ARTIFICIAL INTELLIGENCE BASED PERSONAL COMPUTER PARTS AND LAPTOPS RECOMMENDING ASSISTANT

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DECLARATION

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H.K.S.P.Gunadasa Date

IT16010390

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.

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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

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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
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 PCs. 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 are different from the computers used by a cashier.

As mentioned in the beginning, majority of PCs 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 PCs. 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 the audience and also their expectations.

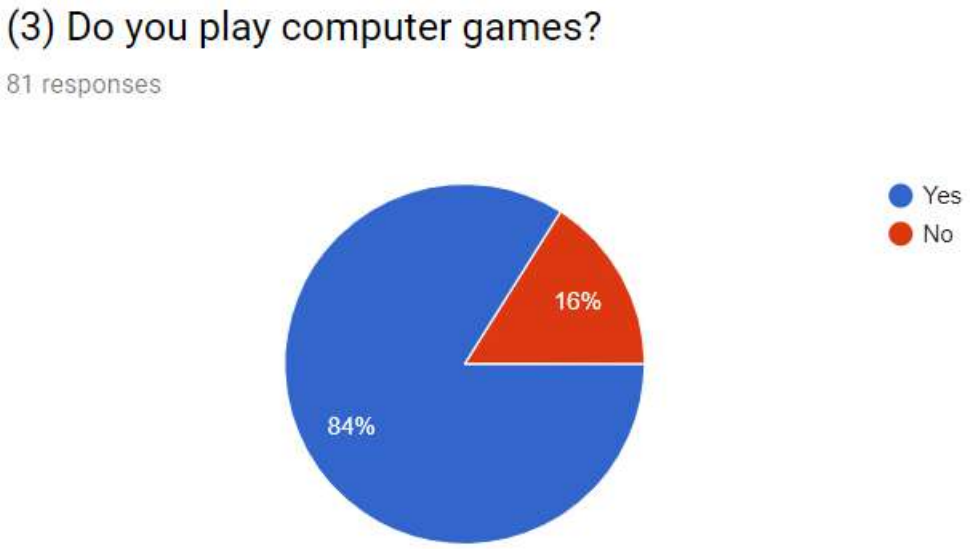

Figure 1. 1 - Survey Result displaying the percentage of gaming community

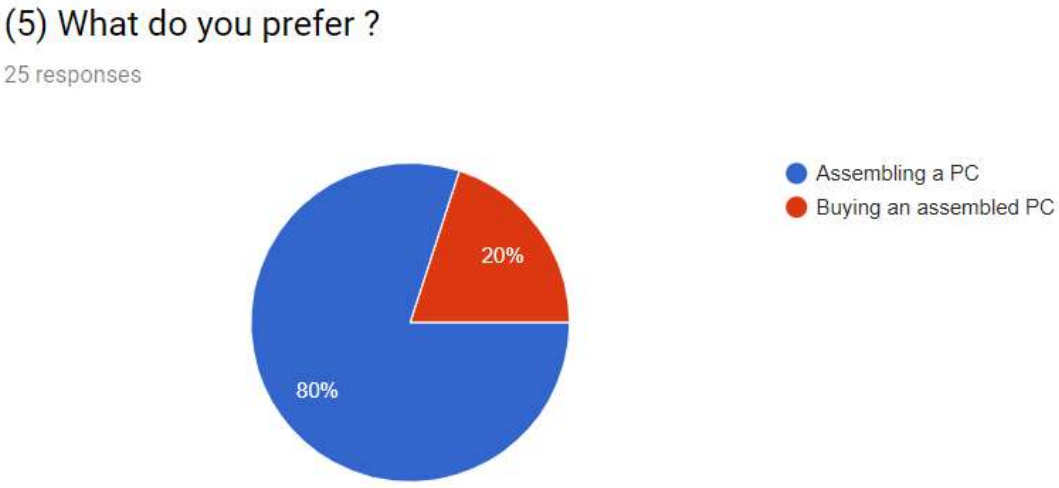

Figure 1. 2 - Survey results of what kind of PC customer prefer for play games

1.1 Background and Literature Survey

1.1.1 Background Context

The concept of having an online assistant for assembling PCs 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

- Assembling Sequence

Neural networks and expert systems greatly improve the decision making and reasoning [1]. According Hou, once the assembling sequence is fed to the system through the expert system, they can make decisions related to the assembling procedure. In this article, they use a layered architecture to find the compatible parts starting from the final product. This step wise approach makes the process efficient and accurate.

