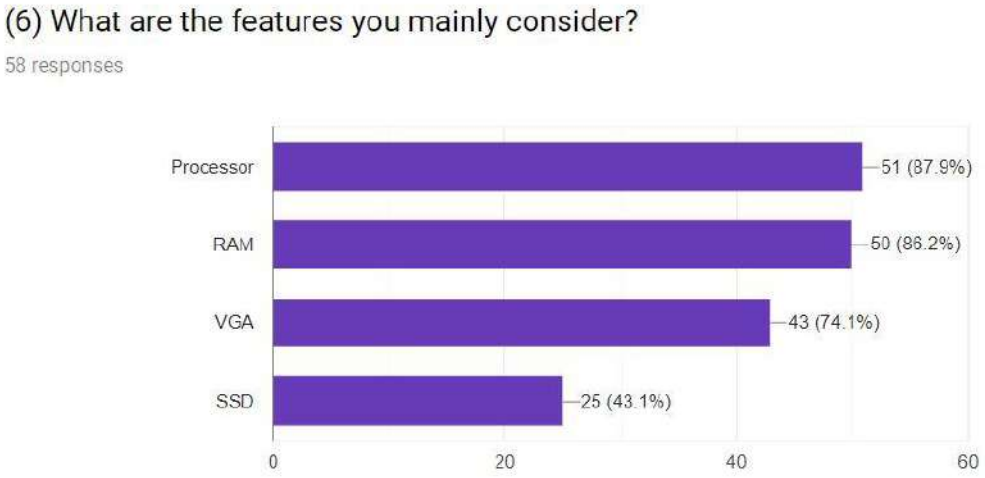

Figure 1. 1 Survey Result of Feature User mainly Consider in Laptops

1.1 Background and Literature Survey

1.1.1 Background Context

The concept of having an online assistant for compare Laptops considering the requirements and the limitations is one of the challenging topics that many researches had their interests on. This is an area that is spread worldwide. Because computers and laptops are becoming a need rather than want in their lives. There were many researchers conducted to what we are building. They have used many techniques, concepts, models that is useful for us as well. Some of the research problems aren't related to our area yet the concepts they have used is very useful for us.

1.1.2 Literature Review

- Comparison Mechanism

According to Krithika and Keerthana, they have compared the two processors considering the computational power. In this to get the computational power of each they have considered the CPU, RAM and motherboard of each component and done the comparison. By comparing the computational power, they have estimated the efficiency. Thus, based on the efficiency, power and cost the comparison is conducted [1]. "It is a common practice to compare different computational power of different models of computation" as Udi and Nachum [2] describes. As they have analyzed they use two standard methods for comparison. Approach C (Containment) and S (Simulation). For an efficient comparison these two approaches need to work in harmony. In brief,

Approach C is finding the best one based on number of functionalities available.

Approach S comes into action because approach C is not always applicable. This method uses a more detailed analysis of the functions by stimulating each function computably.

1.2 Research Gap and Problem

Through the data we gathered from research articles, observations, surveys and online sources it was clear that most of the sites have seldom approaches to provide solutions to the customers. With the rising demands for computers and laptops necessity of a platform which can provide solutions for customer problems is a must.

There are sites that are built for selling PC parts. Some sites display products/parts that belong to one vendor and some sites do display products from multiple vendors. There are some vendors who do not have online platforms as well. Therefore, this is a disadvantage for both the customer and the vendor. The customers might lose a chance of purchasing a product for a much cheaper price than expected. Because same product might be available for lesser price with another vendor. Figure 1.7 shows that majority of people prefer having an option to compare the prices.
The vendor might not be able to reach the customers who cannot visit them physically when they are not available online. One of the main reason local vendors are reluctant to reach the online market is due to the lack of technological knowledge and they feel safe within their comfort zone. But when we spoke with them, it was clear that they also want to join the online market if someone can provide the required guidance.

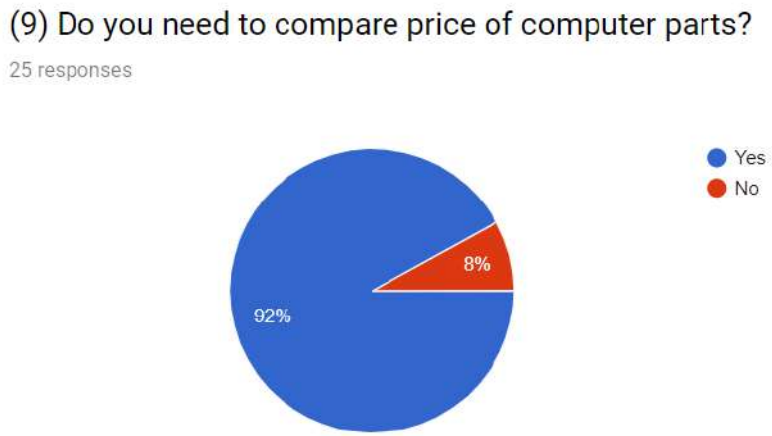

Figure 1. 3 Survey Result of Computer Parts Price Comparison

Through the survey we conducted we got to know that people use different methods to find the compatibility of parts. Mostly, online resources are widely used. They have to access these sources separately and get the required details. Below figure show the most common methods people use in order to access the necessary details.

