SOLENT UNIVERSITY

Faculty of Business, Law and Digital Technologies

MSc Computer Engineering

Academic Year 2021-2022

Research Project – MAA112

Affordable Car Parts: Software Application

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This report is submitted in fulfilment of the requirements of Solent University for the degree of MSc Computer Engineering

Acknowledgement

I want to express my gratitude to Solent University for giving me complete access to the tools and facilities required for the completion of my research as well as for offering me wonderful chances during my study.

Additionally, I want to express my appreciation to the outstanding faculty and staff of the computing department, particularly my supervisor Prins Butt and my second supervisor, Andy Farnell, for their invaluable support throughout my project.

Finally, I want to express my appreciation to my classmates, parents, and brother Alex for their support during my course, which has helped me tremendously when facing challenges.

Abstract

The purpose of this research is to study the market of automotive parts and investigate the current factors affecting this car parts industry. The supply chains have suffered after the COVID-19 pandemic of 2020 and the Russian-Ukrainian war of 2022. Automobile and spare part costs are skyrocketing and customers who need to purchase auto parts are switching from local to online marketplaces as a result. Because spare parts require complex categorization to improve the buying experience and reduce search time, spare part markets on social media platforms like Facebook cannot provide the best marketing strategy. Automobile industry OEMs rely largely on spare parts for their financial viability, and companies are always striving to enhance their production processes. Furthermore, because products must be distributed and sent across long distances with a rigorous deadline and delivery dependability standard, sophisticated logistical arrangements are necessary. This project has researched and identified the technical and functional requirements of an online marketplace that links buyers and suppliers of economical spare parts. A user-friendly layout and a user experience that puts the car owner first will be provided through the website. The developed prototype is designed and shaped based on applied quantitative and qualitative research and evaluated results from research papers and a final survey to test the software using the technology acceptance model. According to the research results, many of the people who tested the website felt that its features were useful and that they would use it again in the future. Finally, the website I created seems to have more features than the apps that are now available, and the research questions are resolved because I was able to sell vehicle parts at a reasonable cost and bridge the gap between car owners and industry professionals.

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Table of Acronyms

Acronym	Definition
ACES	Aftermarket Catalogue Exchange Standard
ARA)	Automotive Recyclers Association of America
PU	Perceived usefulness
PEOU	Perceived ease of use

Chapter 1 – Introduction/Background

Introduction

After the COVID-19 pandemic of 2020 and the Russian-Ukrainian war of 2022, the supply chains have been affected negatively. The prices of automotive and spare parts are soaring. As a result, customers who need to buy car parts are converting to online platforms instead of local ones. Spare part markets on social media platforms like Facebook could not offer the best marketing approach because spare parts require sophisticated categorising to make the shopping experience more convenient and save search time. They added building a social media presence is not enough; viewers must be kept informed about current events by making sustained efforts to do so. These platforms and websites are often too generic as they do not have a feasible interface or the best experience for car owner clients. (Dwivedi, Kapoor and Chen 2015) reported that the small number of research in this category may suggest that either the idea of integrating SMM is taking a while to catch on in SMEs or that successful marketing strategy for SMEs should not exclusively rely on SMM but also take into account other factors. Car owners tend to buy second-hand spare parts because they are cheaper, genuine, and even may have better quality than the new ones. Car insurance is not compulsory in every country; hence, car owners have to search for suitable spare parts themselves among different spare parts providers. Consequently, this leads to the question of how to offer spare parts at affordable prices. The existing eCommerce websites lack essential UI/UX features, and they don't offer much information if a customer inquires for more details because they are not aware enough of what they are selling. An innovative online platform could be an excellent solution for this issue, the online platform is a website that focuses on the customer and will have a better UI/UX implementation that could fill this gap in the market. In the automotive market, cars account for 70% of dealers' total sales and 50% of their profits, while spare parts account for 30% of sales and 50% of profits. (Bijl *et al.* 2000)

Background

Automobile Market. OEMs depend heavily on spare parts for their financial success, and businesses are constantly looking for ways to improve their production methods. Additionally, complicated logistical arrangements are required because products must be disseminated and shipped across great distances with a strict deadline and delivery reliability criteria. Despite these significant obstacles, the so-called "aftermarket" is a lucrative and competitive industry. (Beiderbeck, Deradjat and Minshall 2018)

The growth of online platforms for automobile components is accelerating due to increased competition in the market. To increase product sales, manufacturers are encouraged to provide simple shipping alternatives, flexibility, and smooth online information. Before making a purchase, consumers are likely to compare products and pricing. Moreover, the spike in demand for automobiles from rising economies, as well as the rapid expansion of foreign manufacturers' penetration into Asian countries, particularly China and India, will drive product demand.

(gminsights 2022) reported that the reasons affecting the growth of automotive parts:

- Demand for car upgrades is increasing, and distribution channels are becoming more digital.
- Vehicle sales, both new and used, are increasing.
- Poor road infrastructure and an ageing car fleet

By 2028, the replacement components segment will dominate the market, accounting for over 80% of total revenue. The segment is expected to earn approximately USD 700 billion in revenue. Replacement automotive parts and components are in high demand due to rising car registrations in various locations. The industry's expansion will be fuelled by the development of technologically superior spare components that improve vehicle efficiency. The shifting consumer preference for reconditioned and pre-owned vehicles will result in good industry growth prospects. The demand for customisation, repair, and maintenance of refurbished automobiles will boost the automotive aftermarket's share of the industry.

The car service stations sector is expected to rise at a rate of more than 6%. North America is expected to have an increase in the manufacture of new automobiles, as well as the development of older and used cars, which are driving the regional automotive market. New technical breakthroughs in the automotive industry are providing chances for aftermarket trading organisations to expand. Increased sales of electric, hybrid, and gas vehicles are fueling product entrance in the region due to the growing demand for energy-efficient automobiles. The automotive market in Japan, South Korea, and Australia will be propelled by digital vehicle installation and customization, as well as rising demand for Bluetooth and other electronic gadgets. Europe is likely to offer profit potential due to the region's high demand for innovative technologies, engine warmers, custom-made accessories, vintage auto parts, and rear truck market products. Furthermore, the presence of major automakers in the region will boost market demand. (gminsights 2022)

The automobile sector has changed dramatically in recent decades, as car sales in the United States have declined and more consumers have turned to online markets like Carvana. With the assault of COVID-19, when lockdowns and worldwide supply chain issues led physical car sales to fall, this trend became even more obvious. Despite the reduction in overall automobile sales, the market for automotive eCommerce grew in 2021 and 2022, as most potential car buyers had no other choice. Even as business resumed in 2021, the surge in online sales continued, as buyers grew acclimated to the convenience of eCommerce solutions. Before the pandemic, 32% of automobile purchasers in the United States were willing to use online platforms. Automotive eCommerce, often known as automotive electronic commerce, is the online purchase and sale of automobiles and parts. This can be done using a variety of tools, including computers, phones, and mobile tablets. Automobile eCommerce does not have to be a stand-alone process. Physical and internet sales are frequently combined. A new car, for example, is sold on a physical lot, while aftermarket parts are acquired through an auto parts eCommerce portal. Automotive merchants, like many other digital commerce businesses, are adopting an increasingly omnichannel strategy for selling, in which customers can make informed purchases using both physical and digital channels.

The COVID-19 epidemic has wreaked havoc on the worldwide automotive industry. Imports of automobile parts from China have been hampered by supply chain disruptions, large-scale manufacturing facilities have halted operations across Europe, and assembly factories in the United States are collapsing. There was a worldwide demand downturn as a result of these interruptions. On an operational level, the epidemic has accelerated several years of progress in the automotive performance components sector. Many of these changes are positive for the market, such as improvements in eCommerce and OEMs' willingness to collaborate with partners, both automotive and non-automotive, to provide support and consultation. (futuremarketinsights 2021)

Figure 1 Automotive eCommerce market (Bigcommerce no publish date)

The transition of the automotive industry into the world of eCommerce is not a recent occurrence, but rather a long-awaited movement. More than 99 per cent of buyers said they were dissatisfied with the existing vehicle buying process. This information

emphasises the need for improvements in the automotive industry. If anything, the epidemic may have given many car companies the final push they needed to innovate and modernise how they sell their products and contact customers. With eCommerce anticipated to account for over 60% of retail sales by 2022, the automobile sector's migration online couldn't have happened at a better moment, and it will enable this historically innovative industry to thrive. (Bigcommerce no publish date)

According to (africa-businesspages no publish date), African demand for vehicle parts and accessories is expanding 11% year on year and will be valued at $15.3 billion by 2020, led by Kenya, Ethiopia, Tanzania, and Uganda. The African automobile aftermarket, despite its fragmentation, is one of the most promising in terms of prospective growth. Today, the continent's roadways are home to roughly 22 million automobiles, generating an annual demand for parts and accessories worth more than $8 billion. As a result, it's become a bigger market for worldwide makers of accessories and engine parts including bearings, brake pads, spark plugs, and filters, with a lot of them being re-exported from the UAE.

(Jonathan Garber 2022) reported that automotive part prices will rise another 5% by year's end due to higher costs for items, shipping containers, and labour. This year, prices have already risen by around 5% to 7%. Moreover, he mentions that due to the infrequent nature of purchases, the auto-parts sector has historically been able to hike prices on the customer. Customers rarely need to buy the same part for more than a year or two, and they have no idea how much those components should cost. The number of car crashes in Africa is the highest in the world (Yomi Kazeem 2018). While the prices of new cars increase, a car owner repairs the car instead of buying a new one.

Official manufacturer (OEM) parts that have been taken from a vehicle during the dismantling and recycling process are known as green parts, sometimes known as 'recycled parts' or 'used parts'. The client selects to buy green parts because of cost as they cannot afford to pay astronomical prices for new parts purchased directly from the manufacturer. Green parts are a cost-effective option because they can save you up to 90% over buying directly from the manufacturer. When you choose recycled components, you won't be limited to a small selection; instead, you'll find parts from

Ford, Ferrari, and just about every other brand in between. To maintain the quality of green parts, the spare part is tested by a stand-alone organization such as ARA to assure the part functions efficiently and meets high standards. The ARA helped the insurance repair sector in the United States to adopt using green parts, and it hopes to emulate this success in the United Kingdom. (Trents 2022)

(africa-businesspages no publish date) indicated that African countries are the main importer of used spare parts as these parts are genuine and in good condition. The majority of used replacement parts come from damaged autos sold at bargain prices by insurance firms.

Problem Scope

According to (miway 2021) and (Abdullah Naser 2021), private car insurance is not compulsory in most developing countries. Hence, car owners tend to be responsible for the whole repair process. A car owner relies on private car service providers who may charge high prices for the car parts. So, clients have to search for the best prices in local shops. Most people use also word of mouth and local connections to get good prices. Nowadays, markets on social media platforms can sell spare parts, but these markets are not organised as a client has to search in different groups and pages, and the component he/she looking for could be published on an old date. It becomes harder to find the right part at a good price as it is hard to compare between different sellers. In addition, the client could search online for the parts required for their car on the eCommerce website. A common website like Amazon or eBay does not exist in most developing countries. Even if these websites are accessible, they do not have feasible UI/UX designs that fit the car owner's clients. The available websites are too generic for car parts and cannot address the needs of the customers. The process is quite easy for minor fixes and maintenance, if a car needs a significant repair due to an unfortunate accident, that would be a struggle because the spare parts providers could be far from the client’s location and they do not even have an online platform for the potential clients to reach out. The client would travel to different providers and compare prices to get a deal.

(Bollini 2017) explained some usability issues and how to create a well-organized and appealing user interface that aids users in developing a good mental model and cognitive understanding of the structure The aesthetic creates a straightforward and pleasurable experience.

Auto Parts Procurement

While researching for related work, I used the research term “Auto parts procurement”, “Auto parts eCommerce” and “Auto parts website”. I searched on Google Scholar for papers between 2015 and 2022, but I find very limited papers on my topic. I only found related work when I search for papers between 2000 and 2022.

(Rahman *et al.* 2021) have created an eCommerce application for procurement parts for the car. They mentioned that this kind of service is not widely available in developing countries. They also reported that their application would ease the purchasing process and make it easier and at a low cost, and this application is environment friendly while customers consume fuel while going to local stores.

(Ahmadzadeh, Gholamian and Mohammadi 2011) had comprehensive research on the eCommerce automotive market based on certain indexes, and they also did a refined questionnaire. They proposed a framework that monitors the eCommerce performance of the automotive-based on predefined indexes. In my opinion, the demonstrated indexes for monitoring automotive eCommerce could be outdated as the market has changed dramatically and new factors are needed to be studied.

(Croom and Brandon-Jones 2005) reported the key issues related to e-procurement implementation such as the impact of cost efficiency on the supply chain, the IT infrastructure challenges; and the influence of e-procurement on behaviour and relationships.

(Kaliannan 2008) reported E-procurement, according to both the buyer and seller communities, will serve as a catalyst for a new and innovative supply chain management method in the public sector. More vendors are expected to seize the chance and fully benefit from the e-procurement programme in the next three to five years.

(X. Lei and D. Wang 2012) developed an inventory management system for auto parts which overcomes the drawback of the traditional way which is not efficient and consumes much time.

(Nurmandi and Kim 2015) explained how initiative e-procurement is implemented in a decentralised system on a local government level.

(You Bing Zhang, *et al.* 2011) designed and implemented auto parts data management system for simplifying the procurement process and assisting the enterprise to sell more.

Online Platform

The mentioned approaches of auto parts procurement or management only focus on the business side and ignore the customer needs for a convenient and affordable method of auto part procurement, and many of these solutions do not offer online access for customers to procure spare parts they need. In addition, they did not discuss second-hand spare parts as cheap and considered the environment. Consequently, I argue that an online platform that is specially designed for customers in terms of the system design and the feasible user interface could add value to the current market.

Customers may favour social media over having a specific website for their firm, especially in small organisations. However, social media accounts do not guarantee 100% marketing success since their adoption needs a systematic approach to achieve the intended results. All businesses will still need websites because they enable better search engine marketing, complete content control, and subsequently greater branding. To put it another way, social media business pages are essential but not sufficient. (Shaltoni 2017)

To ensure a rewarding SEO and marketing strategy for auto parts, creating content is one of the best approaches and this can be achieved by building a website. Nearly 25% of all automobile searches, according to data from Google, are for parts, services, and other upkeep tasks. Customers that conduct searches online not only obtain the information they require but also take action. One in two smartphone users who

conduct internet searches for auto parts dial the retailer immediately from the search results. People don't buy cars as regularly now as they used to. Statistics from the industry show that the average age of automobiles and bikes is rising. For those who sell auto parts and offer after-sales services, this trend offers fantastic opportunities. (Bhavin Madariya 2019)

According to certain research, many people are even choosing mobile phones as their primary method of accessing networked resources (International Telecommunication Union). Due to the 5:2 ratio of mobile phone prevalence to fixed internet users, analysts predict that mobile Web access will eventually surpass PC access. (Han Rebekah Wong 2012)

Consequently, I argue that an online platform could solve this issue by connecting car owners and sellers who could meet the demand for affordable spare parts. The website will offer a user-friendly interface and a feasible experience that put the car owner in the centre. As I highlighted the popularity of phone applications, the website will be a responsive interface that is adjusted automatically according to the screen size on desktop and mobile phones. This website will serve as B2C where companies sell parts directly to the clients online. Furthermore, the website will be a C2C service provider as it acts as a mediator between customers and offers an opportunity to sell or purchase car parts directly. The website will foster the spread of green parts as the demand for green parts experiences a high trend, and with industry standards in place, consumers will be able to buy with increased confidence. As automakers plan to produce more environmentally conscious automobiles, it's reasonable to think that consumers will move from pricey, direct-from-the-manufacturer parts to more economical, recycled parts that benefit both the wallet and the environment.