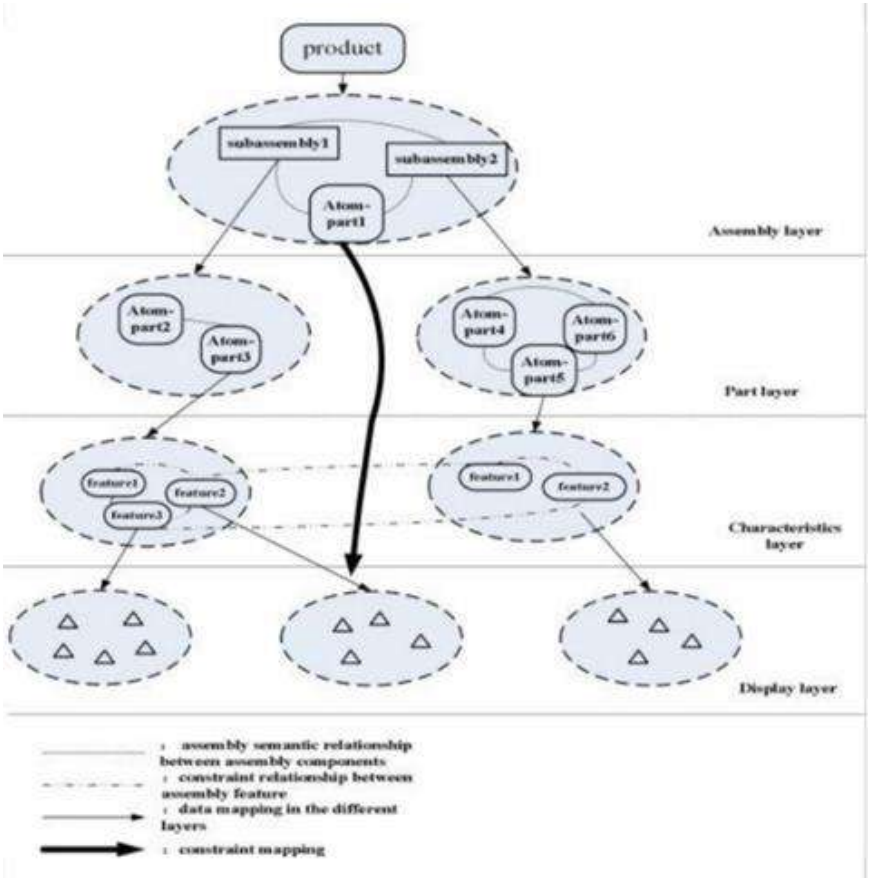

Figure 1. 3 - The Structure of the product assembling model

Source: [1]

Combining the knowledge-based reasoning along with the expert system improve the efficiency and reliability of computer-based reasoning. For decision making based on uncertain factors the researches have used the fuzzy system mechanism [1].

The assembling process for personal computers is long and a complex task [2]. In order for students to learn the assembling mechanisms, researchers have developed applications to assist them. HALT (Hardware Assembling Learning Tool) is developed for that purposes [2]. In identifying the assembling procedures, they have used two main techniques known as CBT (Computer Based Training) and CAI (Computer Assisted Instructions). They have incorporated AI techniques such as Intelligent Tutoring Systems.

One of the most difficult tasks is identifying the 3D objects. Thus, it is necessary to have a precise description of the 3D object and matching algorithm to identify each object [3]. The Theory of Recognition by Components (RBC) explains how human

visual system identify objects by decomposing object parts [4] [3]. One of the most appropriate models that was used was the “Superquadric model”. This model is capable of describing the parts considering primitive shapes with finite number of parameters which consists of rotation, translation and global deformation [5].

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 1.4 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 reasons 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.

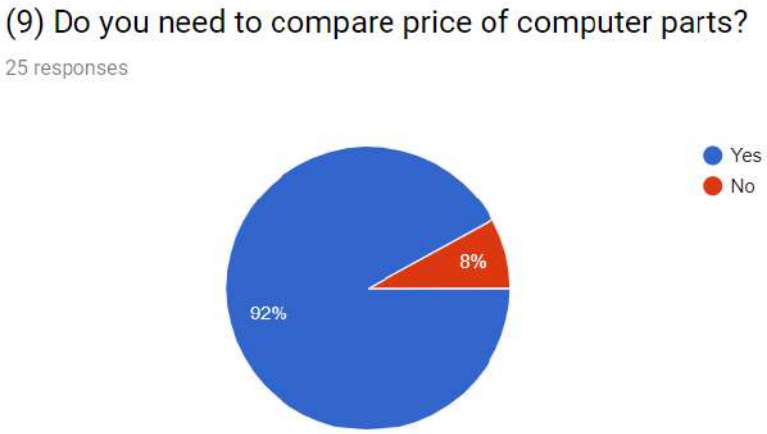

Figure 1. 4 - Survey results of computer parts price comparing

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.

