ARTIFICIAL INTELLIGENCE BASED PERSONAL COMPUTER PARTS AND LAPTOP RECOMMENDING ASSISSTANT

M.A.V.L. Gunathilaka

IT16055186

Bsc (Hons) in Software Engineer Specializing in Information Technology

Department of Software Engineer

Sri Lanka Institute of Sri Lanka

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Dissertation submitted in partial fulfillment of the requirements for the Bachelor of Science

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DECLARATION

I declare that this is my own work and this dissertation 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 my 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 Also I hereby grant to Sri Lanka Institute of Information Technology the non-exclusive right to reproduce and distribute my dissertation in whole or part in print, electronic or other medium I retain the right to use this content in whole or part in future works (such as article or books).

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M.A.V.L. Gunathilaka Date

The above research for the B.Sc. Special (Hons) degree in IT dissertation under my supervision.

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Prof. Koliya Pulasinghe Date

Signature of the Supervisor

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Ms. Hansi De Silva Date

Signature of the Co-Supervisor

ABSTRACT

Previously computers were just a tool used to help in mathematical calculations. But now they have evolved to a greater extent where the computers have dominated the world. It is almost impossible to find a place that don't have a computer. Based on the people needs, the required specifications and capabilities differ. Everyone can't buy the latest products or the most expensive products. In modern day, people are likely to assemble their PCs' accordingly. Therefore, the need of customized PC is of high demand. But finding the necessary parts is time-consuming, matching the compatibility of each PC part is tedious since the users need to have a significant technical knowledge. In addition to that, above people find it hard to select what is best for them since there are a variety of versions, models, and brands available. Apart from this, budget also plays a major role in deciding what to purchase. Therefore, an online assistant to assist above mentioned problematic situations is designed in this research. The research was initiated with the deployment of an online questionnaire. This was to understand our user base and the knowledge base along with aspects and methods used by the users to purchase. In order for a smooth functioning of this platform details from local vendors and E-commerce sites are required. Local vendors can register with this platform and give their prices for products and other data required from the internet will be extracted using web scraping. In order to make the best suggestions for the customers, an analysis will be conducted on the customer feedbacks. Thus, an over role idea of the user experience could be generated. For these comments from social media are taken and analyzed. The results of this research will be a web-based application built using Java, JavaScript and Python with MongoDB as its database. Users will encounter this platform by the name "TechRing" we make the right choices for you.

ACKNOWLEDGEMENT

I appreciate all the support received from the academic staff for the advice and guidance provided.

I would like to thank ‘Redline’ and ‘Nanotek’ local companies who gave us permissions to use their product details.

Finally, I would like to remember the people who filled the survey which we created at the beginning of the research.

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List of Abbreviations

PC	Personal Computer
IDE	Integrated Development Environment
HALT	Hardware Assembling Learning Tool
CBT	Computer Based Training
CAI	Computer Assisted Instructions
CPU	Central Processing Unit
RAM	Random Access Memory
VGA	Video Graphic Array

1. INTRODUCTION

Initially, computers were used as a tool for calculations, but now computers help people finish many aspects in life. It is a challenging task to find a computer that would satisfy the specific requirements like budget. When purchasing PC parts, prices and features of the products are very important. Users are more concerned of the price. Our platform will provide the assistance of having an assembling plan according to the optimum user budget. All the suggestions we provide for user requirements will be displayed in an order where the price optimization is considered. Therefore, the product display will not be in ascending or descending order but in the best possible way.

The assembling process for personal computers is long and a complex task. This is common problem faced by majority of current society. People find it difficult to match the PC parts with each other when assembling because the PC parts have compatibility issues with one another. Information Technology experts might be capable of identifying the compatibilities and the required remedies. But it is not the same with an average person. 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.

1.1 Background and Literature Survey

1.1.1 Background

Computers play a major role in everyone's' life. This device has been capable of pushing themselves into being a need of human beings rather than just a want. Earlier building a computer was less complex comparative to today because computers were used for simple tasks. For an example used as a calculator [1]. Because of that they used one computer model to satisfy the requirement. In contrast, today the computer devices are a must to solve ninety percent of human tasks. Therefore, the tasks computers perform has increased and also they have become more complex. This evolution of usage made the fact that one common computer model is not enough to do the needful. Therefore, based on the requirement the computer specification also differ. For instance, the computer used in the cashier might not be capable of performing the tasks used in video or photo

editing. Because of these complexities of requirements, most of the users have tended to assemble their computers by themselves.