Project Planning

For this project, I will use Flask, a micro web framework written in Python, and the database is PostgreSQL. As an alternative, I could use C#, ASP.Net MVC framework and MS SQL server for the database.

Methodology

Every research endeavour needs to have a specific research question. Inspiration can come from a wide range of sources, such as political, professional, and personal influences. The research question needs to be clear and precise regardless of the source. (Baldwin and Rose 2009)

The research question is how to make car part procurement more affordable. To answer this question, I will search the available approaches and how customers buy car parts.

The first objective is to research available solutions and assess online websites in the market based on the features and services they offer. After I find potential areas for improvement, I will do a survey to validate my findings and prove my argument. Afterwards, I will begin the stage of application implementation. I will search the current technologies and choose a suitable web framework that fit the project requirements and database to store the data. I will program a responsive web application that works on the large screen and phone devices. This prototype product will be tested by doing a survey. After getting feedback for the prototype using the TAM model. Then I will literature the method again, I will implement the system and do improvements based on the feedback from the survey results.

Chapter 2 - Pilot Study

Introduction

Car parts market is expanding and the procurement process of a used car or car components could be challenging. A customer has to know about the car parts before searching among different dealers and websites. Furthermore, the customer needs to make sure that that car part is compatible with his car and had good quality. This is even more challenging when second-hand car parts as they may not have a label or a serial number. On the other side, buying a used car could be harder and the used car salesmen tend to disguise car flaws to finish the deal. I argue that the consulting service may have good potential, it will be a pool for car experts and technicians to share their experience and knowledge and get paid at the same time.

Buying car parts could a complicated because buyers would search for the best prices on many websites, and join forums to discuss the issue with others to know their opinion. Buyers should also check the brand reputation and talk to car mechanics before deciding on purchasing. Car spare parts should be ISO certified to guarantee the product is verified. Finally, they have to choose qualified labour to do complicated maintenance. (businessmotoring 2020)

An automobile consultant aids those who are considering purchasing a vehicle, typically a used vehicle. However, some auto advisors also assist clients in choosing the ideal new vehicle for their requirements. A qualified car consultant could in(Eric Hammer 2021)

Objectives

To come up with an added value solution that could make a difference in the car parts market, The goal of this paper is to evaluate the current solutions and features. This research will help to study what features these online applications offer for car owners. The features that will be studied are shown in table 1 such as the consulting provider could be individual car technicians or a car service business. This website will also have a portfolio where the service providers could show their previous work. In addition, the

service provider could sell new and second-hand car parts. The study aims to provide auto parts at affordable prices.

1. Gather data on the features of the available online approach
2. Discuss the observations of the survey about car parts and consulting services and identify limitations
3. Deduct success factor based on the finding of the pilot study

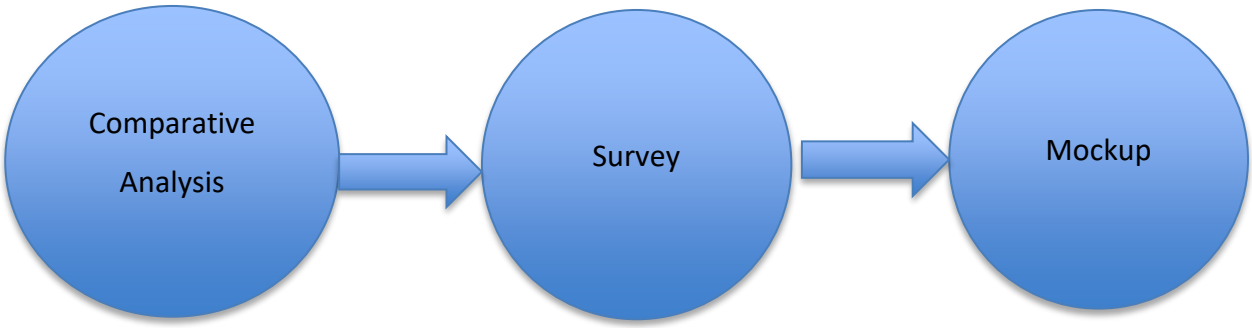
Hypotheses

The following hypothesis is to determine the need for an online car website.

1. Car owners are more likely to use online platforms to purchase car parts than to visit a car parts outlet
2. Car owners pay more money for the car parts than their original value
3. Car owners consider buying second-hand car parts
4. Customers may need a consulting service before buying a used car

Method

I will do a comparison and study online websites for car parts. Then I will survey to help understand the opinion of the customers and to know how feasible my solution is. Finally, I will come up with a mock online solution and survey it. I will use both qualitative and quantitative methods to gather data and answer my research question.



Comparative Analysis

This comparison is between major car websites such as “autodoc” and “eurocarparts”. This kind of analysis is also used by (Martins, Martin-Sanroman and Suárez-Carballo 2020) to analyse online platforms. The evaluation is based on the key features website visitors may look for while buying cars or car parts. It is noticed that the market is very competitive when it comes to providing car parts. The website offers various car part categories such as engine parts, filters, and body parts. Moreover, the comparison table shows the strengths and weaknesses of each online platform. It is noticed also there is a gap in the market when it comes to the consulting service. Many websites do not guide customer if this part is genuine or fit the customer's need. This is quite rational as the eCommerce application wants to make maximum profits. The websites in the search use user-centred design which is outstanding and an adequate user experience.

	autodoc.co.uk	eurocarparts.com	onlinecarparts.co.u	buycarparts.co.uk	carparts4less.co.uk	Amazon	eBay	Gumtree	breakeryard.com	synetiq.co.uk	usedcarpartsuk.co.	Asm-autos.co.uk	My Solution
Sign in/Sign out	√	√	√	√	√	√	√	√	√	√	√		√
Register	√	√	√	√	√	√	√	√	√	√	√		√
Favourite	√	√			√	√	√	√					
Sell Cars							√	√	√			√	
Search	√	√	√	√	√			√	√		√		
Car Parts	√	√		√	√	√	√		√				
Used Car Parts								√	√		√	√	
Contact	√	√	√	√	√	√	√	√	√		√		
Responsive website		√	√		√	√			√		√	√	√
Rating	√	√		√	√	√							
Consulting service											√		√
Previous Work													√
Video calls													

Chat								√					√

Survey

Data Collection. Participants are invited to fill out the survey online and in person. I sent the survey to different social platforms like Facebook and LinkedIn. The offline survey is done by inviting people to fill out the survey in local car shops and pedestrians around Southampton City.

Survey Design.

The technology acceptance model now Technology Acceptance Model is a framework that allows a person to understand the cognitive processes within users and how they'll respond to adopting and integrating a new piece of technology within their life now a new piece of technology doesn't have to just refer to a piece of hardware like an iPad or laptop can also refer to things like software and online learning communities. The technology acceptance model or TAM for short was first created by Fred Davis in his paper they concluded that people form attitudes and intentions to trot toward trying to learn to use the new technology before initiating efforts directed at using or simply put a person will make a cognitive decision and create a bias without ever interacting with a piece of technology first meaning that they're bringing in certain attitudes and they're looking at certain aspects like ease of use and usefulness of that technology and if they can make it work for them now TAM is the most widely used model for understanding the processes of a user but there are also several revisions. Tam and the next is the unified theory of acceptance and use of technology because the technology acceptance model measures external variables this could be a person's predisposition to a certain type of technology. The variables are perceived usefulness and then perceived ease-of-use. Perceived usefulness means it's useful to their everyday life and the perceived ease of use is how much training is going to be needed can I pick this up? The perceived ease of use will influence the perceived usefulness so if something's hard to use. This will

Table 1 Websites Features Comparison

influence a person's understanding of how useful something is most people cognitively speaking are very lazy they want to be able to pick up a new piece of technology and they want to use it right away without really having to open up a user manual. Those two factors will create a specific attitude toward using the piece of technology now that attitude could be a positive attitude or a negative attitude and that's what leads us to this behavioural intention to use or behavioural intention I should say the behavioural intention is a positive use if they think that it's going to be useful and easy to use then, they're going to use it if there's a negative intention then they're not going to use it or more likely will not use it. The TAM model breaks it down a little more for us to understand we can see it's mostly the same in the understanding of perceived usefulness ease of use and then how that flows into the usage behaviour but there are a lot of factors that TAM version looks at first off the subjective factor. Does the person find this technology useful just in general? what kind of image do they have in their head is it relevant to their job? Is it going to produce a higher quality product than what they already are using? other things that influence the idea of usefulness like a person's previous experience. (Marangunic and Granic 2014)

As an evaluation process well first off the thing you need to ask when you're using these models trying to understand whether or not somebody within your system is going to adopt a piece of technology is first you need to identify that person you need to identify your users or your stakeholders who's going to have the most interactions with the product from there ask yourself these specific questions will they find this an easy-to-use system what is going to be the barrier to entry to it do they need to do a lot of back learning to understand what's happening now basically is it easy user friendly. Next is how much training is going to be required are you going to have to develop multiple professional development days or create multiple training seminars on it or can you do it in one or can you even just send it out as an email on how to use it? Then will they find the system useful in their life? This is hard to measure because this is looking kind of in a broad scope of how people might use it each person is an individual and they're going to have their responses to it but overall if you think everyone as a group is going to find this system more useful to their life than the current system that you're using.

Finally what potential attitudes may be developed by users during implementation? Sometimes it's really easy to look at the beginning process and the end process but the implementation process is not convenient. The problems that are going to come up during implementation going to negatively affect your users next once you've done that identify some immediate challenges and some immediate barriers to entry doing that will allow you to create a process to overcome those right away then identify immediate benefits of the system. You should use this as a selling point you know we must let people know what might be an issue but it's more important to let them know why it's going to be of immediate benefit. (Marangunic and Granic 2014)

I have used the Technology Acceptance Model (TAM) to conduct the survey. The technology acceptance model (TAM) has dominated research into the variables influencing users' acceptance of new technology. In a complex link between system attributes (external factors) and potential system utilisation, the TAM presupposes those two variables named perceived ease of use and perceived usefulness would play a mediating function. TAM has assumed a leadership position in describing users' behaviour toward technology. It is derived from the psychology-based theories of reasonable action (TRA) and the theory of planned behaviour (TPB). Without comprehending the beginnings, progress, and changes alongside the model's limitations, there can be no in-depth, systematic research in the area. TAM helps to understand how end-users make decisions when using technology applications. TAM measures two major factors: perceived usefulness (PU) and perceived ease of use (PEOU), PU is defined as the extent to which a person thinks that utilising a specific system will improve work performance. PEOU is defined as the extent to which a person thinks that using a specific system requires no physical or mental effort (Marangunic and Granic 2014). I apply the TAM by classifying the survey questions into two categories. The first question category is for PU and the second category is for PEOU.

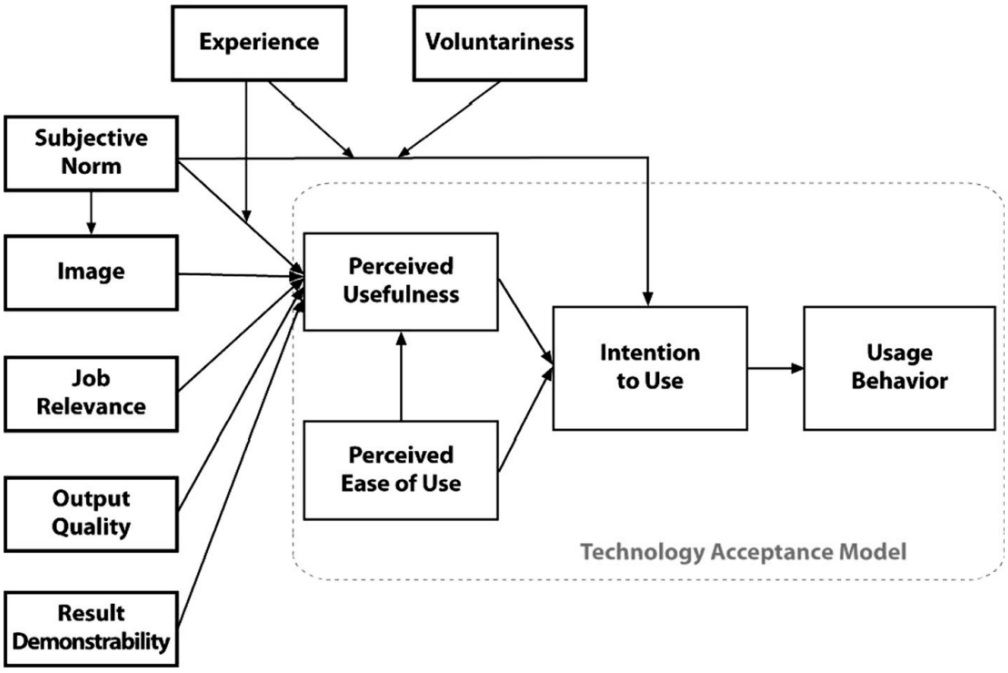


Figure 2 Technology Acceptance Model (Marangunic and Granic 2014)

Survey Questions

(Taherdoost 2019) reported that one of the most popular measurement tools is the attitude and rating scale, which is utilised in fields like sociology and information systems. I used the attitude scale called Likert to study the car owners' points of view with the car parts seller, used car parts and the potential for a car consulting service. Likert indicates the level of agreement; these scales feature a transition from one extreme to another. I used also open questions to know the new ideas and the space for improvement.

Questions?

U1 to U7, E1 and O1 are designed to test hypotheses H1 and H2.

U8 to U12, and E2, are designed to test hypothesis H3.

U13 to U15, O2 and O3 are designed to test hypothesis H4.

	PU Questions
U1	Do you prefer buying car parts online or from local shops?
U2	Which car parts category do you normally buy?
U3	To what extent do you agree you pay good value for the money on online car parts websites?
U4	To what extent do you agree you pay good value for the money on local car parts shops/garages?
U5	What is the website you normally used when buying car parts online?
U6	Please rate your experience on the online car part website.
U7	Please rate your experience from local car part shops/garages.
U8	To what extent do you consider buying second-hand car parts?
U9	Which second-hand car parts category do you consider buying?
U10	To what extent do you think second-hand car parts are good value for the money?
U11	To what extent do you think second-hand car parts have good quality?
U12	Do you consider buying a second-hand car part (Green Part) for environmental reasons?
U13	To what extent would you consider using an online consulting service online or on-site before buying car parts?
U14	Would you consider using an online car consulting service online or on-site before buying a used or new car?
U15	Are you interested to use an online application for a car consulting service before buying a car or car parts?
U16	Please rate your previous consulting service if you have used it before.

	Ease of Use (EOU) Questions
E1	Please rate your experience on the online car part website.
E2	Please rate your experience from local car part shops/garages.