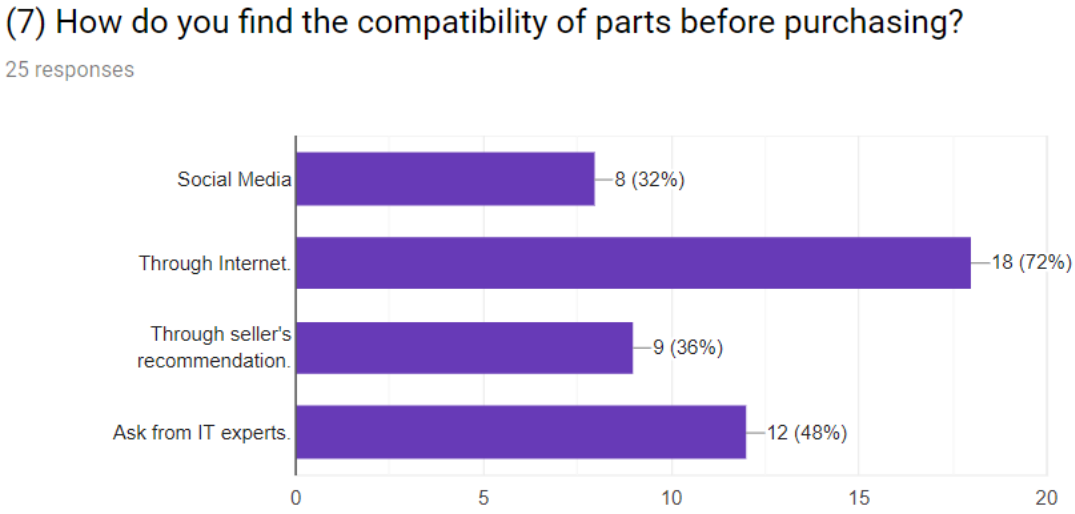

Figure 1. 5 - Survey result of how people check information about PC parts

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 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.

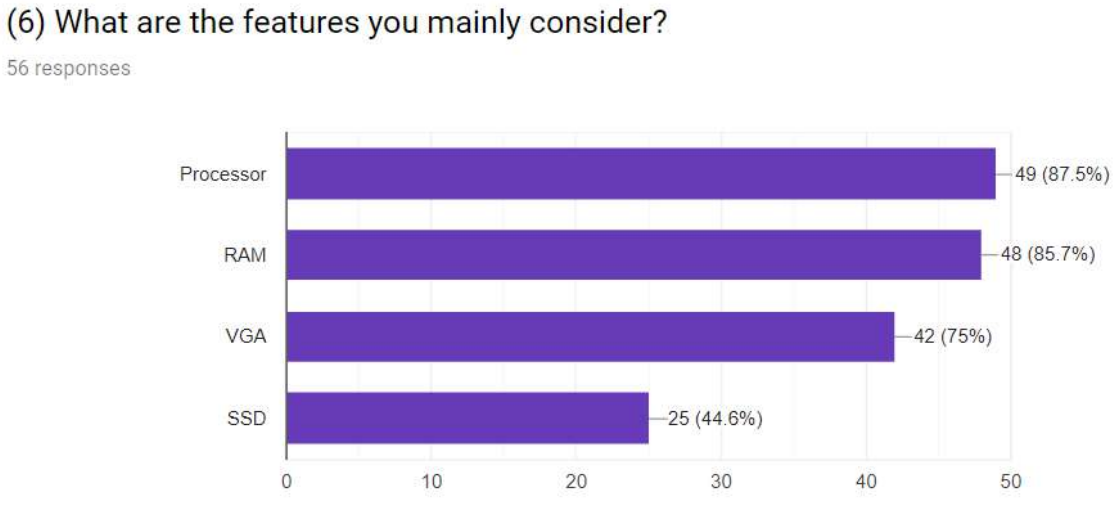

Figure 1. 6 – Survey results of features user mainly consider in laptop

By 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 is to provide an online assistance for people who wants to assemble their PCs by themselves for gaming system requirement. Using our platform user can get the product list of compatible PC parts that need to play the game. The system analyses the requirements through extracting data using web scraping and provide the build sequence plan using that information.

- **Designing an Algorithm to generate an assembling plan based on the user Requirements.**

  Most of the computer games have specification and these specifications are mentioned in different gaming websites. When a user visits our platform and type the game he or she is interested, our platform will display the set of PC parts that are necessary. If they are searching for a part or parts to assemble a PC, our platform will provide the necessary details as requested.

- **Suggest compatible parts with any product**

  When users select a product, the platform suggests best suitable product with the selected one. Then customers don't need to search for compatible parts with the selected product. To check the compatibility of the products socket and the product specifications should be match otherwise those products don't match with the selected component.

2 METHODOLOGY

2.1 Methodology

The goal of the "TechRing" was to develop AI-based PC parts and laptops recommending assistant that helps customers to buy the best suitable PC component and laptops. This platform provides several main services to customers. Those are getting a PC parts list for the user system requirement, analyze customer feedback on social media platforms, price optimization, and comparison of the products and get the best computational power laptop. "TechRing" is a web-based platform we developed using microservices architecture which provides scalability and maintainability to our platform. To implement the platform selected latest technology stack. The web client is developed using AngularJS. It's an efficient framework used to build single-page applications. The API and back end development used Python, JAVA Spring boot framework with MVC architecture. Git will be used to manage version control of the platform and GitHub used as the source code repository.