Nowadays, with technology advancement, there are many sources when it comes to purchasing purposes. Digital platforms and physical platforms. Each source provides their own unique prices based on their costs. Therefore, customers are provided with the opportunity to have a comparison for the vendors. One of the common motives of customers is that they need to buy their products both for best quality and price. Considering these aspects from customers' point of view this platform is developed to the purpose of assist customers in assembling a computer of their need and also to have the hardware products they seek for the best price and quality.

Development of an online assistant for recommending the best hardware solution for the customers is a combination of different concepts, theories, technologies, and methodologies. When building a PC, it is not only about finding the parts that fulfill your requirements. It also needs to satisfy the compatibility of other components. Thus, automating such function is risky and complex. This platform is also designed to find the best product as well. In here the authors consider "Best" as the most pocket-friendly option with the best quality. To achieve this expected automation there are several concepts and theories used in previous researches.

1.1.2 Literature Survey

Web scraping will be one of the prominent technologies that will be used by the authors in order to retrieve data. Eloisa Vargiu and Mirko Urru (2012) has previously used this technology in order to extract data based on web advertisements. Another striking example that highlight the effective use of web scraping is the Russian research done by Maxim Bakaev and Tatiana Adveenko. They used web scraping to extract data about job applicants, candidates in order to manage the labor market in Novosibirsk, Russia. Apart from them for analysis, I have developed an algorithm based on sorting and point mechanism.

Considering the Udi and Nachum research there is a two-stepped standard approach to conduct a proper analysis. That is Approach C and S. Approach C is comparing based on the functionalities whereas Approach S is used in case of Approach C is not enough. Approach S will be conducting a deep analysis of the functionalities fed to the system.
The Lucene Model used by Jianxia and Huang's research is the development of a system which will use apache libraries and web crawling for an effective price and product comparison. Many experiments and test results have proven it is an effective model that give accurate results.

Many kinds of research have conducted researches on this area and they have developed similar service providing platforms. We observed that these platforms have their own limitations and none of the platforms cover all the functionalities that a customer is looking for.

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.

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 [3]. "It is a common practice to compare different computational power of different models of computation" as Udi and Nachum [4] 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.

Today there is a high competition within and between heterogeneous retailer groups. Therefore, Cenak Kocas has designed a model to provide an understanding about the market. In this model they investigate the changes that happens in the market and decide on the online price changes [5].

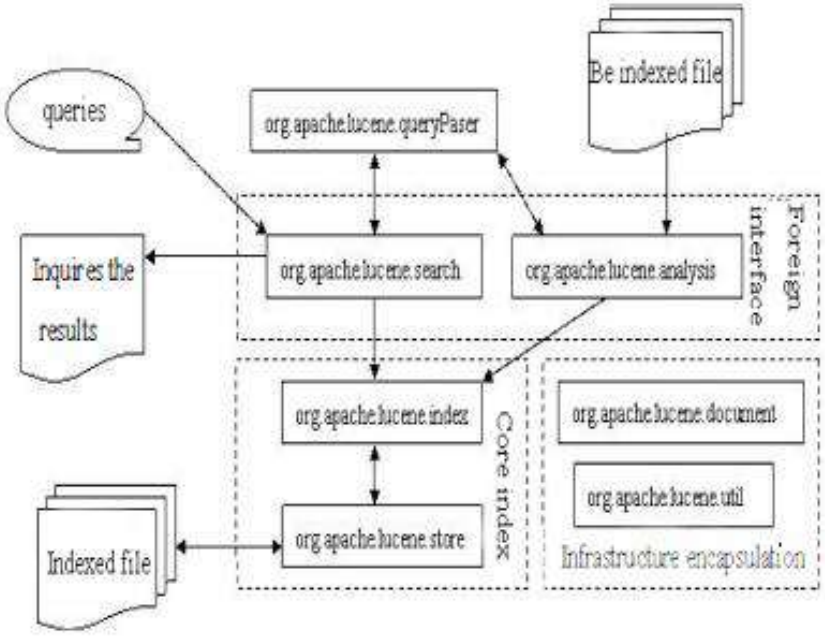

Figure 1. 1 - Lucane Model Diagram

Source: [6]

The market is characterized by rapid variability and high mobility. Therefore, it is important to do a prize optimization for the market. Alexey Zalozhnev has done optimization of prices and production volumes using information on the price elasticity. He has calculated price elasticity

of demand for each product to identify the model. Price parameters and base period prices is used to determine the profit maximizing prices [7].

Pricing optimization can be the basis of adequate manufacturer pricing policy. Reasonable prices will contribute accordingly to the promotion and adaptation of products that are especially important for variable and flexible ICT market.

1.2 Research Gap

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.