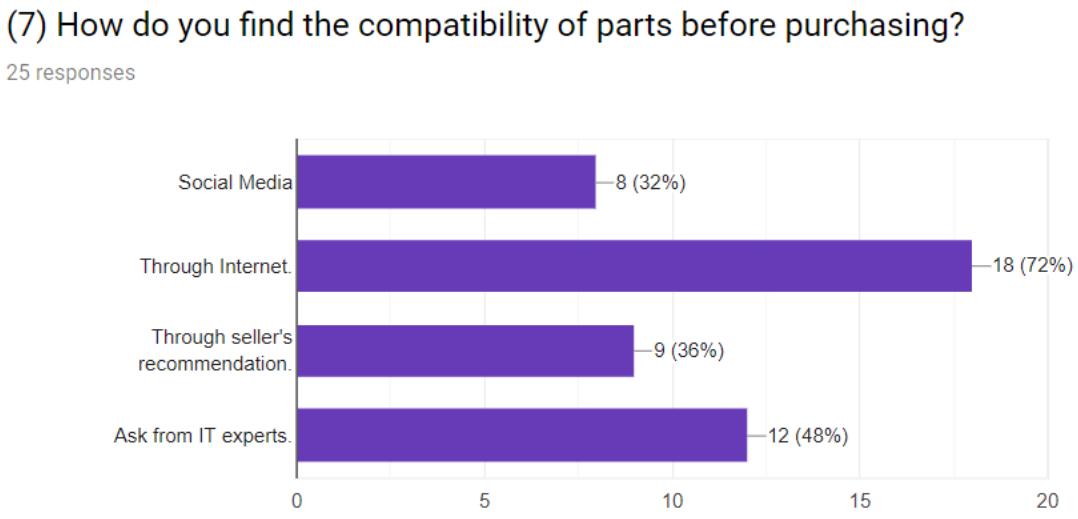

Figure 1. 4 Survey Result of How People Check Information

There are variety of Laptops in the market. When selecting a Laptop these options confuses the customer because they have many functionalities incorporated with one another. Most of the sites which sell laptops have the option where people can compare two or more laptops. But none of those sites recommend the best laptop

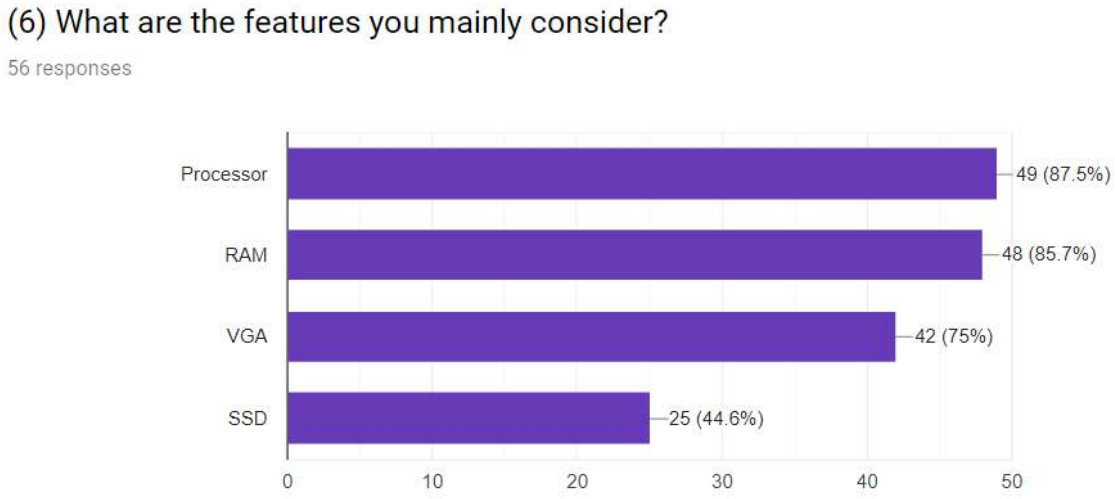

Figure 1. 5 Survey Result of Feature User mainly Consider in Laptops

from them. So, the user is left with the compared functions and choose the best one as they believe. Through the survey we were able to gather factors users mainly consider before purchasing a laptop.

Figure2. 1-Survey results of features user mainly consider in a laptop

y going through many of the research articles several approaches were conducted in order to analyze the comments made in the social media. Reason for us to consider this area is customers look into the customer reviews done for products before purchasing. Therefore, this area is important for PC parts and Laptops. Most of the sites either display the comments that were placed by their previous customers or there are Facebook pages that contain customer reviews for products. Customers have limited access for an analyzed customer overview for the products (E.g.: Number of people satisfied with the product).