	Open Questions
O1	Any suggestions for features or services to improve the car part shopping process?
O2	Please describe if you have used a consulting service before, and how it could be improved.
O3	Any suggestions for the online website I am developing for car parts and consulting services?

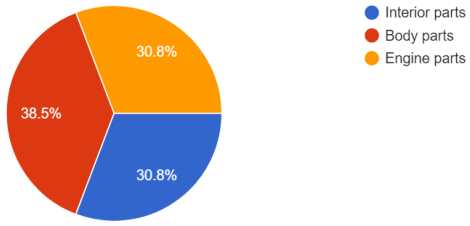
Analysis and Findings of the Survey

After summarising and analysing the data, I deduced the following:

	Number	Percentage
Participants	48	
Males	36	75%
Females	12	25%
Online	13	27%
In-person	35	73%

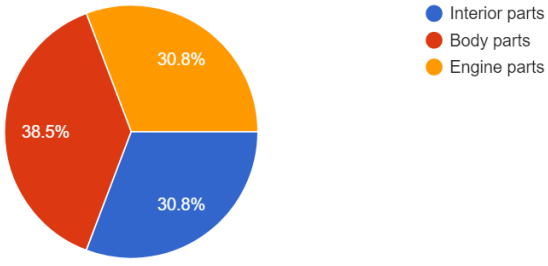
U1: Do you prefer buying car parts online or from local shops?

After summing online and offline responses, the survey shows almost half of the participants use local shops to buy car parts, 23.1% use online platforms, and 23.1% rely on both online and local shops.



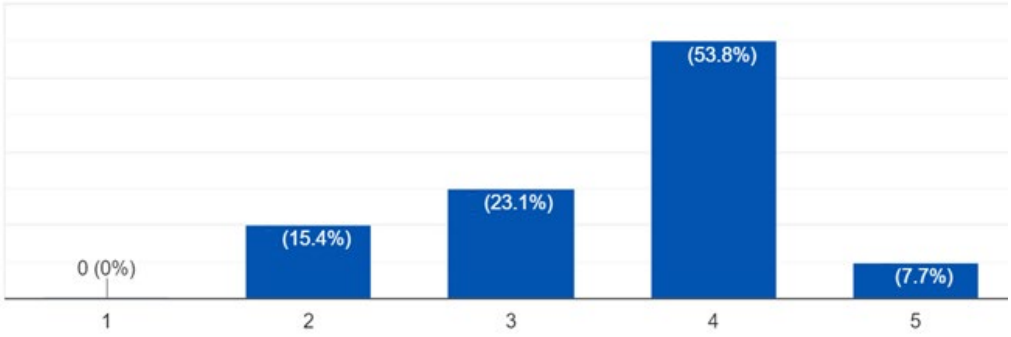
U2: Which car parts category do you normally buy?

The following pie chart indicates there is almost equal demand for all car part categories.



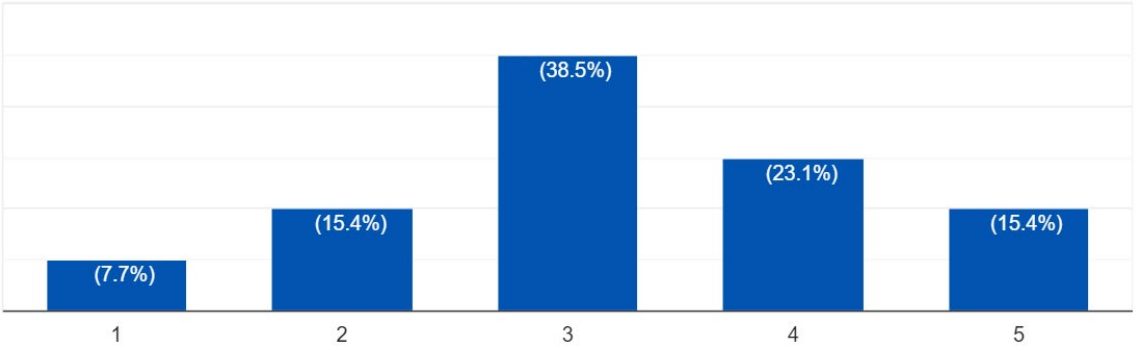
U3: To what extent do you think you pay good value for the money on online car parts websites?

It is noticed that online car part websites offer high-quality products at good prices as 53.8% of the participants think they pay good value for the money.



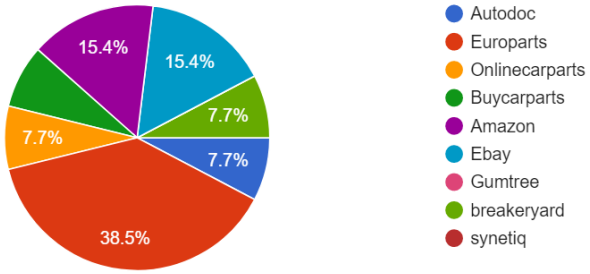
U4: To what extent do you agree you pay good value for the money on local car parts shops/garages?

This chart indicates that the majority of local shops may not have the best prices as 38.5% of car owners agree that they buy car parts at fair prices from local shops, and 11 participants (23.1%) slightly agree with this argument.



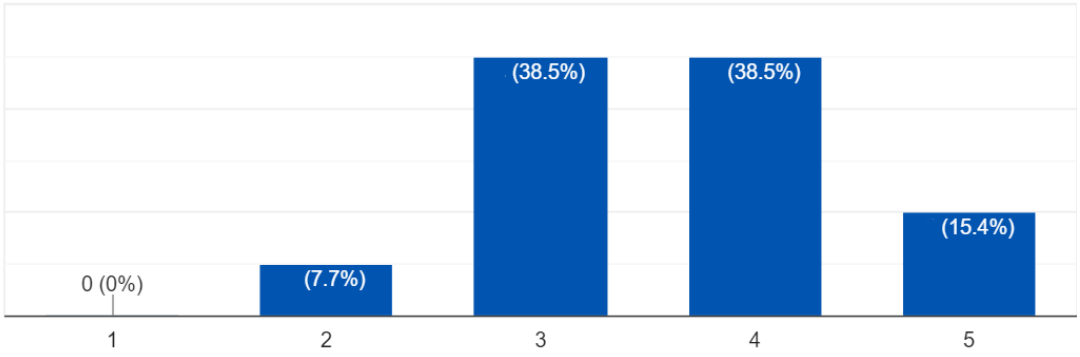
U5: What is the website you normally used when buying car parts online?

The following survey pie chart shows the Europarts website as the most popular one for selling car parts with a percentage of 38.5%. eBay and Amazon come second with 15.4% for each.



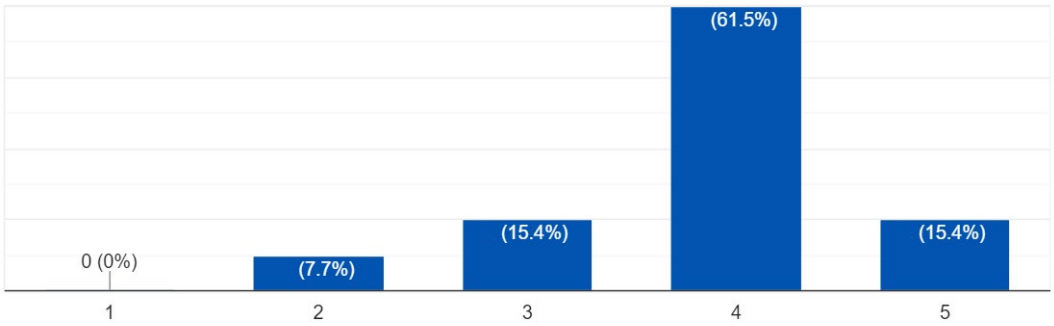
U6: Please rate your experience on the online car part website.

A high portion of the participants gave a high rating for the online platform they use, 38.5% (18 participants) gave a rate of 3 and another 18 participants gave a rate of 4.



U7: Please rate your experience from local car part shops/garages.

The response chart for this question illustrates that 61.5%, 30 of the participants, gave a high rating for the local shop they



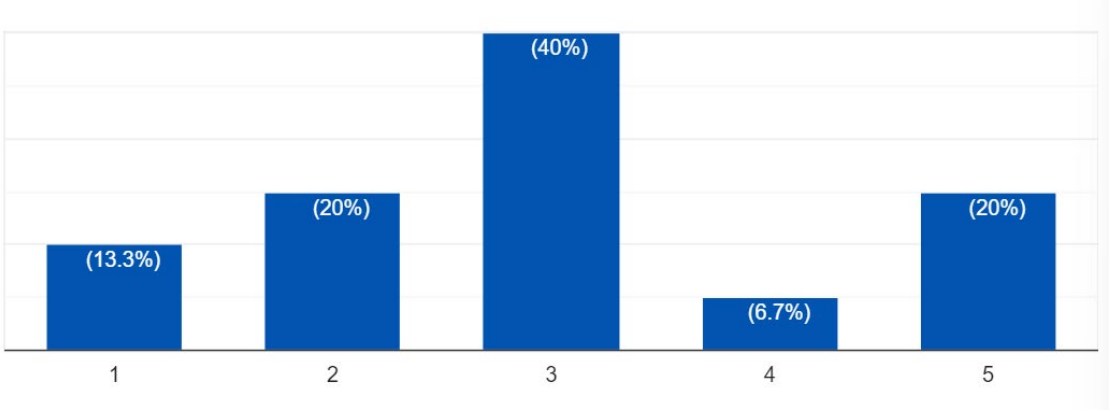
O1: Any suggestions for features or services to improve the car part shopping process?

Some participants asked for better customer service, the sellers should work on improving the rapport with customers. Moreover, they ask for a better refund policy, and features like free fixing or a money-back guarantee are important to customers in case of a car part is not fitting.

After summarising all questions related to H1 and H2 and table comparison (Table 1), my hypothesis about them is not true. The current online and local stores offer a variety of car parts at good prices. I think there is no market gap for car parts and the market could be competitive.

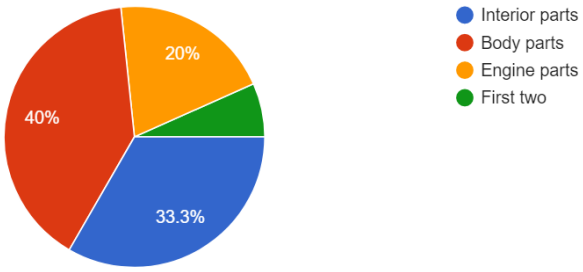
U8: To what extent do you consider buying second-hand car parts?

The chart illustrates that 40% of participants moderately agree to buy used car parts. This could indicate there is a demand in the market.



U9: Which second-hand car parts category do you consider buying?

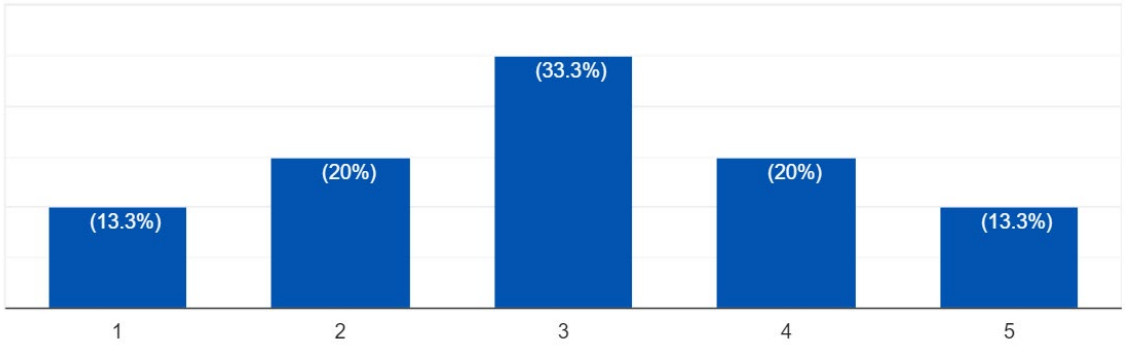
This chart shows that the demand for used car parts is focused on the body parts and the interiors. 40% of car owners would buy second-hand body parts. However, only 20% would buy used engine parts. This chart indicates that buying a used part depends on how this part is critical to the car's performance, buying non-critical parts like body or interior parts could a better deal than the new. However, if the replaced part is critical like engine parts, customers would prefer to buy it new.



U10: To what extent do you think second-hand car parts are good value for the money?

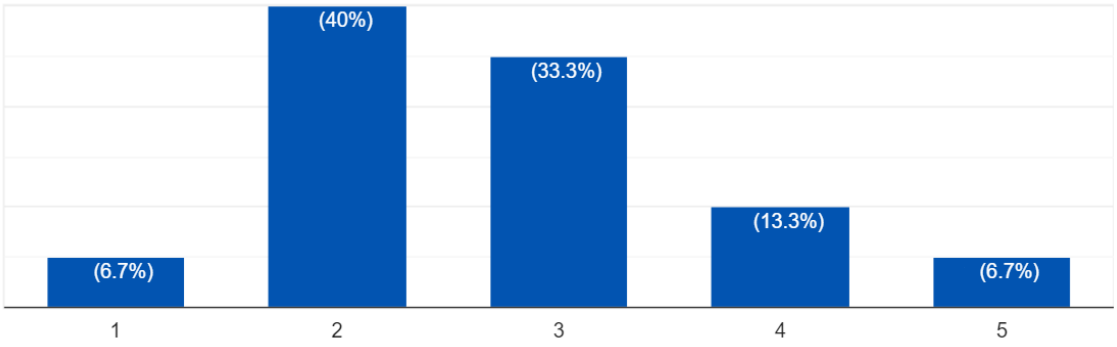
The chart indicates that 15 of the participants (33.3%) gave an average rating for the prices of used car parts. While 9 participants (20%) are either rating of 2 to the price value of used car parts, and a similar portion gave the same rating of 4 to the price value of the used car parts. Compare to U3 about the same question for the new parts from

online stores, 25 participants s (53%) gave a higher rating to the price of the new parts as a better deal. Thus, car owners are would prefer new car parts to used ones.



U11: To what extent do you agree second-hand car parts have good quality?

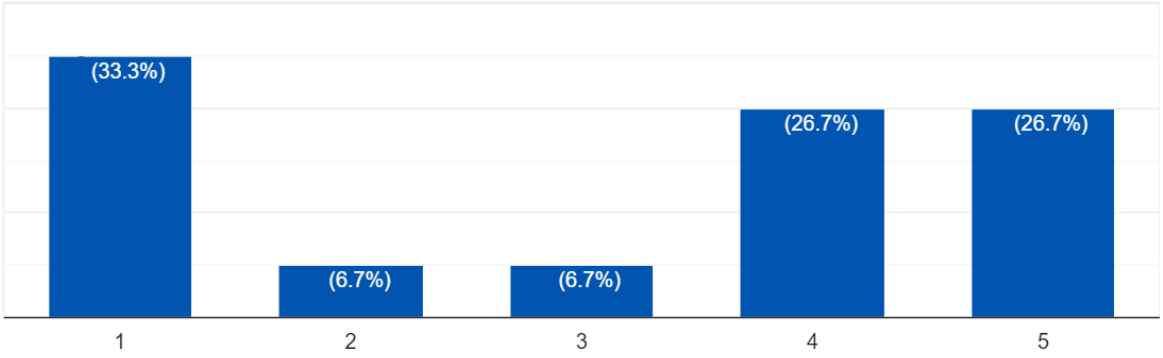
The chart indicates that car owners do not trust the quality of the used parts. The 19 participants (40%) gave a rating of 2 to the quality of second-hand car parts. While only 6.7% gave a 5 rating to the quality of used car parts. I think, this is because the used part could be deteriorated and been fixed before, if the customer could get a new part with a slightly high price, they could have a better deal.