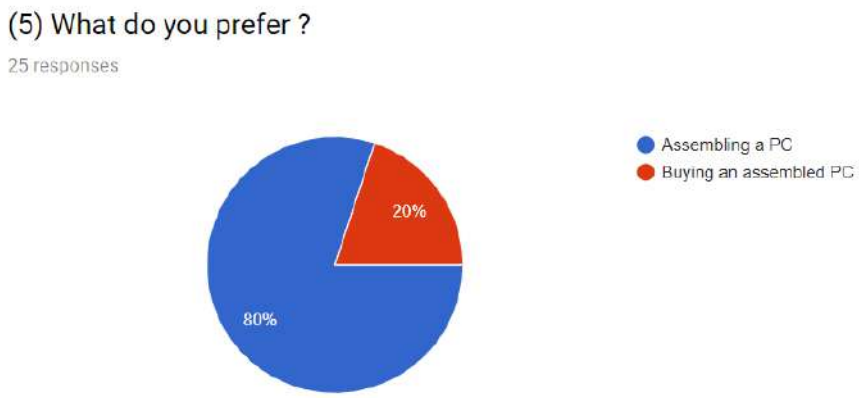

Figure 1.2 Survey conducted

The people who filled the survey have clearly proved that they really need to assemble a PC rather than buying an assembled PC. This is what we were forced into creating the system called 'TechRing'.

1.3 Research Problem

Functions	PCPartPicker.com	NewEgg.com	Noteb.com	TechRing
Select Compatible PC Parts	✓			✓
Pick best products in a product list				✓
Recommend assemble plan according to optimum budget	✓	✓		✓
Display prices and compare of different vendors	✓			✓
Notify Price Drops	✓	✓		✓

Table 1. 1 – Comparison of current available systems with "TechRing"

1.4 Research Objectives

"TechRing" is designed and developed with the motive to provide PC parts buyers with a reliable source to find the ideal solution for their hardware need. Since this platform has a variety of PC parts from vendors, both local and E-commerce sites, customers will be provided with a choice to select. This is also designed to have your own assembly plan for a PC based on the budget you provide. All the recommendations will be provided with high accuracy and reliability. Recommendation of the options that customers should go with in purchasing a PC parts will be displayed considering their prices, features of the product and also by analyzing the customer reviews given for each product. Thus both budget and quality facts are considered. So that customers will be provided with the BEST solution that they should go with.

Most of the time cheapest product is not the best product. Users want to get the best product as well as the cheapest product. In order to do that, this system will have the ability to analyze the product features along with user feedbacks and the price. After analyzing, customers will get the best PC part in that price range.

2. METHODOLOGY

2.1 Methodology

Price Comparison and Optimization is one of the key aspects of 'TechRing' and it focuses on giving the best products for customer requirements. People are able to get a list of good products under their budget limitations, search for products by analyzing them, compare different prices with different vendors and track the prices of products. Most of the time cheapest product or the most expensive product may not be the best product in the given budget limitations. In order to find out that we have to analyze the product features, price and customer feedbacks. The price of a product is not a constant. It is changing all the time. When it goes high people are not able to buy it. Therefore they need to get to know when the price drops happens in order to buy them.

One of these components gives the facility to change the budget range and according to that price range, the system suggests most wanted PC parts such as RAM, VGA, CPU, Motherboard and Hard Disks in order to build a PC for the optimum budget plan. It doesn't give the random products. In fact it searches the best products in the given price range and then it sorts that list and display the list. When giving a build sequence, an item from each category will be selected. That is the best product in the given price range for that category. After giving a budget plan, it is divided into 5 prices according a research has been done. It showed that from the total number of amount, RAM takes 8%, VGA 40%, CPU 20%, Hard Disk 12% and Motherboard 20%. Those amounts are the considered values when selecting an item from each category. Compatibility is very important when assembling a PC. Each and every part cannot be integrated. Therefore looking for the compatibility is very important. How does it happens is mentioned in the later part of this section with the algorithm.

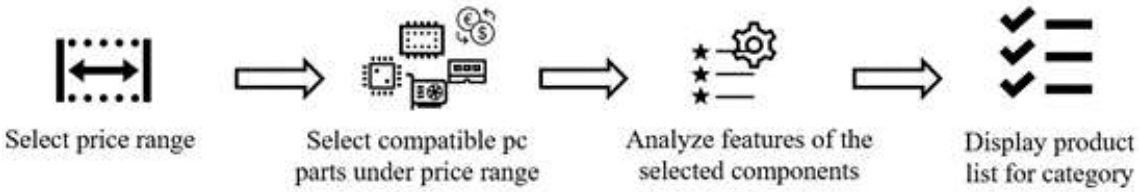

Figure 2. 1 – Steps of Build PC for price range

When customers search for products, it again looks for the best products. For example, if the customer wants to get a CPU products list, the system sorts the items according to the best. Customers are also able to sort that list according to the features, price and user reviews as well.