2.1.1 PC parts Assembly Sequence

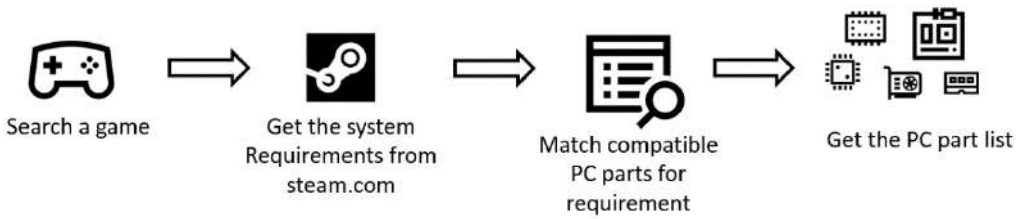

Figure 2. 1 – Steps of the assembly sequence

This platform is focusing on building the assembly plan according to the customer's gaming requirement. After analyzed the gaming requirement, point base expert system gives points for each required part. After that matched with the existing compatible PC parts with our platform that satisfy with the points/user requirements. Once the user inputs the game that he/she wants to play, even though that game is not in our system it will be extracted real-time from the Steam.com and get the system requirements. Steam.com is a gaming platform which is updated every day so we can get the newest games that the user needs to play.

The build sequence is used in order to analyze the final product (assembled PC) and check the compatibility of each component. The build sequence will analyze the final product (assembled PC) as several sub-components and match those specifications. After giving the points to the requirement, it begins to search for the PC parts and those parts are also assigned the points based on their specification. In the algorithm, we match the points and compatibility of the product then finally customer can get the PC part list that is compatible and satisfies user requirements.

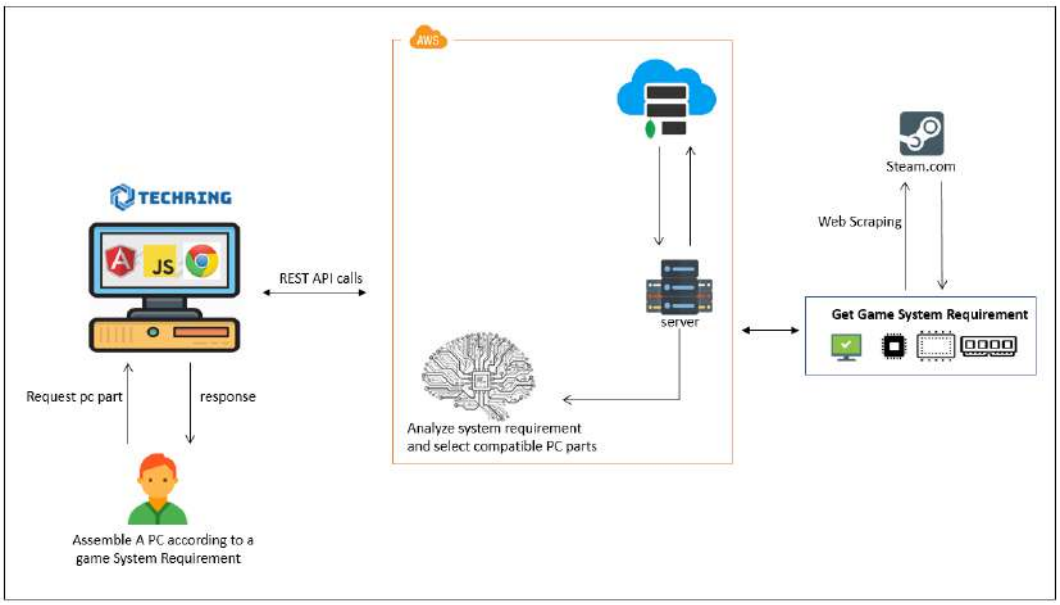

Figure 2. 2 - High level architecture diagram of assembly sequence

When suggesting the compatible PC parts, match the points and compatibility along with the game system requirement. For example, in the CPU of the system requirements get 12 points from the algorithm we suggest the part that contains points 12 or higher than that to satisfy that requirement. Then after we suggest the Motherboard for that CPU by considering the socket of the selected CPU. After that other components will be suggest based on the points and compatibility with other selected PC parts.