U12: Do you consider buying a second-hand car part (Green Part) for environmental reasons?

These char show that 15 participants (33%) marked a rating of 1 which is an indication that environmental awareness is low. However, a total of 25 participants (each 26.7%)

gave a rating of 4 or 5 which indicates car owners could buy used car parts if they are in a good condition.

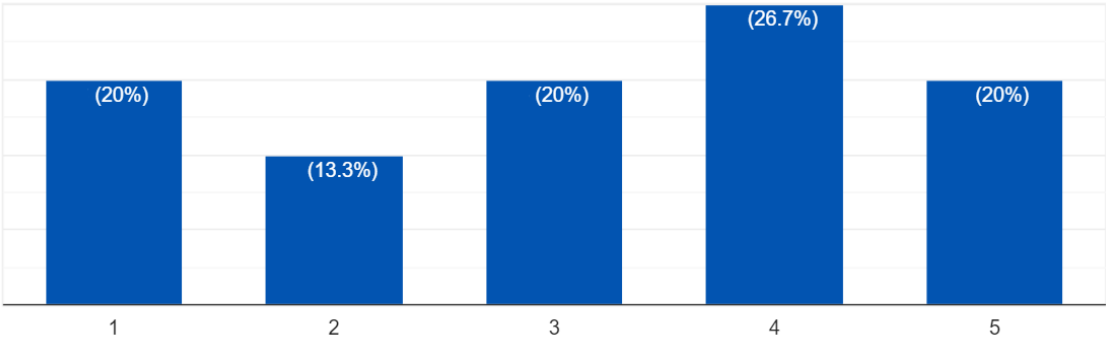


After summering the question of part 2 to test H2, my argument for the demand for used car parts could be true because participants would buy used car parts if they are intact and in proper condition. Many stores test the used car part before selling them to the customer, they could offer a warranty for some used parts.

U13: To what extent would you consider using an online consulting service online or on-site before buying car parts?

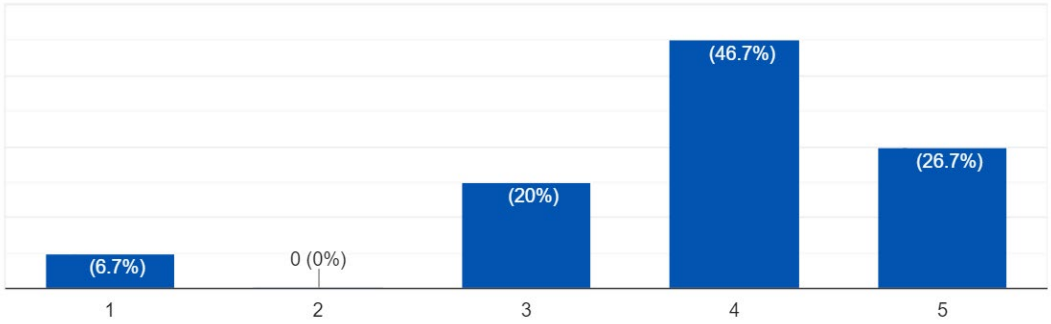
The chart shows that 26.7% of participants slightly agree to use a consulting service before buying car parts, and 20% strongly agree to a consulting service as well. On the other hand, the lower percentage of 13.3% and 20% disagree or strongly disagree with to use of consulting services.

The chart indicates there might be a demand for consulting services from technicians.



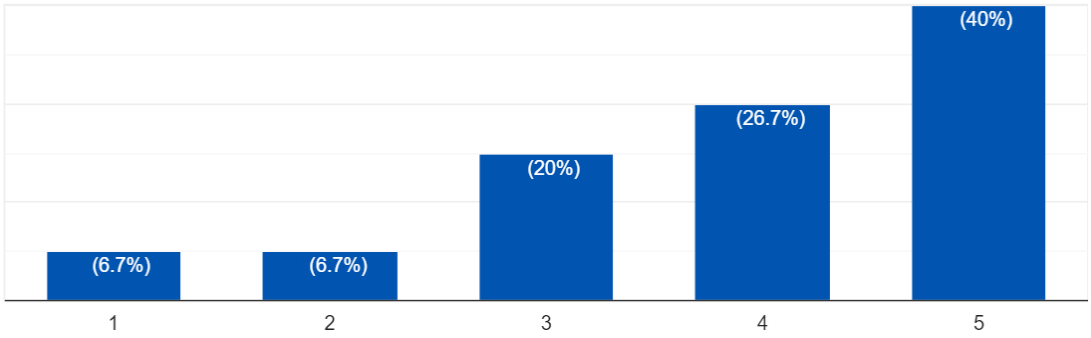
U14: Would you consider using an online car consulting service online or on-site before buying a used or new car?

The chart illustrates that 46.7%, 22 participants, of potential or current car owners could use a consulting service before buying a new or used car. Followed by 26.7% who strongly agree to use consulting services. A low percentage of 6.7%, 3 participants, strongly disagree with to use of consulting services. Compared to U13, there is a bigger demand for car consultants than for technicians because buyers may hesitate to select a car among different brands and dealers, and they would ask for paid advice.

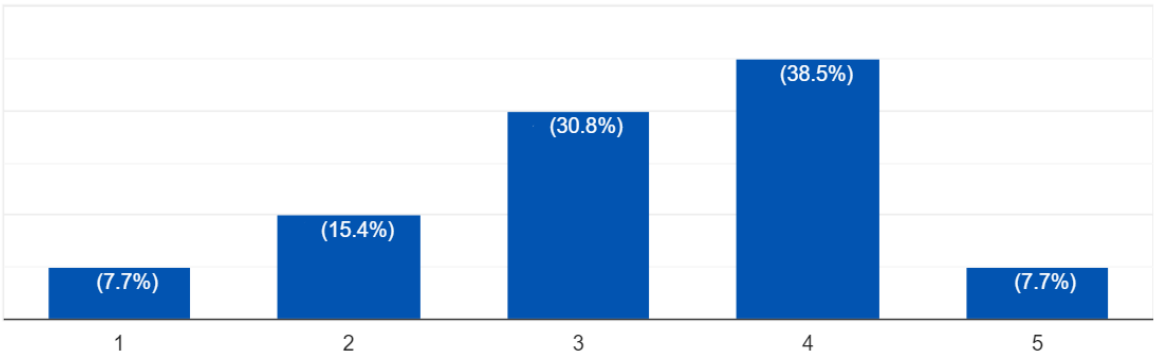


U15: Are you interested to use an online application for a car consulting service before buying a car or car parts?

The chart shows there is potential high demand for my argument for an online consulting service which connects car owners to technicians and car experts.



U16: Please rate your previous consulting service if you have used it before.



O2: Please describe if you have used a consulting service before, and how it could be improved.

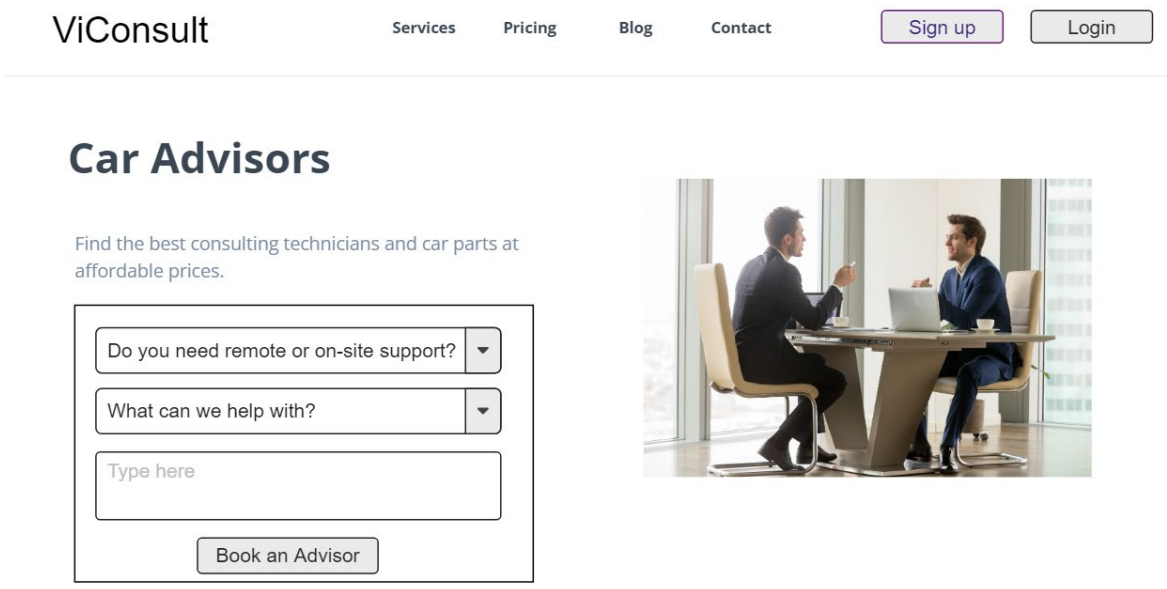
Car owner participants would like to improve the way of communication and the response time. Furthermore, a participant asks for clear terms and simple language. I will that into consideration while designing the web platform.

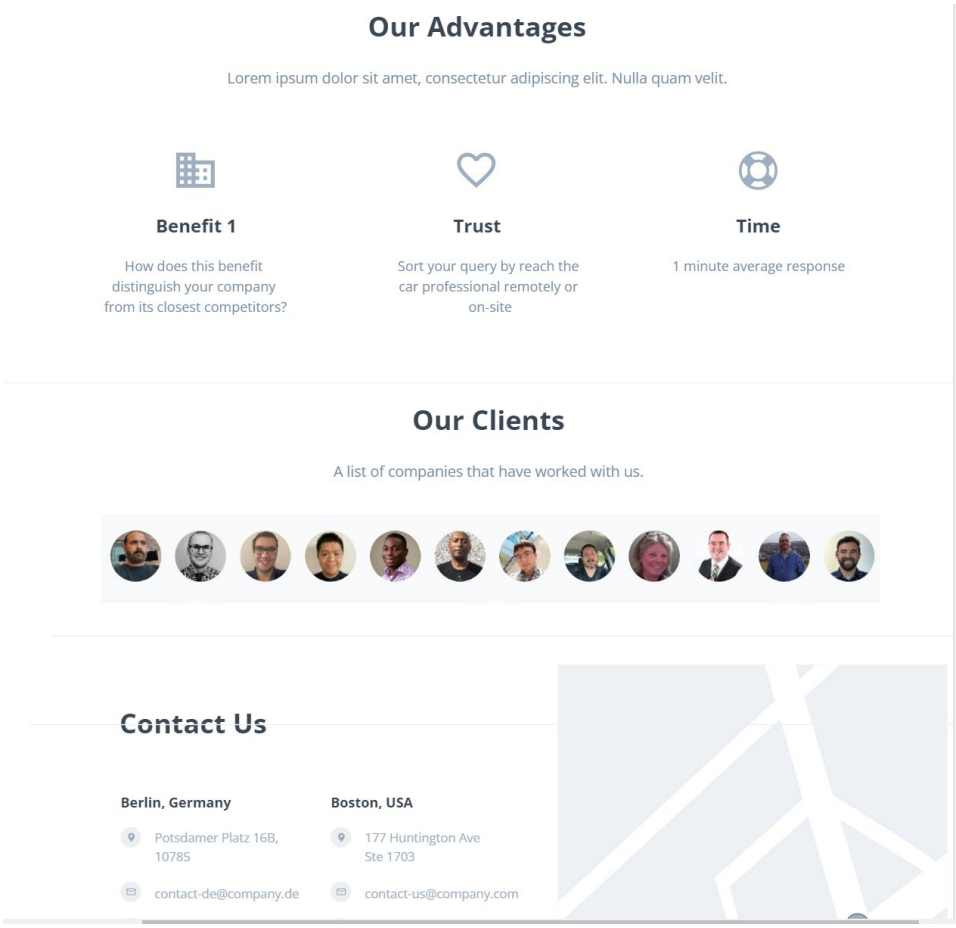
O3: Any suggestions for the online website I am developing for car parts and consulting services?

A participant suggests using a user-friendly interface, and the platform should focus on building a community and being consistent with customers.

The section of the questionnaire is designed to indicate the potential for car consulting services. The responses indicated there is a demand for the car consulting service. This service will be a win-win situation for both car experts who can give advice or recommendation and for the car buyers who may pay for professional advice.

Mock-up. This is an initial design for the online platform, it will be responsive and offer online or on-site support for car issues, and offer consulting services for those who would like to buy new or used cars.





Conclusion

I used both a qualitative and quantitative approach to test my argument for the online platform. The comparison is done among 12 different online stores to analyse the main features and to find a new feature I can add to this market. About 48 participants contributed to the survey which is conducted to test my hypotheses about if there the current online dealer offers prices of good quality, I used rating scale questions and Likert questions to test my argument. Moreover, I asked open questions to give the participants to think and suggest new ideas that could be implemented and add value to the website I will build. I found that customers are satisfied with the current online and local stores and there might not be a space to compete in selling car parts. Regards, second-hand car parts, these products are demanded especially the body parts and interior parts which do not deteriorate with time, unlike engine parts. Furthermore, I found out that there could be demand for the consulting service which will be a pool of car professionals such as car consultants and technicians.

Hence, I will just focus on building a website that offers car part products and additional advisory services. The website will enable clients to find car parts more easily and contact car technicians if they need further help. according to the open question O3, I will make the website interface intuitive and simple. I will also try to minimise the response time after a customer submits his enquiry. In addition, I will make use friendly with clear terms for payment. The car advisors will be paid based on the time they spend with the customer sorting out his query. The website could also include other vehicle professionals in motorcycles, electrical bikes, or trucks.

Limitation and Bias

In the first comparison, I have not considered all factors related to the user interface and user experience for each website which may affect the overall assessment for each website. In the questionnaire, the age of the participant has not been considered while doing the study. The majority of participants are males and the female number is much lower, this may skew the study results. In-person contributors are from Southampton only, which may not reflect the opinion of people in other areas.