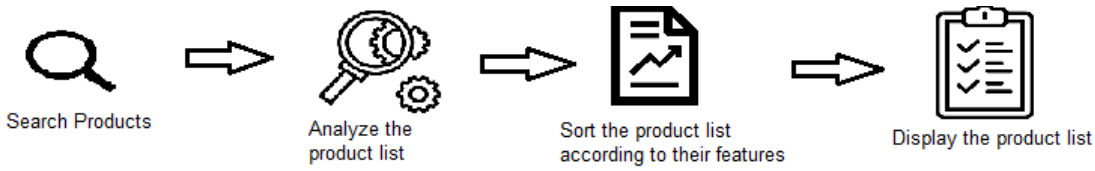

Figure 2. 2 – Steps for searching product

If the price is too high, customers are able to track the price of certain products. They can select certain products and stay on alert. When a price drop happens, they will be notified. This is happening during the web scraping and inserting to the database.

A programmatic schedule has been implemented for the purpose of web scraping. The web scraping is happening 24 hours to 24 hours and those data is stored in the database after validating. In order to get the best products in a given list, I have designed a new sorting algorithm which is looking at the product features, the price of the products and user reviews. This algorithm runs just after the web scrape is done. User reviews will be gotten from the Sentiment analysis component at that time. It gives a rating for each and every product. In addition to this process, a point mechanism will be used as well. In order to analyze, some certain features of each category will be selected. The considered features are as follows.

- RAM - size, speed, type
- VGA - size, chipset
- CPU – cores, clock speed, socket
- Motherboard - type, socket, memory type
- Hard Disk – capacity

The algorithm sorts the products feature by feature. For example, it first sort according to the size in descending order. All the products contain a position. Those positions will be added to the point of the product. Again, checks for the speed and the sort. After that position of the sorted list will be added to the point column. In order to get the best products, the algorithm sorts the products by looking at the points. The products with the lowest points are the best products that we do have since it took first places in every feature. When giving the build sequence according to the budget, compatibility needs to be checked. For that, the algorithm takes Motherboards first. For that motherboard, the algorithm checks for the compatible CPU parts in the given price range. Then for that requirements, RAM and VGA will be picked. After all Hard disks will be selected by looking at the compatibility.

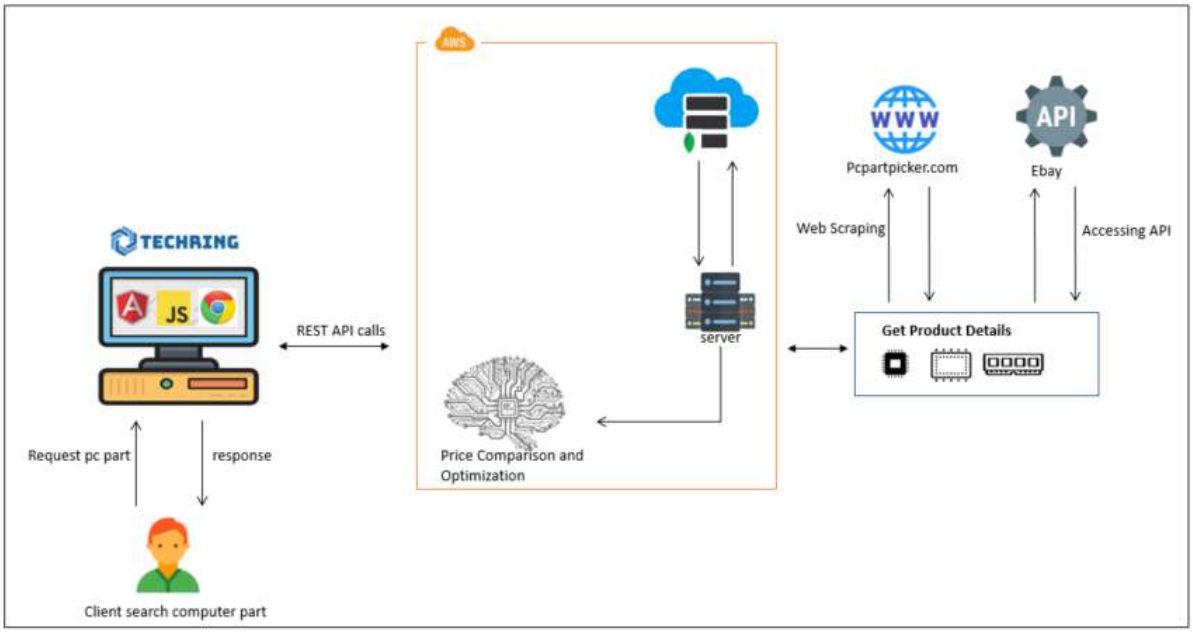

Figure 2. 3 – High level architecture diagram

2.2. Commercialization aspects of the project

The target market for this platform is consisting of two segments. That is the PC parts vendors and buyers. 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 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 Canvas

2.3. Testing & Implementation

2.3.1. Implementation

For the implementation of the system we have used following technologies and tools.