Functions	PCPartPicker.com	NewEgg.com	Noteb.com	TechRing
Select Compatible PC-Parts	✓			✓
Build PC according to a System requirement Of a Game				✓
Display prices and compare of different vendors	✓			✓
Analyze Comments and display rating based on that				✓
Recommends assemble plan according to budget	✓	✓		✓
Recommend the best PC part in a price range				✓
Notify Price Drops to user	✓	✓		✓
Laptop comparison			✓	✓
Recommending the best laptop				✓

Table 1. 1 Comparison of Current Available Systems With TechRing

1.3 Research Objectives

Main Objective

Main objective is to provide an online assistance for people who wants to compare laptop computational power and exactly know what is the most powerful one by themselves for different purposes and to empower the users with information

related to purchasing laptops and PC parts. The system analyses each feature separately in both laptops then suggest to best one to users.

Specific Objective

I. **Generating a comparison between two laptop options selected by the user.**

Users have a difficulty in choosing a laptop due to the similar features available in different brands. When the user type two laptops they are looking we will provide a functionality comparison of the two laptops in the same interface. This representation will provide a clear idea about the features.

II. **Recommending the best laptop to work with.**

Laptops can be graded based on the computational power and that is one of the main feature users look into before purchasing a laptop. Thus, our platform will use a separate grading algorithm to decide on which laptop is best from the selected options.

III. **Displaying Laptop specification clearly.**

2 METHODOLOGY

2.1 Methodology

2.1.1 Laptop comparison

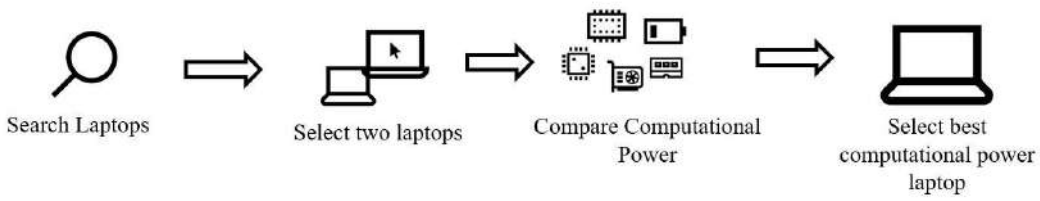

Figure 2. 1 Laptop Comparison Process

Nowadays, there many laptop manufacturers in the world. These manufacturers have a high competition among each other. In order to compete with one another these brands introduce different versions of laptops every year. In a way this is

beneficial for the customers. Yet due numerous options available customers become confused. Because they don't have an idea what is the BEST from the available options. There are online platforms that allow the users to compare two laptop versions or brands. For an example platform like, Noteb.com, NewEgg.com. But these platforms have two main limitations. One is that these platforms only allows to conduct a comparison. Other aspect is that the comparison is based on limited functionalities.

"TechRing" has overcome the above problematic situations. This platform allows to conduct a comparison between two laptop versions or brand. But the service does not limit only to comparison. It also recommends the BETTER of the two options based on their computational powers. In order to conduct the comparison "TechRing" will be looking into both the common features that people look in plus the important Technical aspects that people aren't aware of.