Literature Review

Project risk analysis has been used in production by auto manufacturing companies to increase their capacity to reduce supply and demand unpredictability. Manufacturing companies must invest resources to develop and design automobiles following the needs of potential customers to produce an automobile that is well received in the market. Risks that stress the management of vehicle manufacturing companies include going over budget, having extended lead times, political instability, company that does not create yields, and final goods that do not meet consumer expectations. To reduce these risks and assure the success of new vehicle development projects, automobile manufacturers and vendor businesses must collaborate. Manufacturing companies should also think about how to abide by environmental laws and keep a positive reputation in the marketplace. The natural environment and global environmental issues have evolved over the past ten years into a difficult problem for commercial enterprises that affects their operations. Companies that produce cars should be able to anticipate customer expectations. By insisting on design changes, especially ones that are made after the project has already begun, customers may unnecessarily delay project completion. These adjustments may have, however, been anticipated and added to the design process sooner. Customers frequently confuse the project process without fully understanding how their actions affect the timeline and cost of the project. Being aware of these problems, project managers' needs should take precedence over the influence of functional managers and customer directors. Others advise creating governance frameworks that explicitly state the costs of making last-minute design changes. According to research findings from the German automotive sector, green supply chain management (GSCM) will be more crucial for automakers. Green business strategies can increase company survival and lessen the high-cost issue that automotive manufacturing companies face. To resolve concerns about the sustainability of its supply chain and achieve corporate sustainability, the US automobile industry is considering the Triple-C (ceasecontrol-combine) strategy. Another instance in Japan is the remanufacturing and reconditioning of second-hand cars, which has its trend. Manufacturing companies are encouraged to employ closed-loop supply chain

management due to the focus of vehicle manufacturing companies on a specialised market for used cars in emerging markets. Long-term advantages could result from increased demand from developing nations and lower raw material prices. A Japanese automaker does not have to pay recycling, reuse, or disposal taxes when exporting used cars. (Fernando *et al.* 2018)

(Frooition 2022) pointed out important factors required for every car parts website, every car parts website should have a search by year, make, and model to assist clients in finding the proper item. These factors are described as follows:

- Accuracy: When you use the Auto Care ACES standard, you'll get the most up-to-date car data for your auto components. Show clients in their search results which automobiles your parts fit.
- Speed and performance: Depending on how the drop-downs are populated, a poorly integrated year/make/model part lookup solution could take a long time to load. By utilising a solution that is geared for speed, you may reduce the risk of losing potential clients who are disappointed by a slow, clumsy lookup experience.
- Scalability: As your company grows, you'll be able to add more vehicle components to your inventory. As the number of database items increases, you'll need a year/make/model part lookup solution that can keep up.

Ethics and Data Privacy:

Both people and society depend on software in one way or another. The software must represent human values like freedom, equality, social justice, and privacy because these things are a part of everyday life. On the other hand, software that disregards human values may result in unfavourable events, such as the loss of priceless human lives or billions of dollars in lost earnings for businesses. For years, SE has been investigating a limited subset of human values that have a moral connotation (privacy, fairness) or are connected to software quality (security, dependability). Software regulation is a tool used to tie software development to various requirements, such as safety standards in

safety-critical software used in specific aerial systems through DO-178c [7], the protection of health information through laws modelled after HIPPA [8], etc. Some of these laws are motivated by human values like security, safety, or privacy. To protect the user privacy of EU individuals, the European Union (EU) has unveiled the General Data Protection Regulation (GDPR). (H. Perera *et al.* 2019)

Additionally, GDPR suggests data protection principles and data subject rights as a manual for implementing the correct degrees of user privacy in software. One of the data protection principles, for instance, requires that user data not be kept for any longer than is necessary. One of the rights of the data subject, the right to erasure, is connected to the principle of storage restriction. This right enables users to ask for the deletion of their data in cases where "the personal data are no longer essential," "consent has been withdrawn," "data have been treated unlawfully," and other circumstances. Thus, GDPR aids in breaking down a complex concept like privacy into simpler software specifications. Think of trust as an example. Users' trust in a software system is influenced by how transparent it is. One of the GDPR's data protection tenets is transparency. The GDPR specifies a number of measures, such as "informing the purpose of data processing at the time of data collection," "allowing users to get a copy of personal data with data controllers," and "allowing users to amend wrong data without delay," and so forth, to achieve transparency. This breakdown demonstrates how GDPR aids software professionals in understanding privacy and trust in software development. (H. Perera *et al.* 2019)

The GDPR act has a total of 173 recitals and 99 articles. The GDPR rules are outlined in the articles. One or more recitals provide additional explanations for each of these articles as well as their practical implementations. To ensure the privacy and protection of users' or citizens' data, also known as data subjects' data, a series of articles and recitals explain data protection principles and data subject rights. The six principles set forth the primary requirements that businesses must follow while gathering, handling, and storing personal data. Furthermore, the GDPR grants data subjects nine rights to exercise control over their personal information. By exercising these rights, data

subjects can make sure that their personal information isn't being used for anything other than what it was intended for when it was first obtained.

The GDPR's guiding principles were presented in an ambiguous way that makes it challenging to apply in real-world situations. For instance, the first GDPR principle, "personal data shall be treated legitimately, fairly, and in a transparent way about the data subject," states that personal data "shall be processed." This is a difficult-to-understand abstract idea. Providing more information on the circumstances and scenarios that these principles apply to, recitals and rights that are consistent with such principles aid in their interpretation. However, no prior research has connected GDPR principles to rights. As a result, we suggest connecting the GDPR's data protection principles to the rights of the data subject. (H. Perera *et al.* 2019)

Implementation

While the technology underlying cloud-based apps served as the impetus for the new paradigm, software engineers soon realised a new type of web-based application would require its own set of platforms. This necessitates that the platforms be practical, testable, adaptable, configurable, and maintainable in a cloud context. These platforms have been referred to by a variety of names over the years, including web-based, full-stack, net-centric, cloud-based, client-server, Software-as-a-Service (SaaS), and frameworks for cyberinfrastructure. Each of these words denotes a different class of web-based software with unique features and goals. Despite this, each term achieves the same fundamental goal of offering services over the Internet for consumption by a client, who may be a multimodal consumer. (K. Schutt and O. Balci 2016)

The.NET designation was given to all web-based technologies during development because Microsoft's .NET framework was created with network-centric architectures in mind from the start. When creating a.NET application, C#, ASP, and to some extent F# are the preferred languages. These apps have the advantage of being quickly and readably deployed into a Microsoft environment that uses Internet Information Services and is scalable and simple to maintain (lIS). Furthermore,.NET has a sizable developer community, which makes developing.NET applications much simpler. The server- and

client sides of Node.js are both written in JavaScript, making it the most distinctive web-based framework currently accessible. Although it is still in its infancy, Node.js offers an intriguing example of how a web server ought to operate by using an event-driven architecture rather than a multithreaded one. By utilising event-driven programming, Node.js can easily handle millions of queries, unlike other platforms. Python is a fascinating language that has grown in popularity recently because of its straightforward syntax and prevalence in non-technical schools. The entry hurdle for new and nonprogrammers alike has been lowered by the emergence of Python modules and wrappers for numerous complicated and scientific applications. One such platform is Django, which offers software engineers a framework that adheres to the convention-over-configuration and the MVC architecture pattern in a way that makes the concepts understandable to developers with less formal training. Although this paper focuses on Django, there are other alternative Python frameworks and extensions that make it simple to access different parts of a client-server architecture. (K. Schutt and O. Balci 2016)

Selecting Web Framework

I will compare 3 web frameworks: .Net Framework, NodeJS, and Django, and then I will select a framework to develop the online platform that meets the project objectives.

.NET FRAMEWORK, MICROSOFT PLATFORM. A client-server architecture built on the.NET framework is shown in Figure 3. A variety of languages, including C# or Visual Basic (VB), can be used to generate code-behind web pages and web services for.NET web applications. It varies from scripting languages like Python in that it can be executed on the common language runtime (CLR) engine, which can offer further performance advantages, after being compiled to Microsoft Intermediate Language. (K. Schutt and O. Balci 2016)

1. Client: Similar to most other web application frameworks, .NET supports HTML, CSS and JavaScript to properly display the content to the user. Similar to Java EE, .NET applications also support XHTML, which is a well-formed XML-based markup language. Depending on the implementation of a .NET application, the

output data format can vary depending on the client. A .NET application can output HTML formatted data to be displayed by a browser, or, as a .NET web service that outputs XML formatted data to be ingested by a client application. A .NET web service can follow either the RESTful or SOAP paradigm depending on its implementation. (K. Schutt and O. Balci 2016)

2. The second stage of the web tier involves sending the request to the appropriate web page for processing, regardless of the web server. Depending on the web application and.NET version being utilised, there are two distinct ways to handle routing in.NET applications. A direct request for a web page using the VRL is the first method. A specific page defined by the URL path is requested by the web server and displayed to the user. The user receives a 404 page not found error message from the web server if a page is missing. Dynamic routing defined in a.NET MVC web application is used in a second way. Because of the processing of the URL path, enables the developer to define data-driven web pages. (K. Schutt and O. Balci 2016)
3. Business: There are numerous components, extensions, and objects in the business tier of.NET applications that can be used and developed in design code or code-behind files. This can range from straightforward VI components to intricate application-specific logic. To reduce code reuse and improve modularity for both VI controls and application logic, modules and components can also be added to web applications. Although there isn't a single location where.NET modules and components are kept, many can be accessed by using Google or the Microsoft Developer Network (MSDN). (K. Schutt and O. Balci 2016)
4. Data Mapping: Although Microsoft advises Entity Framework for apps, ADO.NET serves as the primary data persistence layer for.NET online applications. Because it only uses specific data structures and relies heavily on the developer to configure much of the SQL and data access, ADO.NET is not a true object-relation mapper (ORM). Other ORMs, such as Entity Framework and Fluent NHibernate, are available for RDBMS that are more capable and simpler to manage. The convention-based implementation of an object that represents relational data is

significantly superior to that offered by any of these extensions, each of which comes with trade-offs of its own. To make dealing with database objects more readable, some ORMs also enable LINQ.

5. Data Sources: SQL Server is the main data source for.NET web applications, but other relational databases like MS Access, SQLite, MySQL, DB2, and Oracle (via the Oracle Client data provider) are also supported. Data sources like MongoDB can also use NoSQL support. With the Object Database Connectivity standard (ODBC), Microsoft also offers additional adapters and drivers for non-traditional data sources such as spreadsheets, object databases, and Microsoft Access. (K. Schutt and O. Balci 2016)

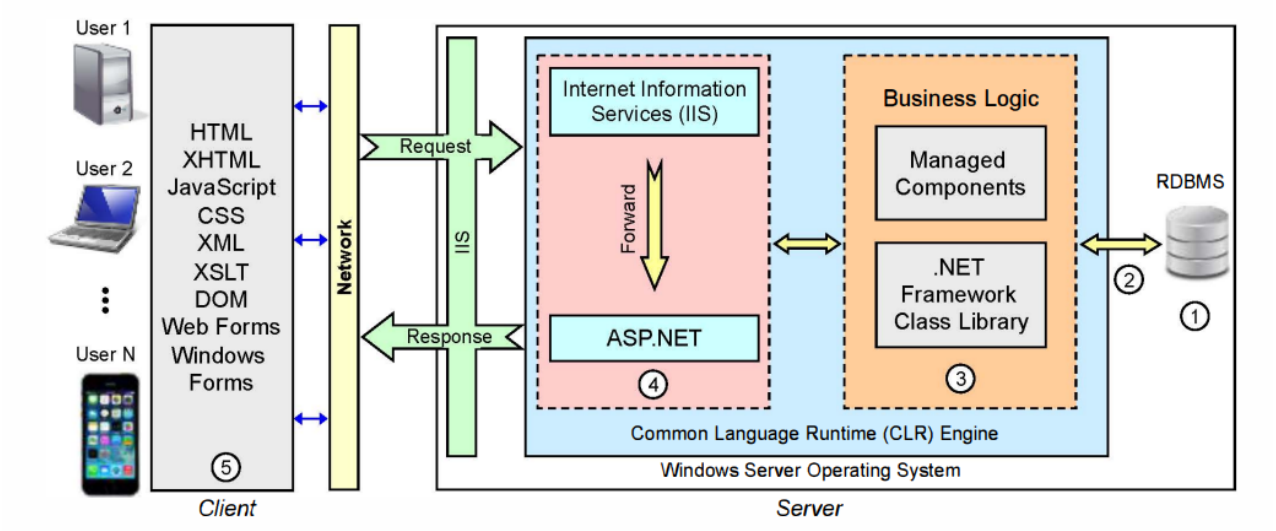


Figure 3 .NET-based Client-Server Architecture (K. Schutt and O. Balci 2016)

NODE.JS FRAMEWORK. Figure 4 depicts a client-server architecture with five levels based on the Node.js framework. A web application framework called Node.js was created entirely in JavaScript for the server-side and client-side. This overview stands out since it was written entirely in the same language from the front end to the back end. Only client-side JavaScript is used by other frameworks that have been considered. This design decision lowers the entry barrier for developing web-based applications as a developer just needs to invest time in learning one language. Node.js can be used as an independent web server or in conjunction with Apache or Nginx. When a properly formatted URL is sent to a Node.js application, the web server receives the request. The user-defined router receives the request and forwards it to it. To carry out a business operation, the router sends the request to the designated controller and action. The database may need to be accessed for this action via the data-mapping layer. Typically, the Node.js data-mapping layer is written as a JavaScript object (the schema of which is dependent on the JavaScript data mapping framework employed by the user). The response is then transmitted back to the web tier, where a templating engine like Jade creates data-driven webpages to be shown to the client after the business transaction is finished. (K. Schutt and O. Balci 2016)

1. Client: To show a webpage, the client-side code needs to employ HTML, CSS, or JavaScript. Another possibility is that the client invokes an API. Several client-side JavaScript frameworks, such as Angular.js and Backbone.js, can be used by Node.js applications to build dynamic webpages. The additional advantage of Angular.js is that it is a client-side MVC/MVP framework, enabling the web application to be a straightforward API that can be digested by Angular.js to build dynamic webpages on the client side. This significantly reduces the amount of rendering that typically takes place in the web layer when employing server-side templates.
2. Web: In most cases, Node.js acts as the web server and manages the web tier. If needed, it can run in the background of Nginx or apache. Node.js is an event-driven web server that can register with the operating system and handle requests coming into the web server. It was created using the Google V8

JavaScript engine. The Web tier, like other architectural layers, serves two purposes: it routes incoming requests and creates template HTML documents to send to the user. Routing can be specified for Node.js by a wide range of different frameworks, with Express.js being the most durable.