- Server Requirement
  - AWS Cloud Computing Server

- Technologies
  - Angular JS
  - Spring Boot
  - Python
  - MongoDB

- IDEs'
  - Visual Studio Code
  - PyCharm
  - Jupyter Notebook
  - Robo3T

2.3.2. Testing

When creating a system, testing does a major role since there may be a lot of errors. Errors can carry the entire project into a wrong direction. Therefore, it is necessary to do the testing from the early stage till the end. The system was developed in set of prototypes and milestones. Therefore it was easy to do the testing for each and every phase since it was clearly separated. In addition to that, the system was designed as component wise. Each and every function belongs to a component. Because of that, if we want to test a function, a component test is enough for that.

Faults are the reason for a failure. Here failure means the entire system failure. Faults are similar to small problems up to component errors. They can force the system to a failure. In order to avoid that, testing in every phase is required.

Unit Testing

The system was developed as set of components. The whole system was broken into several units/components and they were developed and tested separately. After creating components one by one, testing was performed in order to check those functions were

right. First thing to test was connection between frontend, backend and the database. Then the web scraping part was checked.

Integrating Testing

Components were created separately. Therefore, integrating the all components that I had created was necessary before combining other team members' components. After integrating all the components which I had created, testing was required to check that nothing happened to fail the system. Then combined all the work of other members. Then again tested all the components in order to make sure that they are working properly.

System Testing

After integrating and doing integrate testing, a system testing was needed in order to make sure system is working fine and find the existing bugs if any.

2.3.3. Test Cases

Test case Id	Test Case 1
Test scenario	Check whether expected item attributes are there in the site.
Pre-Conditions	There should be a proper internet connection to scrape data.
Test Procedure	1. Visit 'TechRing' website and go to the browse items and select a product. 2. Check whether most important item attributes are there.
Input	Product id
Expected result	Product details

Table 2. 2 – Test Case – 01

Test case Id	Test Case 2
Test scenario	Get PC parts for customer budget.
Test Procedure	1. User enters their price (budget) 2. Click submit button 3. User gets major components to build a PC under his budget limitations.

Input	Budget limitations
Expected result	Display relevant computer parts.

Table 2. 3 - Test Case-02

Test Case No	Test Case - 03
Test scenario	Get the compatible PC parts
Test Procedure	1. Visit 'TechRing' website and go to the build for price section. 2. Give budget limitations. 3. Check whether the given pc parts can be integrated.
Input	Price limitations
Expected result	Display compatible PC parts.

3. RESULTS & DISCUSSION

3.1 Results

This research will be highly beneficial for all most all the industries prevailing in society. Because PCs are vital components in every industry. Depending on the requirements people either tend to purchase a preset computer or assembly their PCs, by themselves. PC assembling is a common practice, especially in the modern century. Finding what is best for the users is complicating. Considering the above-mentioned aspects of the final outcome of this research is designed. That is the final output is an online assistant which will assist any user in finding the best hardware solution for them. This will be a web-based application which goes by the name "TechRing".

There are similar platforms like "TechRing". But these platforms only cater to only one hardware perspective. Before the development of this platform, authors conducted a study on the functioning of the prevailing platforms. Since the parts that are mentioned in the sequence are already available with the same platform users can find the outlets who sell these products for the best prices. Thus, the PC assembly requirements will be solved

from just one platform. Since sequence will be displayed in an easy clear manner any user with average technical knowledge will easily understand the sequences.

Accordingly considering the above facts the uniqueness of the platform is built. In addition to this, there are other features where the users are provided with ample products and vendor solutions to select with. All the products are displayed in accordance with the grade they are given from the algorithms designed. Moreover, another feature the authors prefer to highlight is that user is given sequences algorithms not only based on their technical requirements but also based on their budget requirements.

Thus "TeachRing" will be the ideal solution for any person who is looking for a hardware component. Authors guarantee the reliability and accuracy of the recommendations given by this platform. Efficiency and effectiveness will be achieved with the use of the algorithms used and designed. Each function is designed based on the users' requirements. The front end is designed in a way where any person who has access to the internet and who is comfortable in the use of the internet can find what they want from a few clicks. Eye-catching and friendly interfaces are designed in order to attract new customers along with the motive keep the existing customers attracted to our services. All these described functionalities are proven to be capable of satisfying the user needs that are mentioned by the authors previously.