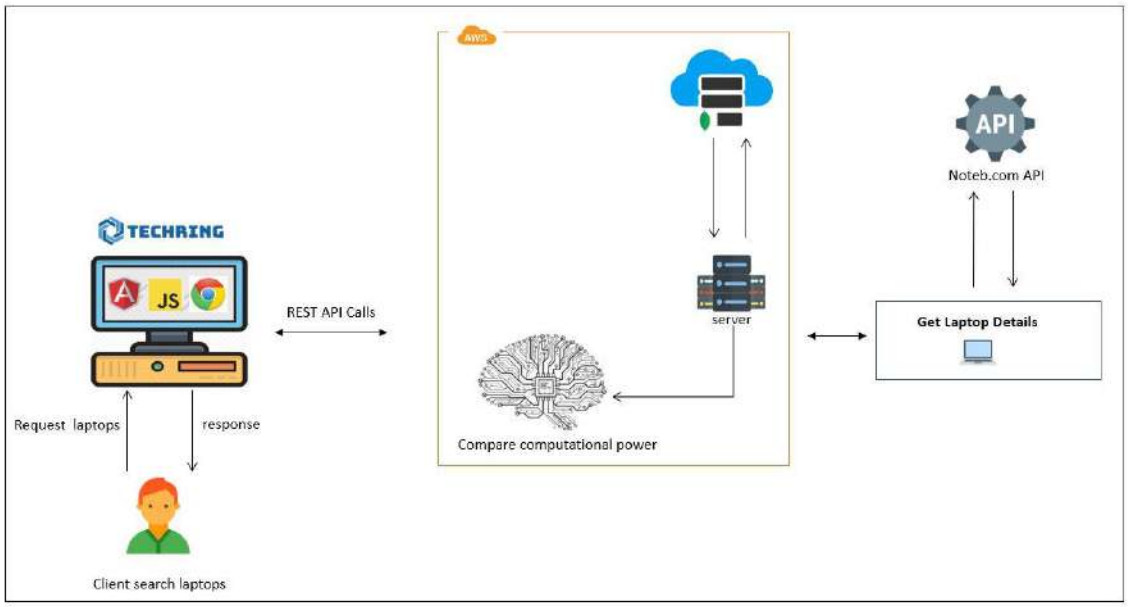

Figure 2. 2 High Level Architecture for Laptop Comparison

Internal process of laptop comparison model we must pass specific features below table show what are the mainly considered feature in our system for compare two laptops.

Feature Names	
• CPU model	• Core size
• Cash size	• Boost speed
• Ram type	• Ram size
• Storage type	• Storage size
• Battery type	• Battery size
• GPU size	• GPU boost speed

Table 2. 1 - Features consider by User when comparing laptops

In order to compare two laptops, we created rule based expert system. The selected two laptops will be sent through this rule based mathematical model. This mathematical model generates points for each laptop.

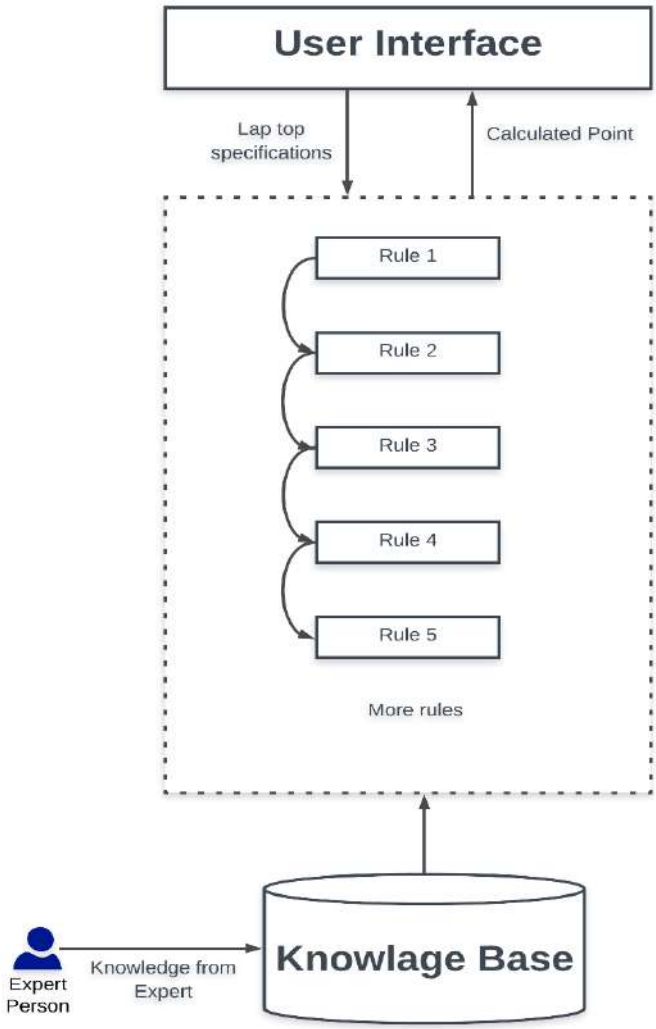

Figure 2. 3 Mathematical Rule Base Model (Expert System)

2.2 Commercialization Aspects of The Project

The target market for this platform is consisting of two segments. That is the PC parts and Laptop seekers and the PC parts and Laptop vendors. Currently "TechRing" is focusing only the local market. The seekers category is then sub divided in to two categories as

- Gaming population.

- Student population.

From the total Sri Lankan population, that is 21.44 Million, 18% of the population represent the school community and 14% represent the Gaming population in Sri Lanka. Thereby our user base will be approximately 32% of the total Sri Lankan population.

Considering the vendor sector, this is considered as an industry in Sri Lanka. Governmental Industrial Statics conducted in 2016 stated that this is placed 26th among the industries in Sri Lanka. By the year 2016 there are 32 establishment under this category. Under these establishments there are 3226 people involved. This set of people will be our target vendors that needs to be onboard.

Initially we will be using a cost-effective Market Plan. Thus, the most effective marketing platform is the Digital Marketing. We will be using the Facebook, Instagram and YouTube for our marketing purpose. Below is a diagram of our Business Canvas that we have designed.