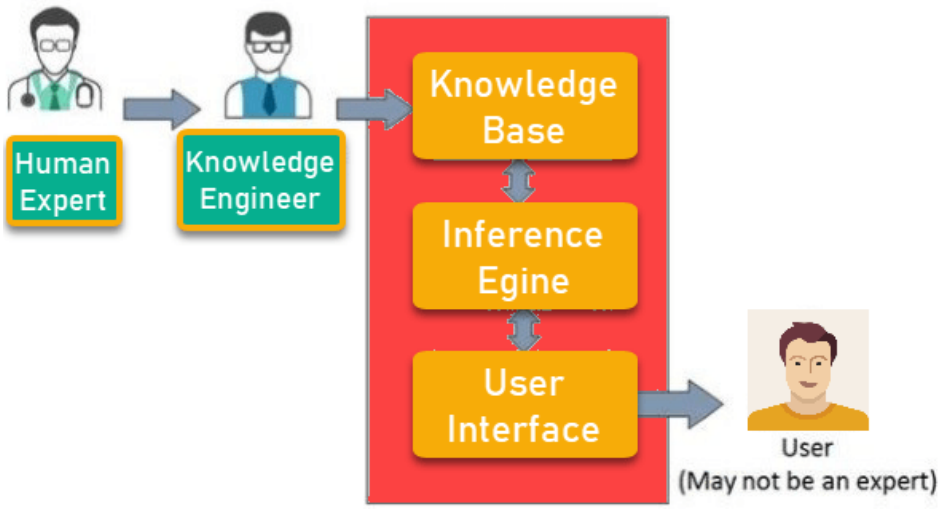

Figure 2. 3 – Expert system components

Source: [6]

To assign the values to PC parts and system requirements, rule based expert system is used. The expert system can resolve many issues which generally would require a human expert. [6] We can add rules to the system and if the rule is satisfied, desired outcome will be fired. To implement the rule base expert system, we allocate points for the PC parts if the specification contains that part. Otherwise the point isn't allocated. After allocating points, we get summation of those points and compare with the System requirement to get the matching part that satisfy the user requirement.

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 for now. 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 colspan="2">Cost Structure
• Platform development costs
• Vendor acquisition cost
• Marketing the platform and services</td>
<td colspan="3">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>
</tr>
</table>

Table 2. 1 - Business Model 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
  - MongoDB
  - Jupitar Notebook
  - VS Code

- **PC parts Assembly Sequence**

I. Scrape Game System Requirements from Steam.com

In the assembly sequence, identify the pc parts to satisfy the user requirement. To get the gaming system requirement, used python script with selenium web driver. Selenium is an automating web applications tool that used to build automation testing on web applications. After the user enters the game name and sends those keywords into backend API. From the API keyword pass to the python script by command line arguments. The gaming requirements are scraped from the Steam.com. After searching the game on the site and extract the system requirements. In the script create a JSON object and send it to the backend API.

II. Based on system requirements assigns points

Figure 2. 4 – System requirement of the game

Before matching the compatible PC part had to identify the required PC parts. To identify the PC part filter the requirement components used a rule-based algorithm with a point mechanism and assigned points for each components.

III. Match the Compatible PC parts

After assigned point for required PC part then PC part matching process will be executed. By using the point can be identify the required PC parts. First, match the compatible CPU and after that build sequence will identify the compatible PC part list that needs to satisfy the user requirement. Then the user can purchase those products and no need to worry about the compatibility or the requirement.

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 deploy 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. [7] Our product “TechRing” has different sub units so we have to 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 integrate with the system. During the development of our application we have to 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 introduce to the market.

2.3.2.1 Test Cases

Test Case No	Test Case - 01
Description	Check whether expected game system requirements scrape from the steam.com and save to the database.
Pre-Conditions	1. There should be proper internet connection access to the application to get that system requirements real time.
Test Procedure	1. Visit the "TechRing" build for system requirements section. 2. Enter the game name in the search bar. 3. Check the game system requirement showing after scrape the requirements of the game.
Input	Game name
Expected Output	1. System requirement of the game should be stored in the database.

Table 2. 2 – Test Case 01

Test Case No	Test Case - 02
Description	Get the compatible PC parts that satisfy the user requirements
Pre-Conditions	1. System requirement of the game should be scraped and saved in the database.
Test Procedure	1. Visit the "TechRing" build for system requirements section. 2. Enter the game name in the search bar. 3. Click the "get pc parts" button to get the compatible pc parts.
Input	Game name
Expected Output	1. There should be a compatible PC parts list showing to the user

Table 2. 3 – Test Case 02

Test Case No	Test Case - 03
Description	Suggest compatible PC part for product
Test Procedure	1. Click the product 2. Get the compatible part list
Input	Product name
Expected Output	1. There should be a compatible PC parts list with the product showing to the user

Table 2. 4 – Test case 03

3 RESULTS AND DISCUSSION

3.1 Results

"TechRing" is the platform which is recommend the most suitable and best product to the customer out of various brands and components. Therefor our platform should have more accuracy of the tasks in order to be trustworthy to the customer.