3.2. Research Findings

TechRing is a result of a survey which we conducted at the beginning of the project. It provides some solutions for the people who are looking to assemble and buy PC parts. In order to use the system, there should be data. We have taken data from e-commerce sites such as 'Ebay' and 'Amazon' as well as from local vendors like 'Nanotek' and 'Redline'. There were two ways to select a product list in a given budget. First one was to get the best motherboard first for any price which is under the budget and according to that, choose other items. If other items are not able to pick under the budget limit, then change the motherboard. Second one was to divide the total budget into 5 separate prices according to the category prices and considering those prices pick the products for each

category. After doing testing I found out that the second one was way better that the other one. Therefore, it was used for this.

As a result of the research, I could give some solutions for the people such as give the ability to build a PC for their budget limitations, show the best products in a product list, sort products according to their needs and track the prices of products.

3.3. Discussion

This document discusses the solutions for PC parts assemblers as well as PC parts sellers and buyers. This system will be helpful for most of the modern generation. Depending on the requirements people will force to buy a preset computer or assembly their PC's by themselves. PC assembling is a common practice especially in the modern generation. Gamers are hungry of playing latest games. Since good performances are required for that, they are always looking to upgrade their computers.

"TeachRing" will be the ideal solution for any person who is looking for a hardware component. The author guarantees the reliability and accuracy of the recommendations given by this platform. This is the best platform to compare prices of different vendors, get to know the product lists to build a PC in a budget limitation, pick the best products in a selected product list and track the price of certain products. This is a web solution which is very comfortable and eye-catching and has friendly interfaces.

4. CONCLUSION

This document contains a detailed overview of the online assistant that is developed. This is an artificial intelligence-based PC parts and Laptop recommending assistant. This platform will be helpful to the people who sells PC parts and who is looking for buying and assembling them. When the user gives the budget limitation, this platform will generate the build sequence required. These sequences will be generated by considering their compatibilities of one another. Another aspect that is overlooked is the users are allowed to have a choice in a purchase. For each product, multiple vendors with their prices will be displayed. Thus, this also gives an opportunity for local vendors to compete with the global market and also local vendors are given the opportunity to reach the customers breaking the geographical barriers. As another aspect users look in before purchasing is the previous customer experiences when the brand or the version is not familiar. This platform gives an analyzed customer overview in a rating format since the users can have an idea at a glance. In suggesting the products, they will be arranged by considering the features, prices and the results of customer ratings.