<table>
<tr>
<td rowspan="2">Key Partners
• Local PC parts Vendors
• Local Laptop Vendors
• E-Commerce Web sites
• Facebook

Key Resources
• Online Platform
• Registered Users
• Local Vendors
• YouTube Data</td>
<td rowspan="2">Key Activities
• Provide vendors for each product
• Provide assembling plans
• Price Optimization
• Display updated and analyzed customer reviews</td>
<td rowspan="2">Value Proposition
• Assembling plan customized according to game preference of customers
• Convenience – One stop for both PC parts and laptop requirements
• Speedy and on time assistance
• Trustworthy Suggestions. Notify customer about the price drops
• Real time data extraction</td>
<td rowspan="2">Customer Segments
• We will be dealing with a Mass market. Thus our customer base will be ranging from school students to professionals.
• Both expert and Non-expert person will be using this platform.
• Our target age range will be 15yrs to 60yrs or above</td>
<td>Customer Relationships
• Automated Service
• Customer Requirements are detected and then the system will provide necessary responses.
E.g. – Provide product Suggestions

• Customized Assistance
• Solutions provided will be based on each customer requirements
E.g. – Games specified Assembling Sequences</td>
</tr>
<tr>
<td>Channels
• Our main purpose is to direct the buyer to the best seller. Product delivery is the vendor's responsibility
• We will market our services initially using social media platforms such as Facebook Instagram and YouTube</td>
</tr>
<tr>
<td>Cost Structure
• Platform development costs
• Vendor acquisition cost
• Marketing the platform and services</td>
<td colspan="2">Revenue Streams
• Initially, we plan to build our revenue streams through customers
• The registered users are allowed o have one assembly plan build for free. This free test sample is given for them to identify our service. But for other plans, they need to make a payment and afterwards, only we provide them with the assembly plan.
• Later on, with our development rate and increased publicity we will ask the new vendors to pay a registration fee to enroll with our platform.
• In future we plan to advertise their products if there are any special promotions campaigns conducted.</td>
<td></td>
</tr>
</table>

Table 2. 2 - Business Canvas.

2.3 Testing and Implementation

2.3.1 Implementation

In our platform used below technologies and services for implementation.

- Server Requirements
    - AWS Cloud Computing Services

- Software Requirement
    - AngularJS
    - JAVA Spring boot framework
    - Python
        - Pyknow library
    - MongoDB
    - Jupitar Notebook
    - VS Code
    - Spring Tool Suite
    - pycharm

- **Laptop comparison**

I. Extracting laptop details

In finding laptop details we used Noteb.com API. Noteb is online laptop details publish website in order to they provide API to access their laptop details. Noteb development team developed that API adding some security. Forget the details we need to provide

- apikey
- method name
- param[model_name]

Above mention values in our request, then Noteb API return JSON object with laptop details. We can specify laptop brand then API response according to the we mentioned laptop brand. After getting laptop details, we store those data in MongoDB. MongoDB is document base data base.

II. Implement laptop comparison model

In laptop comparison model is developed as API using python flask library. It allows Post request with laptop details object which is pass from our MongoDB Database. Laptop comparison rule base model calculate point according to the

passed laptop object, then result return to the web application and show to users to best laptop with suggestions.

2.3.2 Testing

To validate the system, need to implement test cases to make sure the functionalities of our system is producing the expected outputs. Before deploying the system its necessary to identify the weaknesses and vulnerabilities of the system. So that we can fix the bugs earliest stages without interruption to customers. Each iteration of our development process we test the product to make sure the functionalities are working properly. From the beginning of the project we have to identify the critical tasks and need to develop test cases for validate those components. In this section will be discussed the mechanisms and procedures we followed to test our product.

- Unit Testing

The objective of the unit testing is to isolate a section of code and verify its correctness. In the SDLC unit testing is the first level of testing before doing the integration testing. [3] Our product “TechRing” has different sub units so we must test the units before integration with other unit/ components. We divide our sub components into several units and implement those as a logically separated unit. So that we can easily test the units and make sure the unit will produce the expected output. Once individual unit is developed by a person himself or herself checked the component before integrating with the system. During the development of our application we must test all the units.

- Integration Testing

After the unit testing, we do the integration of the components and begin the integration testing. Integration testing is designed as a type of testing modules integrated locally and test the product as a group. In the four main components of

our system were developed by four members in our group. Some components depend on the other component output, so we have to test those parts while the integration of the system. These tests ensure the communication of data between the components of the system.

- System Testing

One of the black box testing method. After integrated all the components we have to do the system test to check whether the system functionalities meet the expected output. These testing enhanced the user user's experience with the application. These tests done before introducing to the market.