3. Business: A Node.js application's business tier can make use of a variety of JavaScript frameworks to speed up application development. As long as they are written in JavaScript and can be processed by the Node.js web server, the developer can also construct their classes. The well-known frameworks are Backbone.js, Spine.js, Express.js, and Socket.io. Although each of these frameworks has a unique implementation approach, they are all designed to offer a potent sandbox in which to execute business logic. Many of these tactics are based on event-driven networking, model- and data-driven web pages, and asynchronous user interfaces.
4. Data Mapping: Depending on the kind of database being used, Node.js offers a wide range of data mapping frameworks. These frameworks may be designed for MongoDB using mongoose or a SQL database using Sequelize. Additionally, Node ORM, though still in its immaturity, supports both SQL and NoSQL databases.
5. Data Sources:

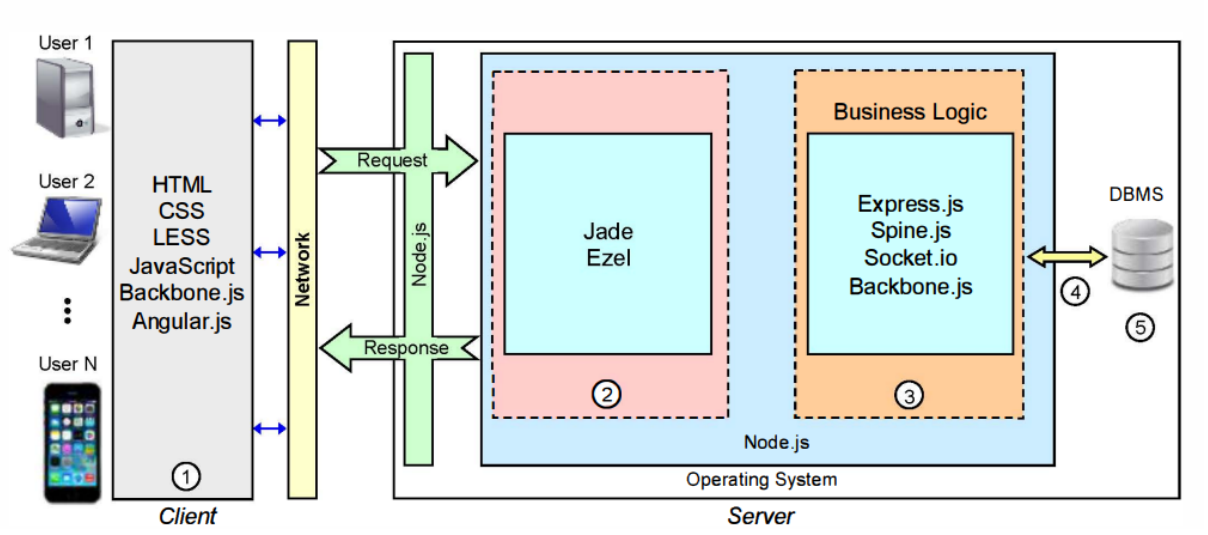


Figure 4 Node.js-based Client-Server Architecture

DJANGO (PYTHON) FRAMEWORK. Five tiers of client-server architecture built on the Django (Python) framework are displayed. Python is swiftly rising to the top of the list of languages used in a variety of fields, including statistical analysis and Geographical Information Systems (GIS). Python has also been used to develop several web application frameworks, including Django, Flask, and many others. Although Python is typically thought of as a high-level procedural language, it has evolved into a dynamically typed multi-paradigm language that can be used to address a wide range of programming issues on all significant platforms. This paper gives a quick overview of a Python CSA utilising Django, one of the more sophisticated and feature-rich web application frameworks for Python. Django adheres to the MVC architectural pattern and offers many of the same components as many of the other frameworks mentioned. (K. Schutt and O. Balci 2016)

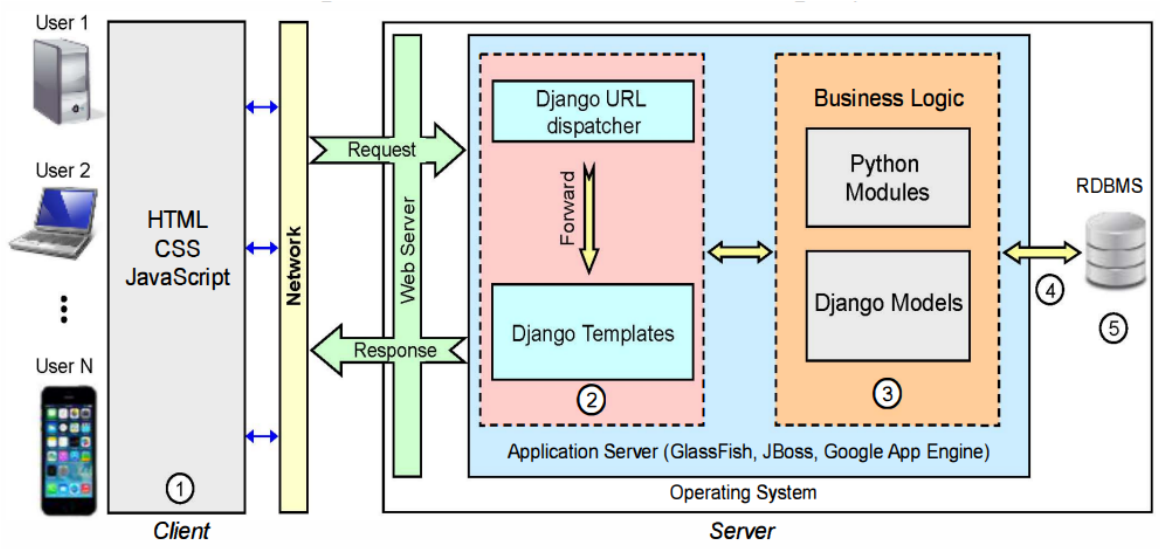


Figure 5 Django (Python)-based Client-Server Architecture (K. Schutt and O. Balci 2016)

There are various ways to deploy a Django-built web application, including GlassFish and WildFly. The web server receives the initial request made by a user on a client device. While deployments into a production environment typically need Apache or Nginx with a Python extension, Django comes with a built-in web server for development and testing. After receiving a request, Django's URL dispatcher, which is highly flexible but has fewer functionalities than a full-featured router, receives it. The view, which in this

case serves as a controller, receives a call from the dispatcher's function. The view makes use of any included Django models and Python modules. The Django Models are then translated to a database management system (DBMS), which may be relational or document-based. Control shifts back to the view after the business logic is finished, which invokes the template code that is specified in a Django Template. The user is presented with HTML, JavaScript, and CSS generated by these templates. (K. Schutt and O. Balci 2016)

1. Client: To show a webpage, the client-side code needs to employ HTML, CSS, or JavaScript. Another possibility is that the client could invoke an API. Python web frameworks are ideal for converting data to JSON or XML that can be used by a client-side native application.
2. Web: To manage incoming requests, Django (and other Python frameworks) employ a straightforward URL dispatcher. In some circumstances, running a particular function to build a page serves as the URL dispatcher. In contrast to Node.js, the URL dispatcher does not offer a complete router to handle requests; instead, it just matches regular expressions. Django Templates are views that create data-driven websites using the Django Template Language. Once the syntax and extension system is established, these templates are very expandable and reusable.
3. Business: The real power of Python may be seen in the business layer of a Python-based framework due to the expansion and maturation of numerous high-profile and potent modules created in Python (or, at least, a Python wrapper). Given Python's current condition, there isn't much it can't do. Complex numerical and statistical analyses, as well as calculations that were previously handled separately by R or MatLab, are now possible thanks to modules like NumPy and SciPy. The Django business tier offers a data model schema that can be used to rapidly access data in an object-oriented way and lets developers incorporate any Python modules. Depending on the business necessity being addressed, these modules and models can operate independently of one another.

4. Data Mapping: The number of modules available to help developers link a model to a database entity, whether it be relational or document-based, is as plentiful as the business tier. SQLAlchemy and Django's ORM are the commonly used mappers for relational databases. PyMongo is used as the ODM for mongo. Additionally, Django can utilise the data mapping to Google Datastore when running on Google App Engine. In addition, Python can use GlassFish and JDBC to enter data.
5. Data Sources: Django supports nearly all of the major relational and document-based databases, similar to other web application frameworks. These include MySQL, SQLite, PostgreSQL, and other relational databases. NoSQL and document-based databases, MongoDB and Google Datastore are examples of this. Again, any database can be used as long as the developer can make the appropriate data mapper.

The cloud-based application might make sense to use Node.js with a relational database if the staff have more knowledge of JavaScript and SQL and the issue requires high throughput processing. This is a crucial aspect to remember when designing a software system of systems in the cloud since it takes into account both functional requirements and more esoteric, non-functional requirements. While there are fewer possibilities for.NET, it is rather simple to find several types of UI extensions for Django. (K. Schutt and O. Balci 2016)

(Adrienne Domingus 2021) mentioned reasons for selecting Django Framework are open-source and support third-party libraries. Strong object-relational mappers (ORM) that make it easier and more secure to communicate with your relational database. The Django Admin panel offers basic CRUD (Create, Read, Update, Delete) capability that you may use until you've designed your interface, allowing you to launch an MVP more rapidly. If you need to slightly increase the functionality, you can also add custom views and templates to it. Django is fairly feature-rich, thus it is probably unnecessary if you only require a few web endpoints or a static website. Flask might be a nice option if you want something more portable or don't require an ORM but still want to build in Python.

Though it's not nearly as easy to learn as Python, the best programming language for people just starting, C# has a comparatively low learning curve when compared to more complicated languages like Java. Developers with intermediate to advanced coding skills might choose C#. (Pluralsight 2019)

The web framework for perfectionists with deadlines. It promotes quick development and straightforward, practical design, allowing you to concentrate on building your programme without having to create anything from scratch. One of the best Python web frameworks is Django, which routinely tops the list of frameworks to learn while building web applications. (GeeksforGeeks 2022)

Django and NodeJS would be suitable to develop my web application. Since I have better fundamentals with Python. I will select Django because it has a fast learning curve and because I have to develop my web application in a short time.

Selecting Database:

The choice between PostgreSQL and MySQL when selecting an open-source relational database management system is crucial. Both PostgreSQL and MySQL are tried-and-true database management systems that can compete with business solutions like Oracle and SQL Server. PostgreSQL is frequently referred to be an open-source version of Oracle since it has many more advanced capabilities than MySQL, which is known for its simplicity of use and speed. (postgresqltutorial 2022)

I will use the Postgres database as it supported by Django ORM

Entity Relation Diagram. The system includes users who can post products, one to many. A user can also ask for advice, one too many, and tag a product. Each Product has a title description, price, and a car model. The product table has a one-to-many relationship with the car brand table. The advice has the user id and advisor id who is selected to give advice. Each Advice might have multiple replies that represent the conversation between the user and the advisor.

Application Features:

1. Users can log in (using email & password) and sign up
2. User create/view/delete/update product
3. Users can ask for advice from other users
4. An advisor can reply to the advice request
5. User has full name, email, password, interests, phone number, summery
6. The product has a title, image, description,

Application URLs:

(/home page) (/products) (/crerate_product) (/update_ product/<product_id>) (/Advices)(/ask_advice) (/reply_advice) (/user_profile) (/update_profile) (/update_password)