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6. APPENDICES

6.1 Appendix A: Use Case Diagram

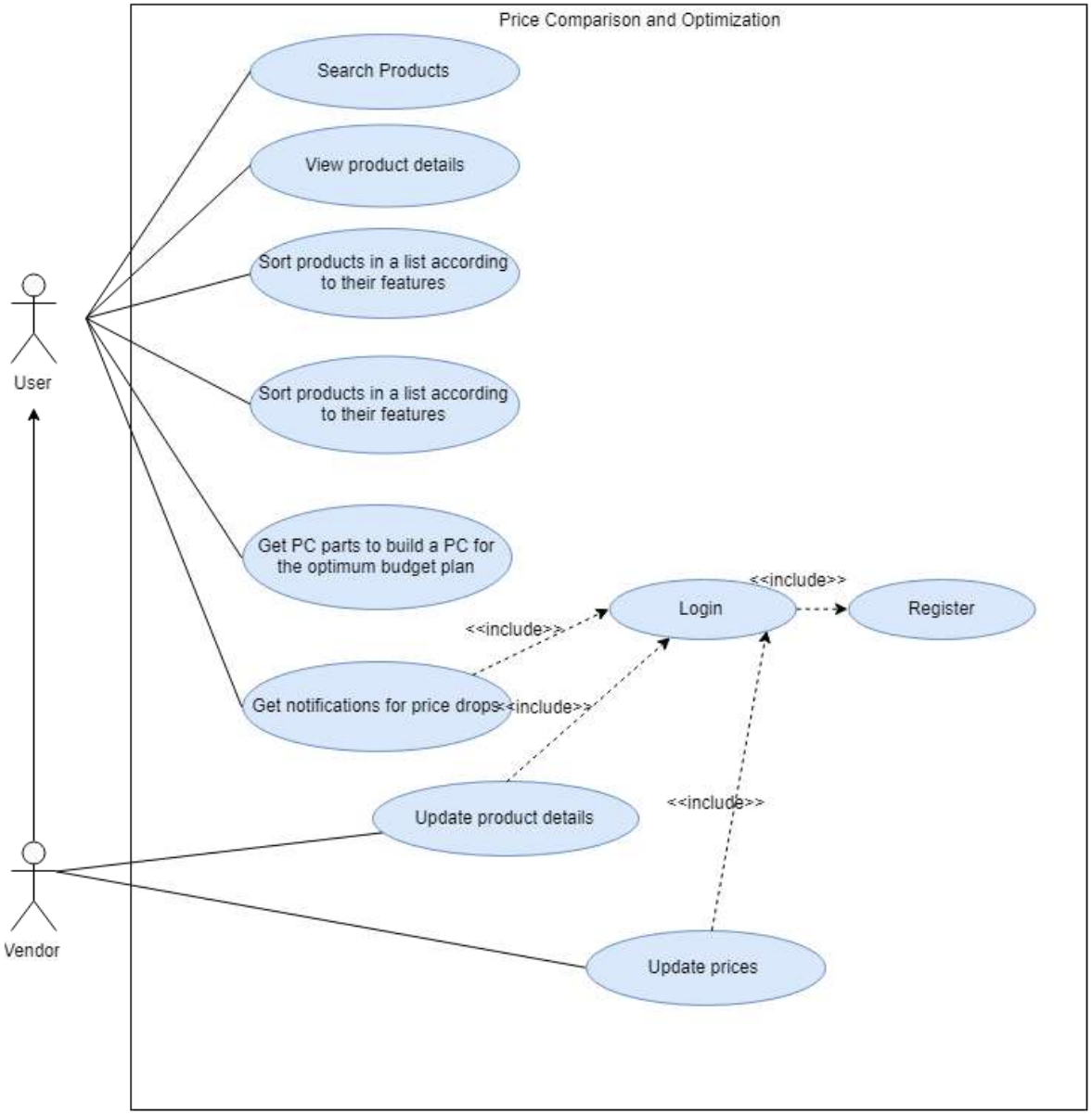

Figure 6. 1 – Use Case Diagram

6.2. Appendix B: Activity Diagram