2.3.2.1 Test Cases

Test case Id	Test Case 1
Test scenario	View selected one laptop more details.
Test steps	1. Go to TechRing site. 2. Navigate to laptop comparison page. 3. Select laptop brand 4. Click selected laptop among the displayed laptops 5. Click more button.
Test data	Laptop
Expected result	User should display popup window with additional details.
Actual result	As expected, one

Table 2. 3

Table 1. 2 Test case 1

Test case Id	Test Case 2
Test scenario	Check laptop search properly working with valid laptop name.
Test steps	1. Go to TechRing site. 2. Navigate to laptop comparison page. 3. Enter laptop name in search field. 4. Click search button.
Test data	Laptop name = hp
Expected result	User should navigate laptop comparison page. Then he/she must enter laptop name and click

	search button. Then he/she can see matching result in the web page.
Actual result	As expected, one

Table 1. 3 Test case 2

Test case Id	Test Case 3
Test scenario	Check two laptops are selected for comparison.
Test steps	1. Go to TechRing site. 2. Navigate to laptop comparison page. 3. Select laptop brand and select two laptops.
Test data	Laptop one Laptop two
Expected result	User should select minimum two laptop then he/she can see compare button is enabled. Otherwise display disabled button.
Actual result	As expected, one

Table 1. 4 Test case 3

Test case Id	Test Case 2
Test scenario	Check two laptops are selected for comparison.
Test steps	1. Go to TechRing site. 2. Navigate to laptop comparison page. 3. Select laptop brand and select two laptops.
Test data	Laptop one Laptop two
Expected result	User should select minimum two laptop then he/she can see compare button is enabled. Otherwise display disabled button.
Actual result	As expected, one

Table 1. 5 Test case 4

3 RESULTS AND DISCUSSION

3.1 Results

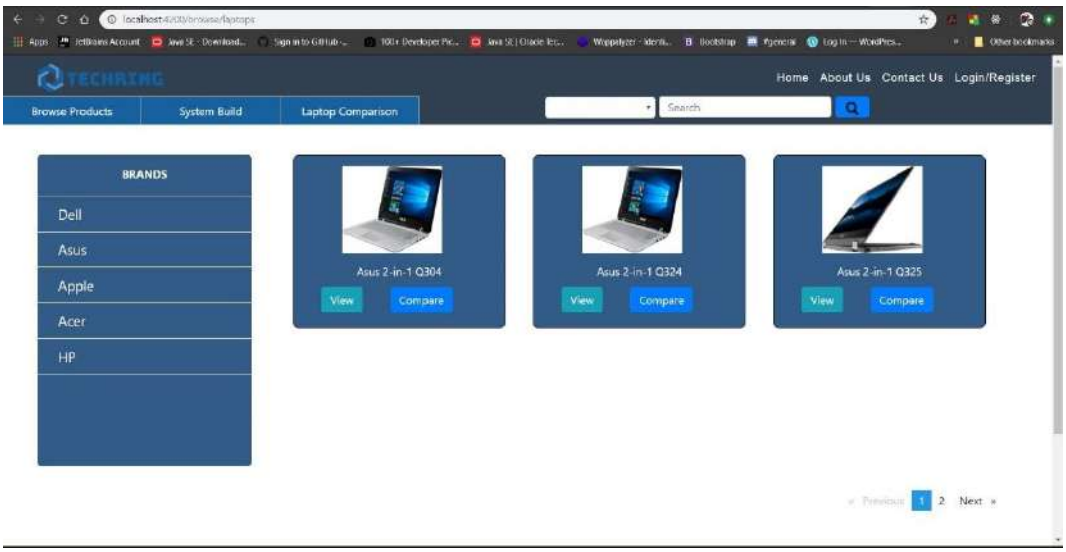

Figure 3. 1 Laptop select screen

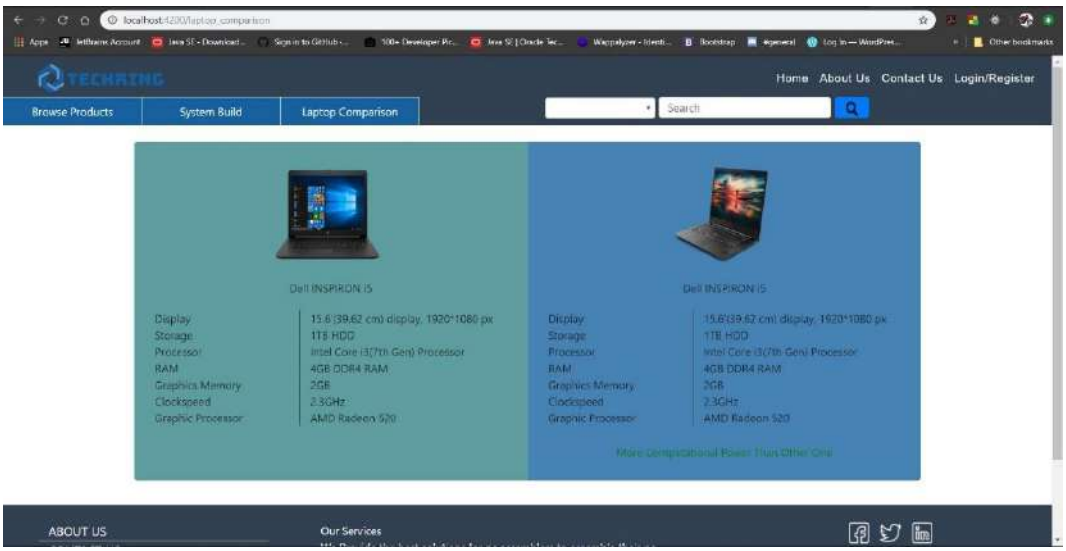

Figure 3. 2 Laptop comparison Result

3.2 Research Findings

Machine learning models cannot be directly applied to any problem. Because if we take such approach it will be difficult to manage the future developments. First step we need to follow, is study the data set properly. Above mentioned is one of the