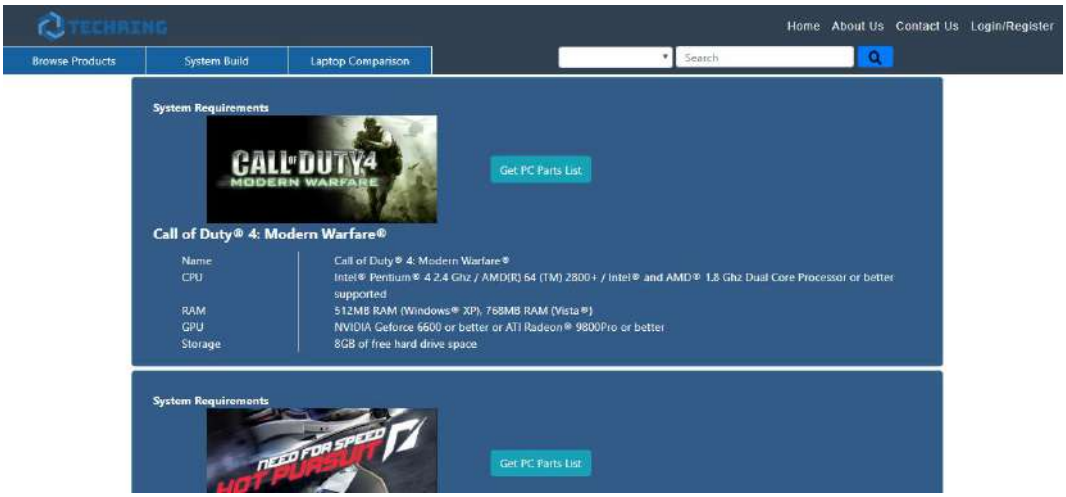

Figure 3. 1 – User Interface: Search Games

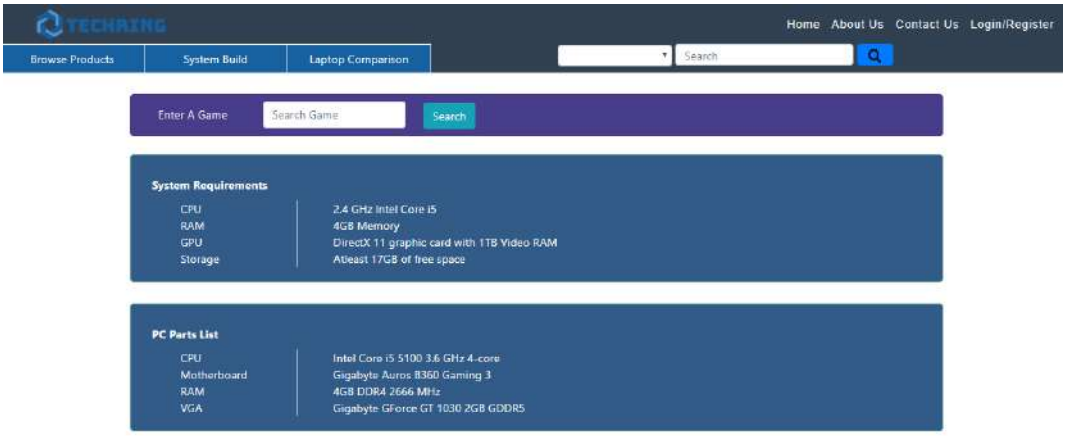

Figure 3. 2 – User Interface: Matching PC parts for System Requirement

When user searches a game and get a PC part list for that particular game by extracting data from Steam.com using a web crawler. To get the system requirements of a game the crawler will spend average 135 seconds to extract the data and save it in the platform database.

Game Name	Time Taken to extract the System Requirement(Seconds)
Far Cry® 5	130
Need For Speed: Hot Pursuit	140
Call of Duty® 4: Modern Warfare®	135

Table 3. 1 – Crawler web scraping time comparison

Using the crawler, we could get 80% accuracy results. When we extract the data from the Steam.com we send the keyword of the game name sometimes the game is not in their database if so our crawler get the matching game system requirements to the keyword.

3.2 Research Findings

We found that to scrape the gaming system requirements tried different technologies but those were unavailable to do the scrape system requirement due to some limitations. Using Selenium, we could be able to scrape the game system requirements with more accuracy within less time. Using the full game name, we could get higher accuracy than the partial name. To test that team members had to test the crawler with different names of the game and versions.

3.3 Discussion

In our research, we are focused to provide self-assistant for the gaming community to assemble their PC's by themselves. Our platform will provide guidance to select the best suitable product by analyzing their system requirements. Our product can also use expert technicians and also non-expert people. By using our platform, they can get more benefits like they can find compatible pars easily, don't need to bother about the requirements and also save money, time for searching compatible products through the internet.

4 CONCLUSION

“TechRing” this platform mainly focus on the gaming community because they always find the compatibility of the PC parts and requirements of the game. They need a way to know the parts list that needs to play a particular game. They can use our system and easily get the compatible PC part list. Using our platform, they can save their time that spends for searching to find the best product and compatible PC parts. Our platform we can extract the game system requirement 80% accuracy. Sometimes crawler gets the system requirements of a matching one not the customer requested one because we scrape from the Steam.com gaming platform. Some games not available in that platform because of that keyword related game will be scrapped. We provide user-friendly interfaces to do the customer needs easily.