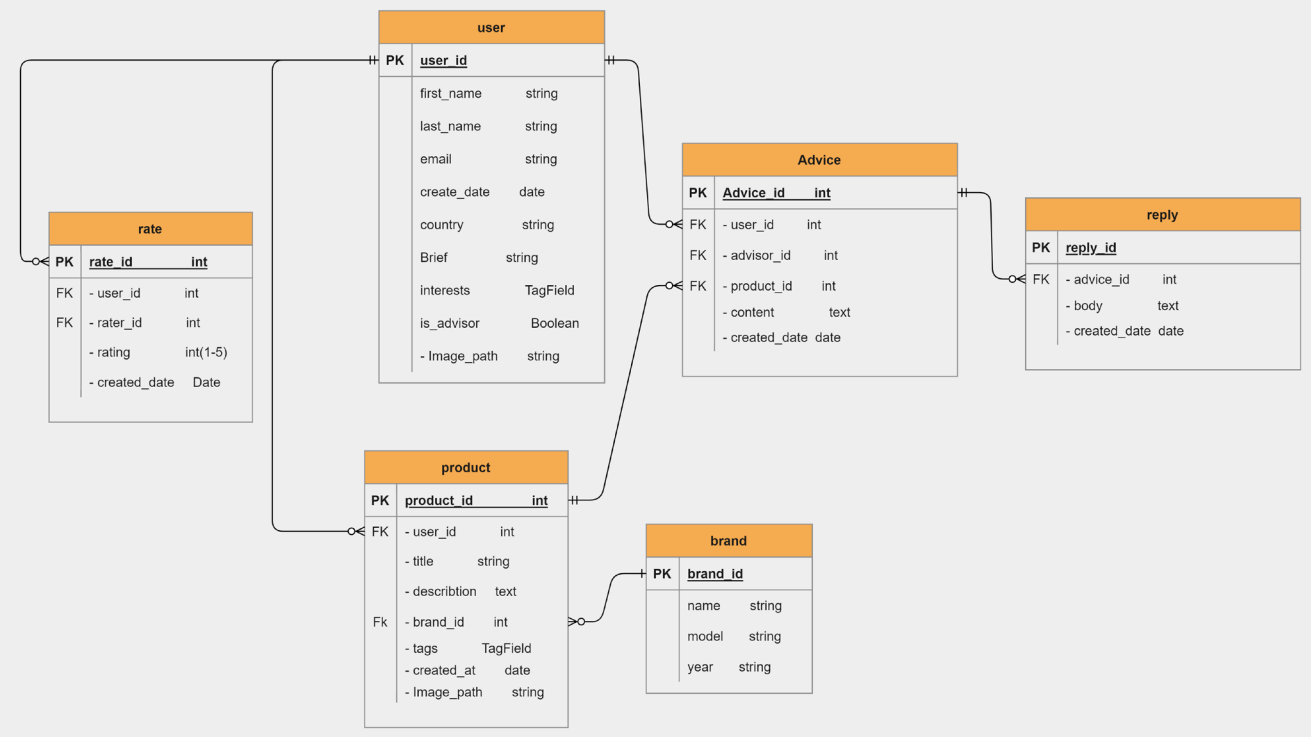


Figure 6 Application Class Diagram

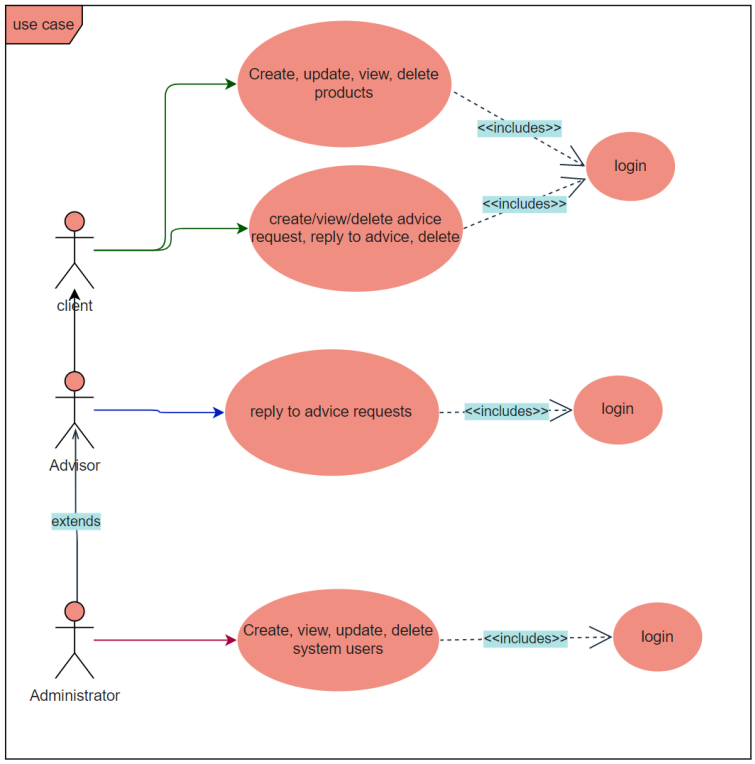


Figure 7 Use Case Diagram

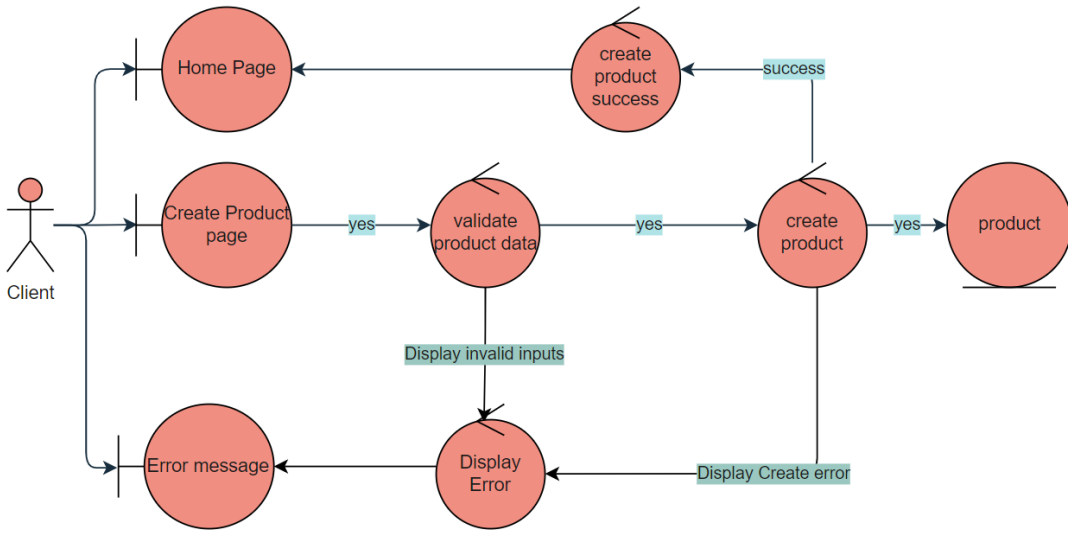


Figure 8 Robustness Diagram 1

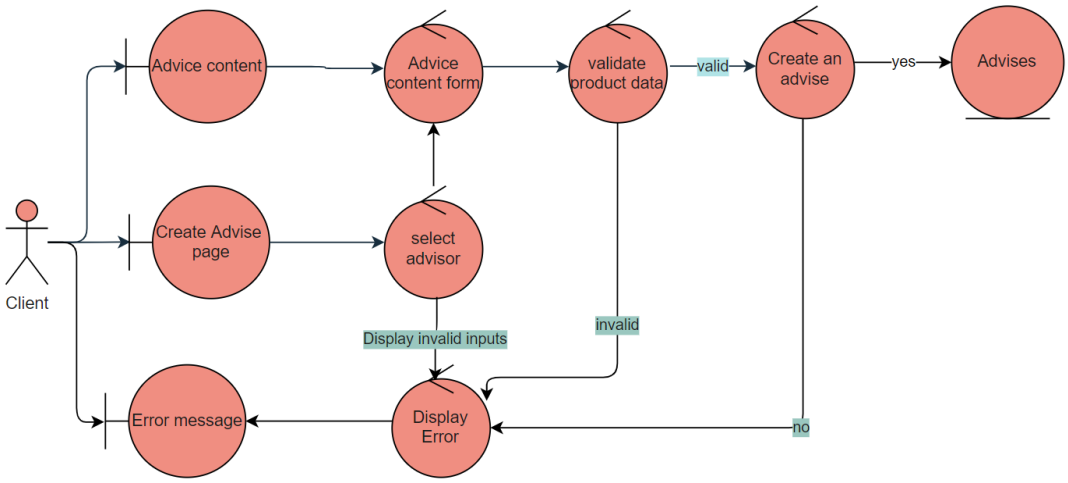


Figure 9 Robustness Diagram 2

Final System

The home page in Figure 9 displays the main services of the application and why to Choose Car Advisor. The page is responsive and works on smartphones. On the landing page, users could identify the immediate benefits of the application and what it solves such as saving time and money by getting a professional consultancy service for car parts. Taking into consideration that the UI/UX is not the main area of research during the implementation and I used standard bootstrap design.

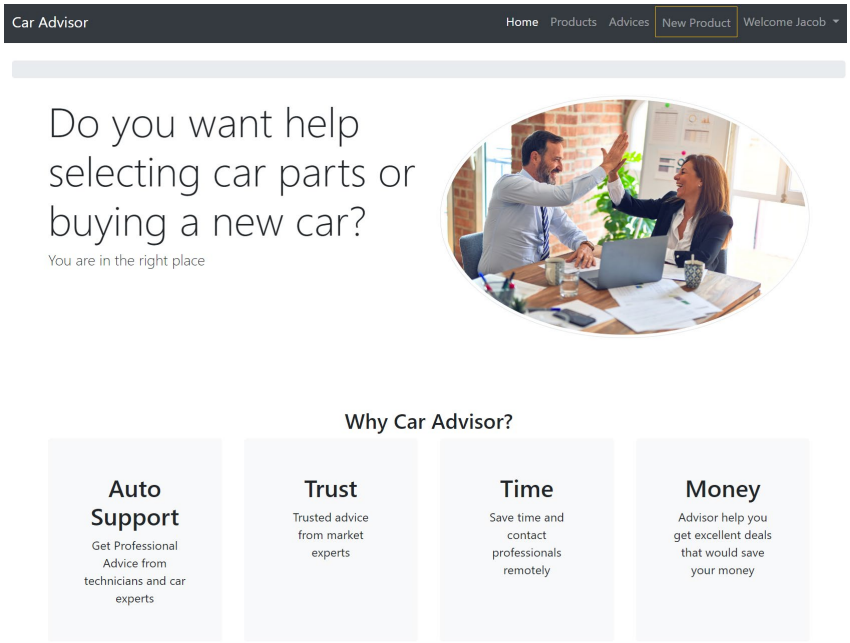


Figure 10 Home Page

The client can add a product and decide title and description and the car brand, shown in Figure 10.

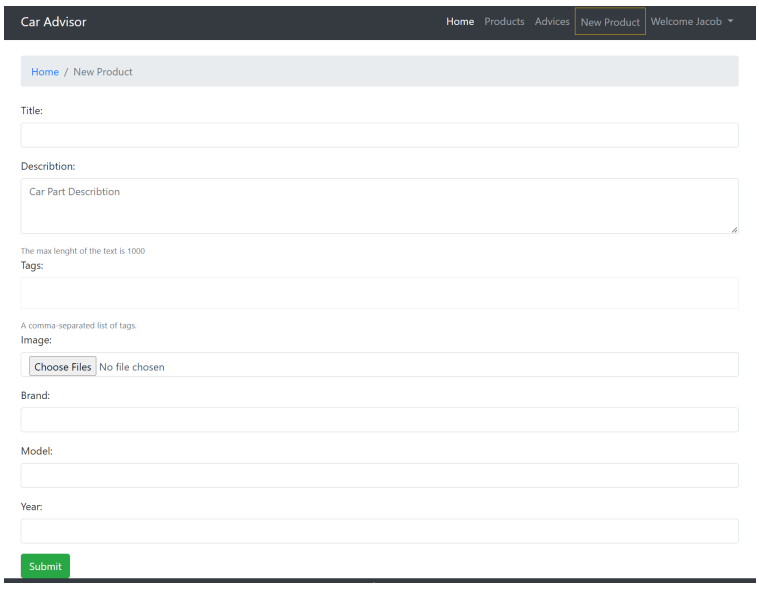


Figure 11 Create Product Page

The client users can view created products and ask for advice or update the product details, Figure 11.

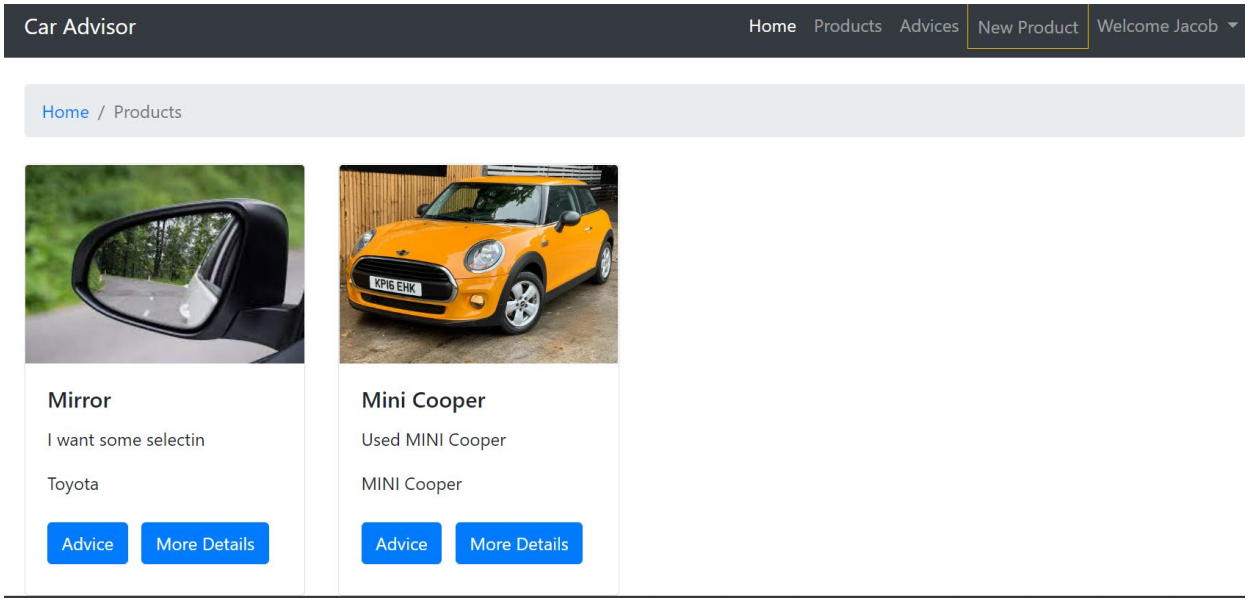


Figure 12 User Product

The advice button from Figure 11 pops up a window to submit advice content.

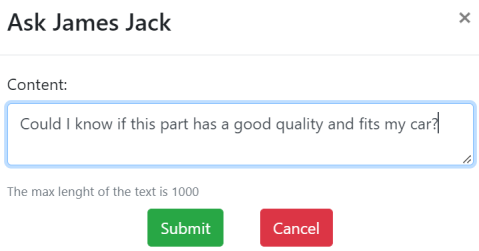


Figure 13 Ask for Advice

The client user selects an advisor based on the advisor's profile and his/her experience.

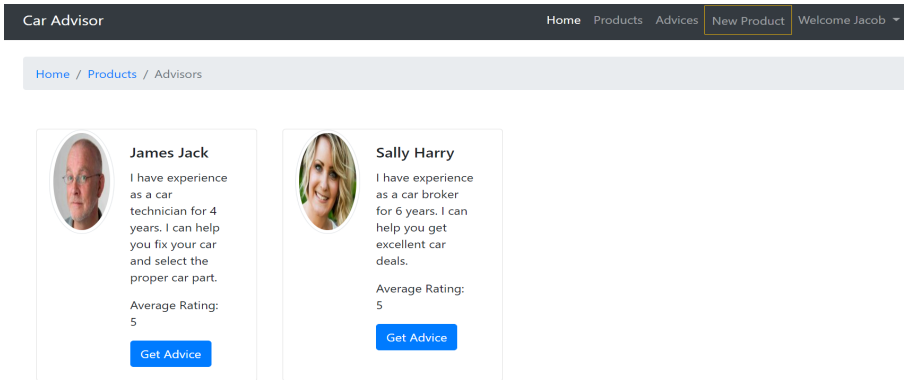


Figure 14 Advisors Page

The advisor user could view advice requests and reply to the client's inquiry.

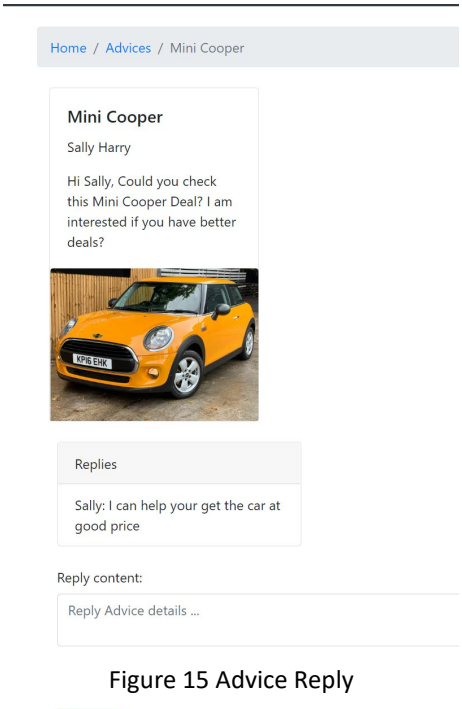


Figure 15 Advice Reply

Figure 15 shows the user profile page, the user can update his account information, update/delete created products, and update/delete created advice.

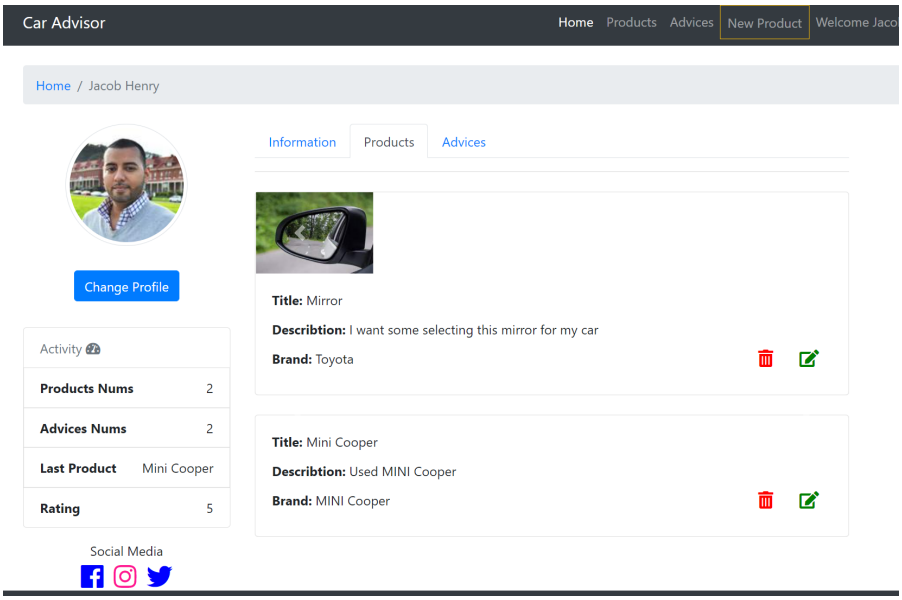


Figure 16 Profile Page

I deployed the web application on the Heroku cloud provider where users could use the application, and test its features.

Survey

Method

I used the Technology Acceptance Model that is used in Chapter 2 – Pilot Study to measure many factors associated with the Car Advisor application I have implemented.

Principles for effective survey design, development, and implementation, as determined by research

1. Style:
    a. Use open-ended questions instead of closed ones that only allow for "yes" or "no" responses so that the interviewee can be more detailed in their responses.
    b. Ask direct, concise questions.
    c. Limit each inquiry to one possible response (not two in one)
    d. Avoid making strong associations (positive or negative).
2. Biases:
    a. Stay away from any kind of leading questions.
3. Language:

    a. Keep in mind the interviewees' language proficiency, age, career, and technical background as you speak in a clear, simple manner that they can understand.

    Sources: (Qu and Dumay 2011)

To apply the TAM model, I should identify the users who will the application and answer the following hypothesis:

- H1: The application is easy to use and navigate
- H2: The application has a good UI/UX design
- H3: The application is useful and has an added value

The survey question will be categorised into two categories to measure the PU and PEOU to assess the mentioned hypothesis as follow. I used the Likert scale to rate the application interface and features.