aspect that we used an expert system implemented using Python for Laptop Comparison.

It is said that Expert systems are capable of making decision similar to that of a human being. Such accuracy is predicted to have from a well-trained expert system. Another reason for us to use an Expert system is that through this system it is easy to implement and we can do the implementation faster. Expert system can be implemented and developed using language such as JAVA, Python, C++ and CLIPS.

When I compared the results gained from a trained neural network and expert system, it was clear that results of Expert system holds a high accuracy.

3.3 Discussion

Main motive of the “TechRing” is to be the ideal online assistant when it comes to searching the hardware components. This is to be one stop for both your PC parts and Laptop requirements. Any person with internet access and average IT knowledge can access our platform and we will be readily available to satisfy your hardware requirements.

4 CONCLUSION

“TechRing” is a web based online assistant designed to provide solutions for your laptop comparison. TechRing provides users to compare selected two laptops and he/she provides to suggestions what is the best one considering computational power. This is very helpful for anyone is going to by laptops. In this document it focuses on the laptop comparison part. TechRing laptop comparison function work with high accuracy and high availability. In order to TechRing provides user friendly interface it is easy to work anyone how not much familiar with internet. User need to do only select two laptop and TechRing provides to them best result.

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6 APPENDICES

6.1.1 Use case diagram

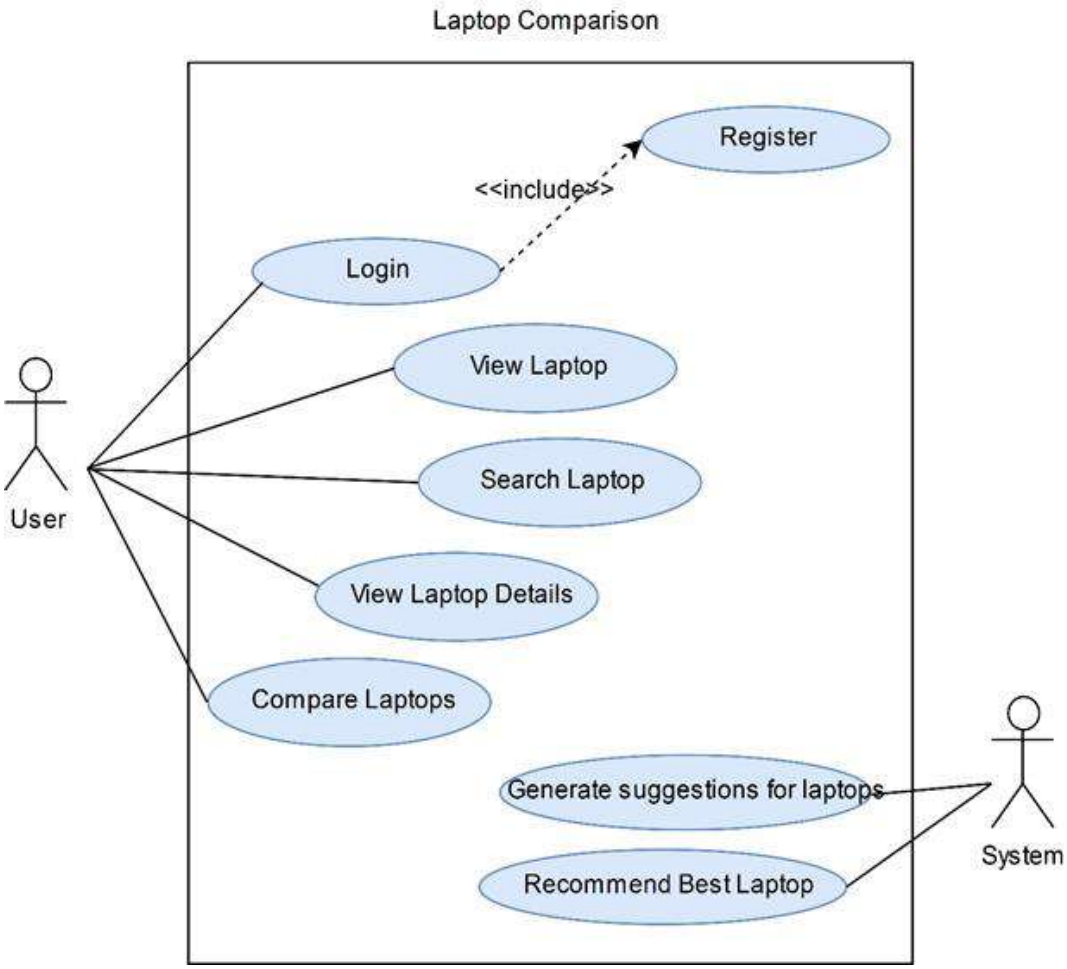

Figure 6. 1 Use case diagram

6.1.2 Activity diagram

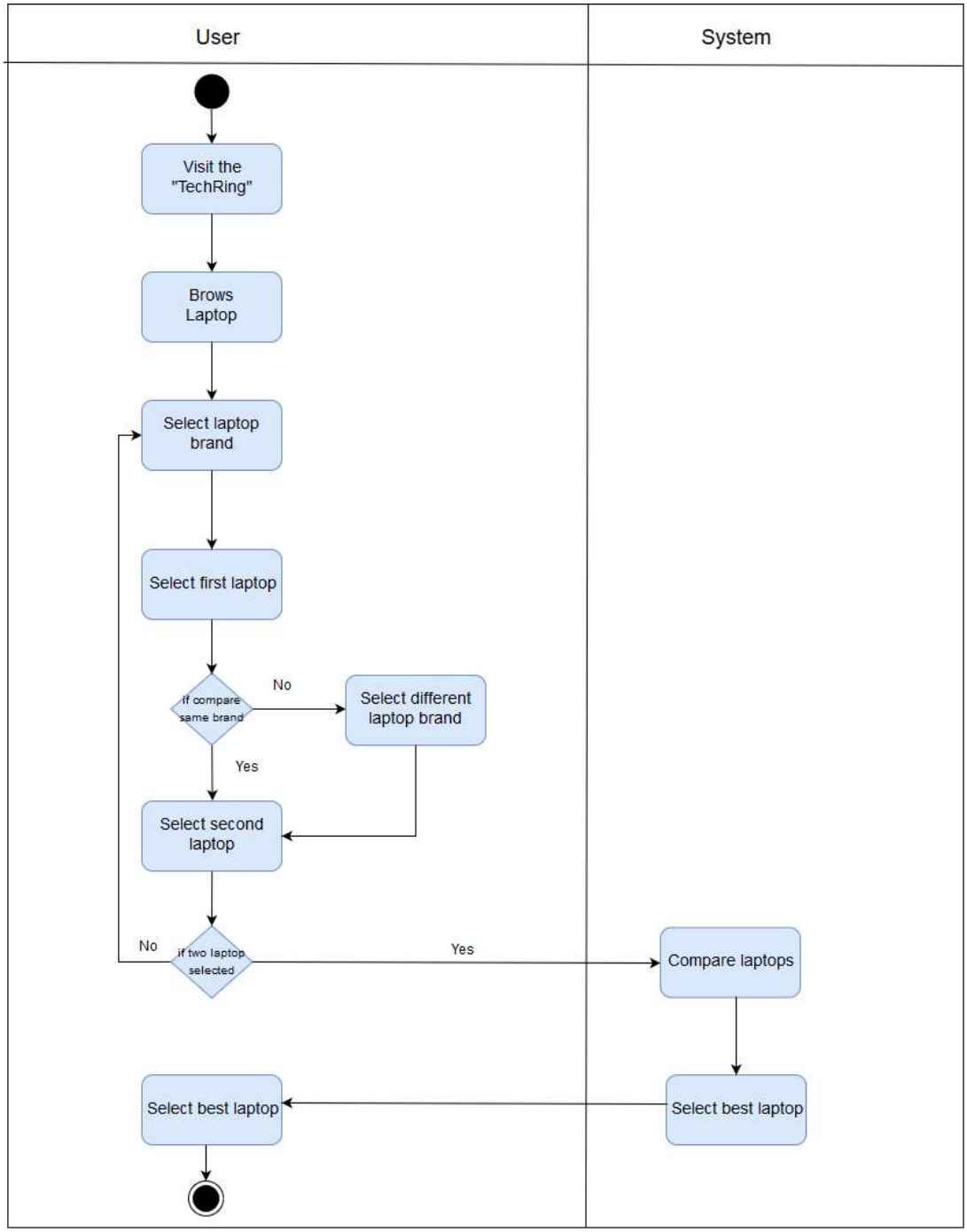

Figure 6. 2 Activity diagram

6.1.3 Survey result (Google form)

- Questioner
  https://docs.google.com/forms/d/1kcaZ96I1M7lUrWDbo9UqmquWT8q9dlo-mg8O4J8HT68/edit

- Results
  https://docs.google.com/forms/d/1kcaZ96I1M7lUrWDbo9UqmquWT8q9dlo-mg8O4J8HT68/edit#responses