In the future research group plan to add two new components to the platform. The team is planning to add assemble a PC for software requirements and check whether the current PC can match with a particular game or software requirement.

5 REFERENCES

[1] W. Hou, X. Li, Y. Jin and J. Wu, "A Study of Intelligent Decision-Making System Based on Neural Networks and Expert System," 2013.

[2] S.-T. Tan, "Multimedia Based PC Assembly Learning Tool," 1996.

[3] P. J. B. a. R. C. Jain, "Three-dimensional object," vol. 1, 1985.

[4] R. T. Chin and C. R. Dyer, " “Model-based recognition," vol. 18, 1986.

[5] a. R. B. F. Solina, " “Recovery of parametric models from range images : the case of superquadrics with global deformation"," Vols. vol:1, vol 2, 1990.

[6] "guru99," [Online]. Available: https://www.guru99.com/expert-systems-with-applications.html. [Accessed 05 08 2019].

[7] "Guru99," 2019. [Online]. Available: https://www.guru99.com/unit-testing-guide.html. [Accessed 08 09 2019].

[8] C. Kocas, "Online price competition within and between Heterogeneous Retailer Groups," 2004.

[9] R. H. Jianxia Chen, "A price comparison system based on Lucene," April 2013.

[10] N. D. Udi Boker, "Comparing Computaional Power," 2015.

[11] B. L. Minqing Hu, "Mining and Summarizing Customer reviews.".

[12] K. N. Kirithika B, "Comparison of Intel processor with AMD processor with Green Computing," 2013.

[13] Y. N. A. O. I. O. BabolaT. Issac, "Assemblin a Desktop Computer System with In-Bult Uninterrupted Power Supply.," 2017.

[14] A. Salinca, "Business reviews classification using sentiment analysis.," 2016.

[15] S. R. S. J. Zeenia Singla, "Statistical and Sentiment Analysis of consumer product reviews," 2017.

[16] A. L. Robert Ireland, "Application of data analytics for product design: Sentiment Analysis of online product reviews," 2018.

[17] F. N. Leo Rizky Julian, "THE USE OF WEB SCRAPING IN COMPUTER PARTS AND ASSEMBLY PRICE COMPARISON," 2015.

[18] Y. 2. LinghuiLiu1, "ApplicationofAgileMethodintheEnterprise WebsiteBackstageManagementSystem," 2012.

[19] A. J. M. Kamaljeet Kaur, "Applying Agile Methodologies in Industry Projects: Benefits and Challenges," 2015.

[20] J. D. A. a. O. B. Shvetha Soundararajan, "A Methodology for Assessing Agile Software Development Methods," 2012.

[21] [Online]. Available: http://jaspervanderhoek.com/wp/methodology/agile/pursuing-a-fully-agile-software-lifecycle/ [image].

[22] A. Zalozhnev, "The ICT Products Prices and Quantities".