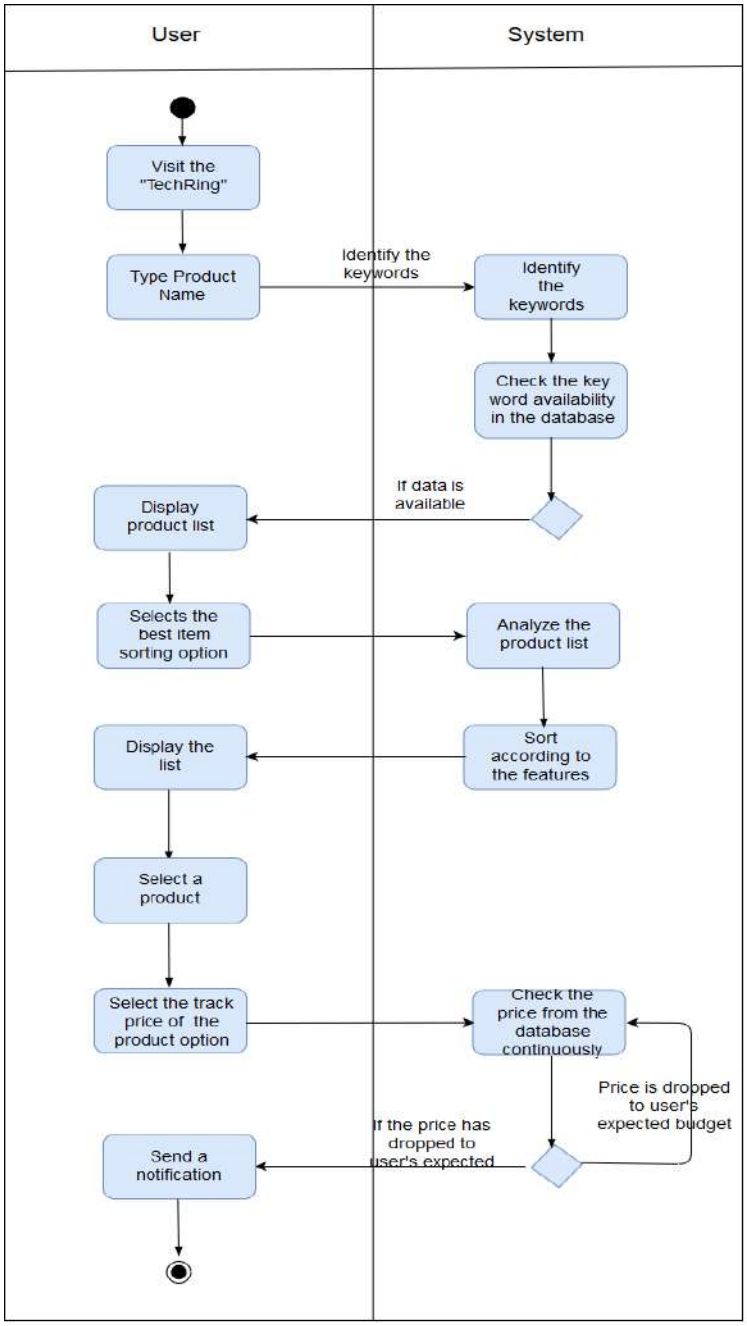

Figure 6. 2 – Activity Diagram: Search and sort product list

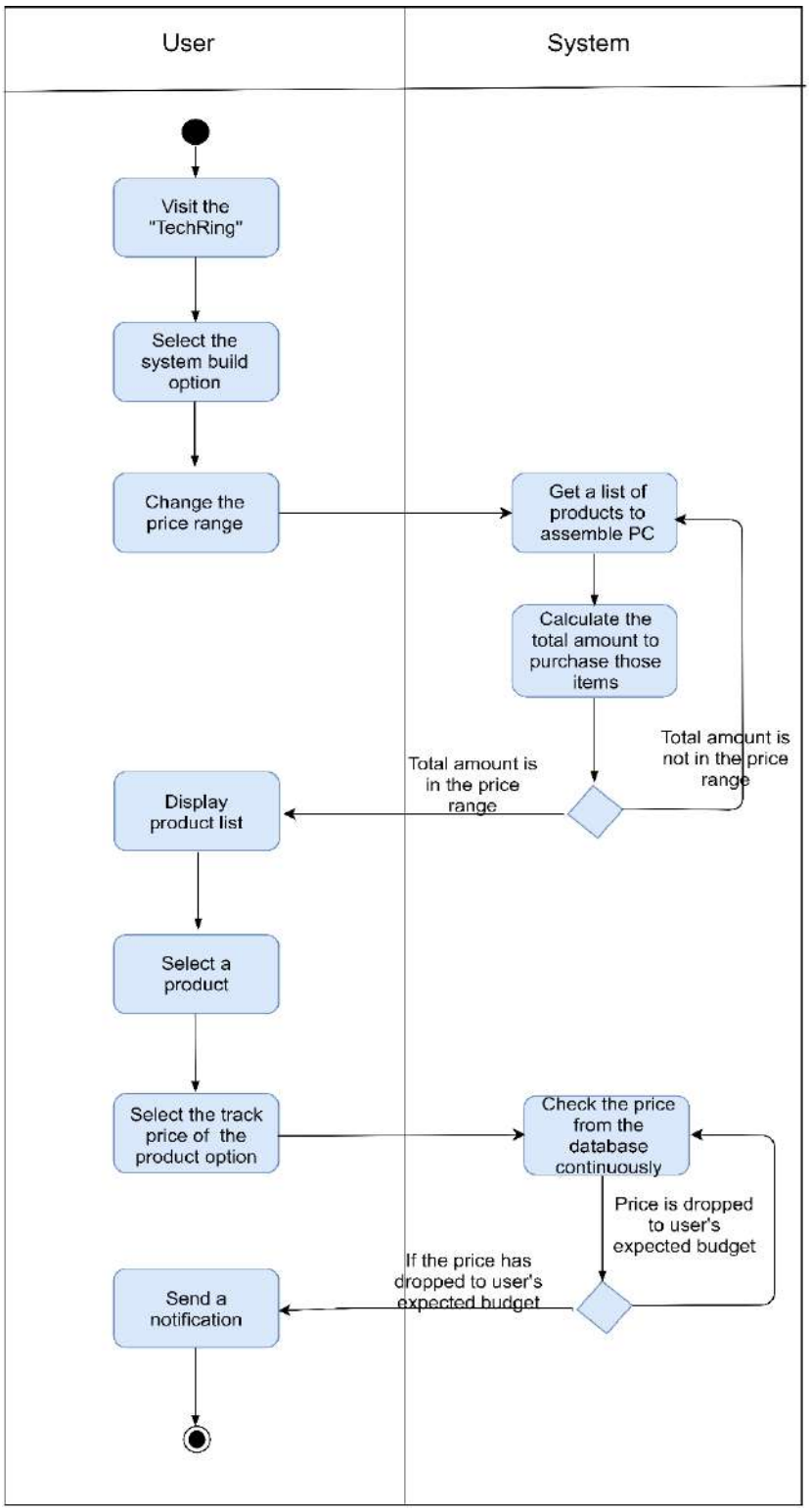

Figure 6. 3 - Activity Diagram: Get product list for Customer budget