6 APPENDICES

6.1 Appendix A : Use case diagram

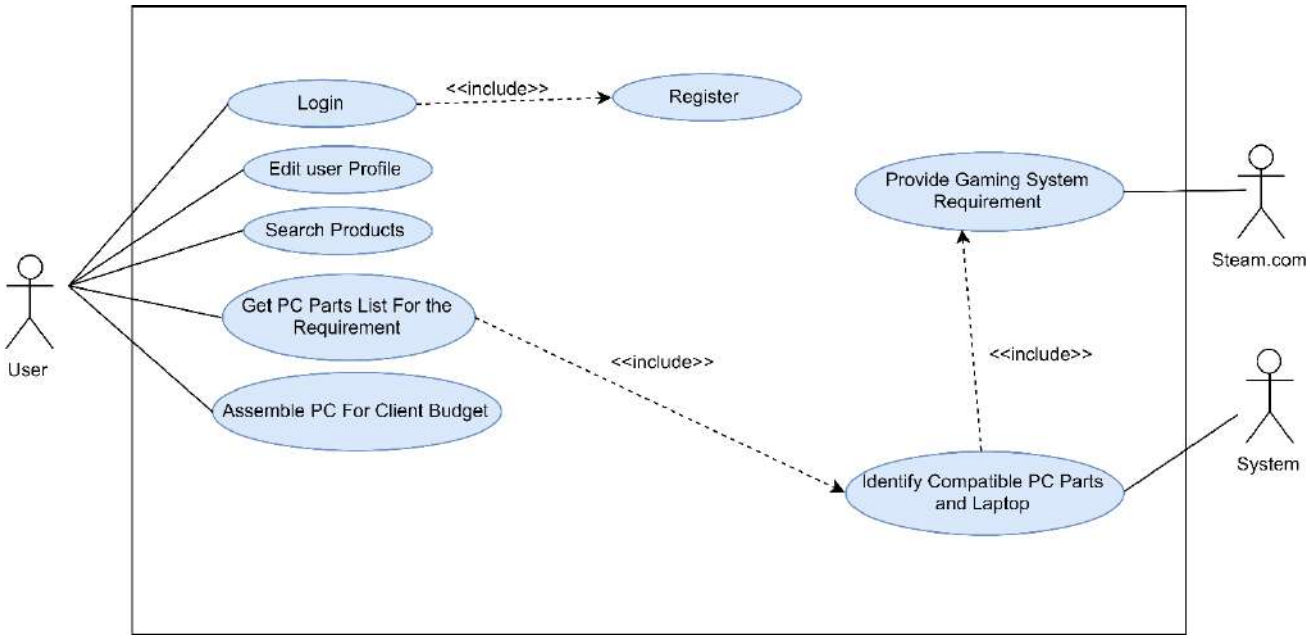

Figure 6. 1 – Appendix A: Use case diagram for assembling sequence

6.2 Appendix B : User Survey

- **Survey**

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

- **Survey Results**

https://drive.google.com/file/d/1COKVjgpRApagijZNzkqG1XN5q-IMzPJn/view?usp=sharing

6.3 Appendix B : Activity Diagram

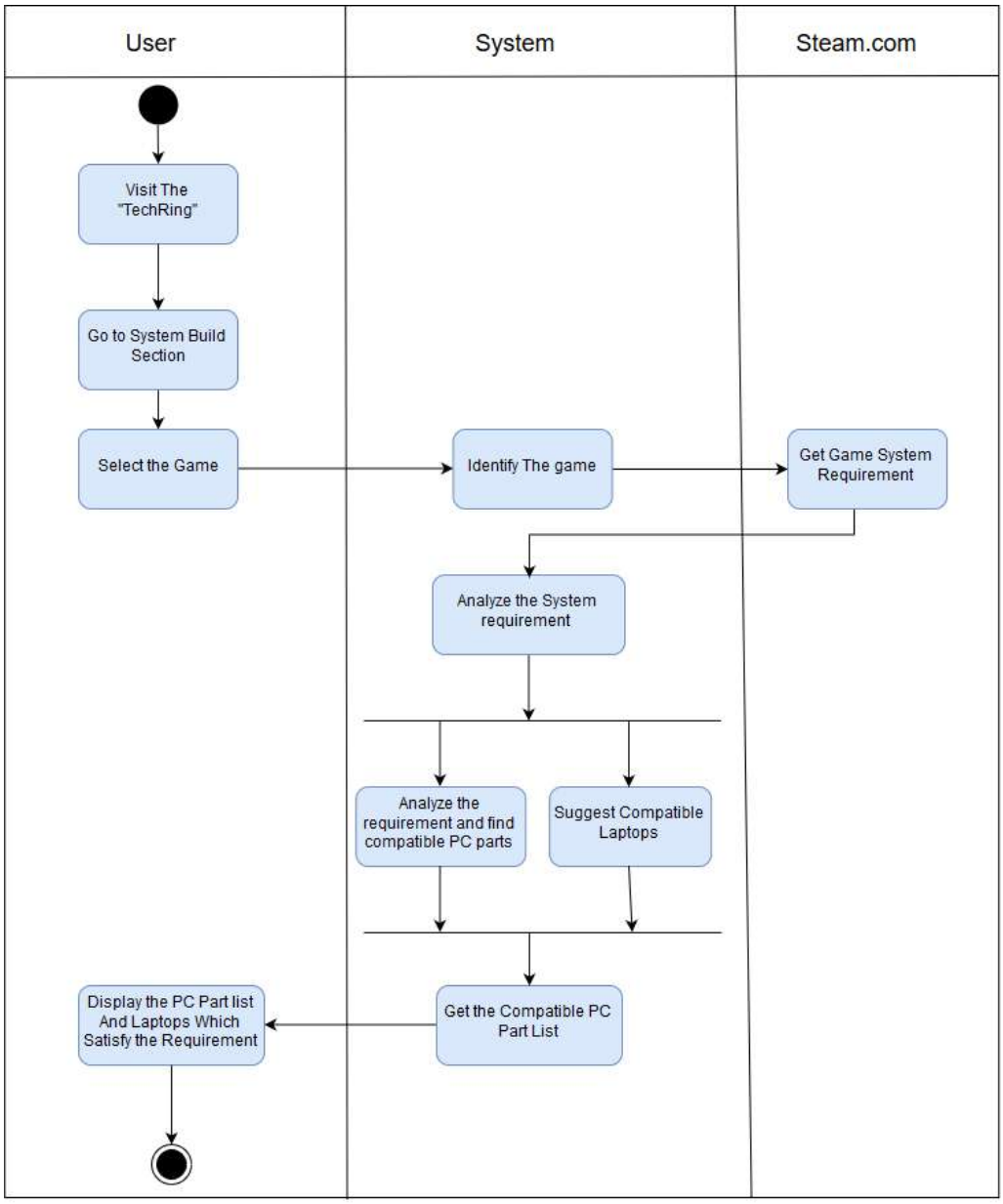

Figure 6. 2 – Appendix B: Activity Diagram