Q1	What is your gender?
Q2	What is your age?
Q3	Are you a car owner?
	PEOU Questions
E1	To what extent do you find the application interface easy to navigate?
E2	Please rate the colours used in Car Advisor.
E3	Please rate the font size and font used in Car Advisor.
E4	To what extent do you find it easy to add a product?
E5	To what extent do you find it easy to ask for advice?
E6	To what extent do you find it easy to update/delete products?
	PU Questions
U1	To what extent you would use this service when buying a car part?
U2	To what extent you would use this service when buying a new/used car?
U3	Do you think you would save time and money by using Car Advisor?
U4	To what extent you would use Car Advisor in the future?
U5	To what extent you would recommend Car Advisor to other people?
U6	To what extent you would use Car Advisor over other similar applications?

Because I used a free hosting service, I indicated to users who will use the website that, it could be slow to load pages as the server is in the USA and this may cause some delay. I sent the survey on social media platforms such as Facebook, and friends.

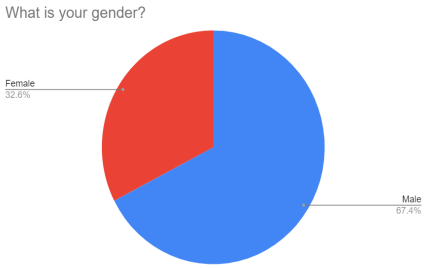


Figure 17 Q1 Result

Survey Results

The total number of participants in the survey is 43

Gender: Figure 16 indicates the male participants represent 67.3%, and the females are 32.6%.

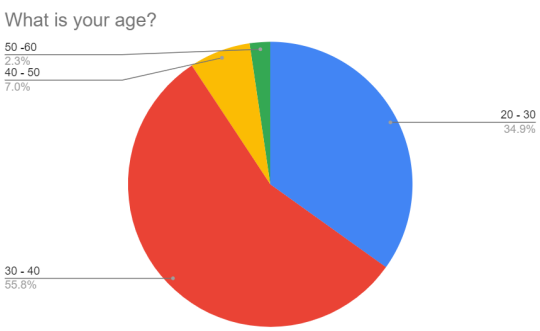


Figure 18 Q2 Result

Age: the questionnaire indicates the majority of users, 55.8%, are between the age of 30 to 40. And users aged between 20 to 30 represents 34.9%. Figure 18 shows that the majority of participants are car owners, up to 86%.

Figure 19 shows bar chart analysis for E1, E2 and E3. These three questions are an indication of how convenient for users to navigate the website and if the website has a user-friendly and intuitive interface. It is shown users gave equal rates of 3 and 4, with 18 votes for each respectively, and rate 5 has 7 votes which is an excellent indication that nav bar design and page design is a perfect fit for these users. On the other hand, around 35% gave a rate of 4 for the colour tones used in the website. Moreover, the rate of 3 and 5 have an equal percentage up to 21%. Regarding the font used in the design, it is shown that this factor got a high rating, equal portions of participants, up to 37%, gave a rating of 4 and 5 for 3the font size and font family. Overall, all three factors have around 37% of rating 4 which indicates the user interface is clear, concise and attractive.

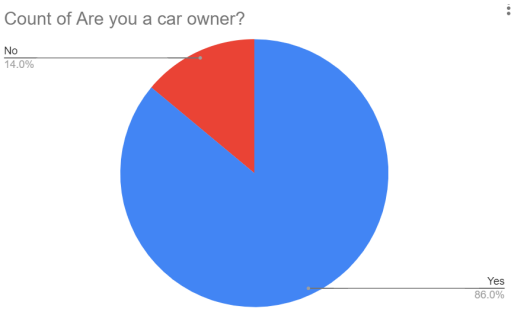


Figure 1920 Q3 Result

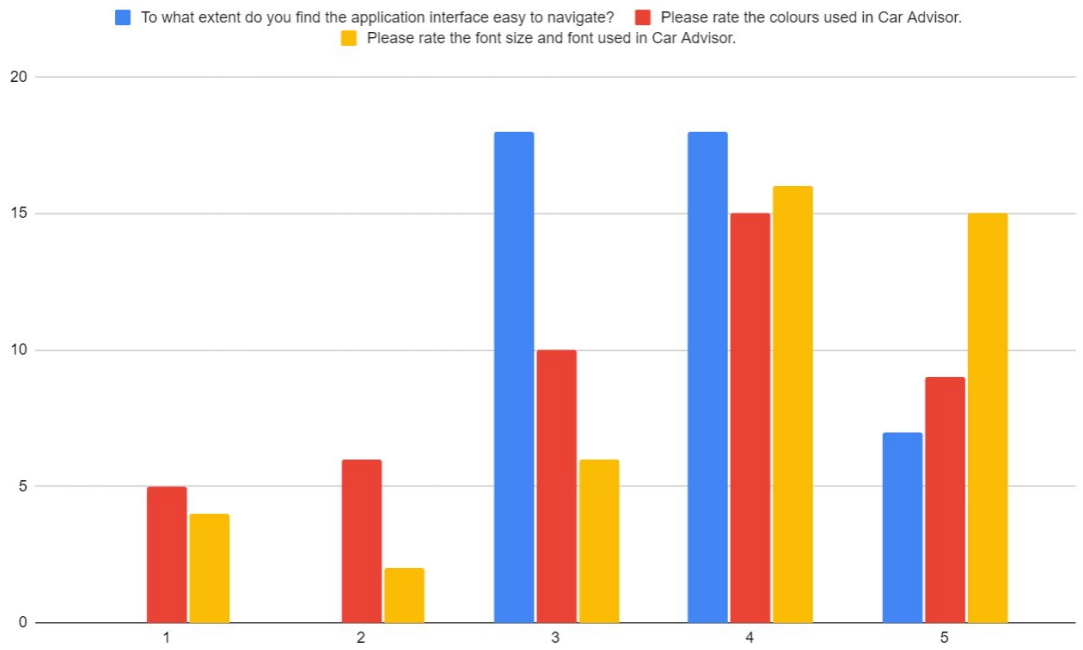


Figure 2019 E1, E2, E3 Results

E4, E5 and E6 questions are designed to test the functionality of the main features of the website such as adding a product and asking for advice from an advisor. The highest rating is for add product feature which has a rating of 4, representing 40%. Then updating and deleting product comes second, representing 32%. However, the average rating for the three shown features is rating 3 which represents about 27% of the total participants. Overall, this chart indicates the website features work well and could be an added value.

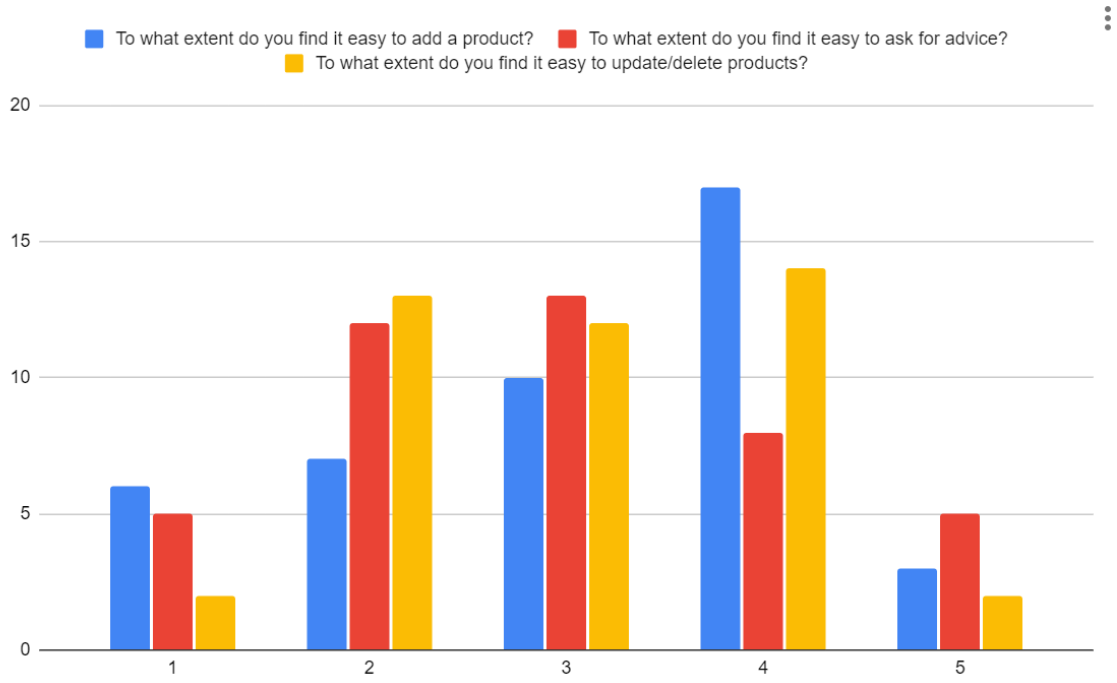


Figure 21 E4, E5, and E6 Results

The following charts in Figure 21 indicate the result of PEOU for questions U1, U2, and U3. The chart illustrates that up to 56% of U1, U2, and U3, system users gave a rating of 4 for the usefulness factors and they would use the application when buying car parts or new/used cars. Furthermore, the chart indicates the application idea could be successful and benefit car owners by saving money and time.

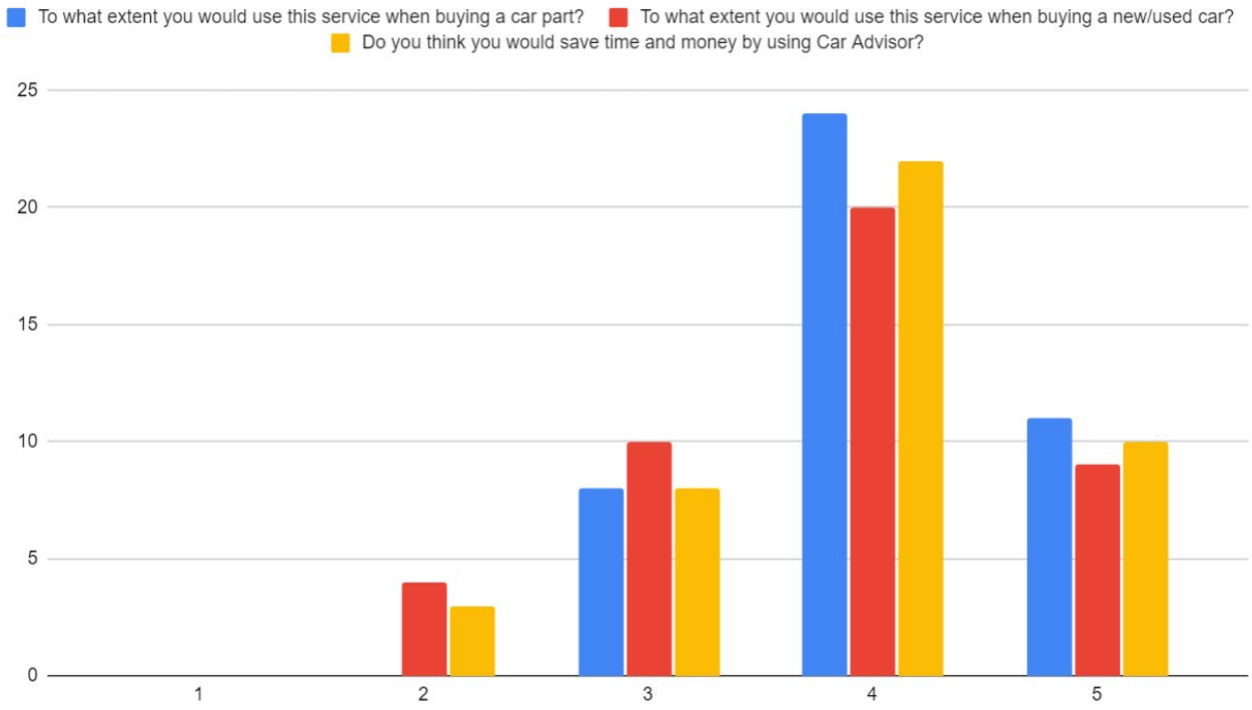


Figure 22 U1, U2, U3 Results

The following bar charts demonstrate the results of usefulness questions U4, U5 and U6. 27 of the participants, 63%, agree and gave a rate of 4 and they would use the application again. It's also noticed they 21 of the participants, 49%, could recommend the application to other people which is promising results that point out the application idea could have a market share in the market of automotive parts. Finally, around 34% of participants have a neutral opinion of U6 and gave a rating of 3 versus 28% of participants who agree to use the Car Advisor website over similar applications.

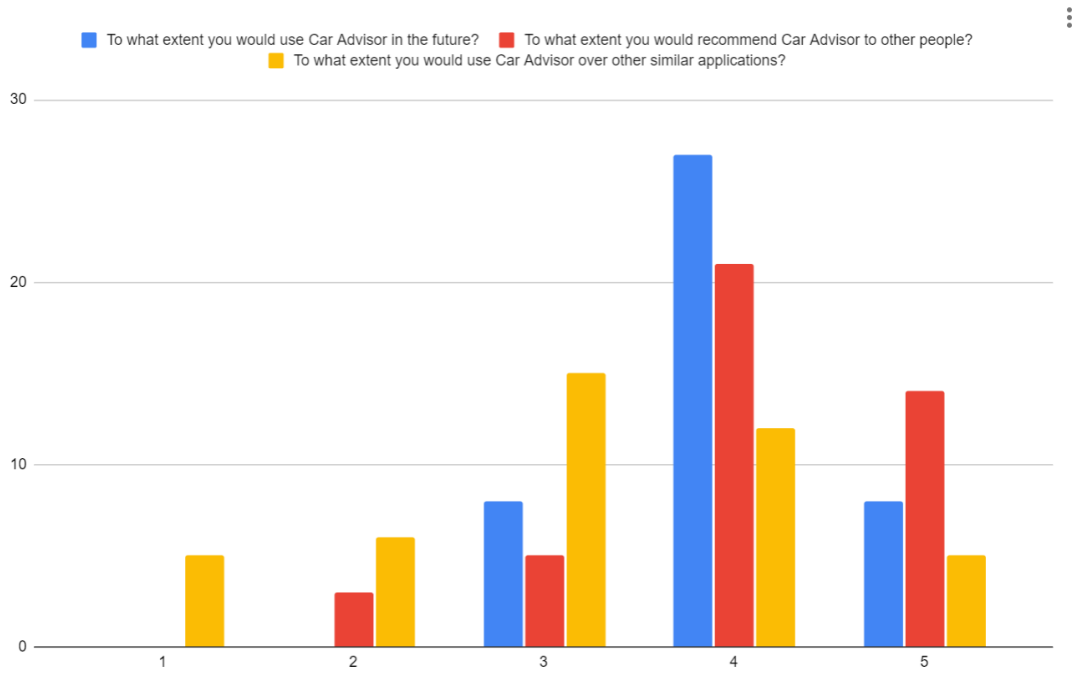


Figure 23 U4, U5, U6 Results

Discussion

The survey was an assessment of the developed software application. The outcomes of the TAM model of the PU, shown in Figure 20 and Figure 21, support hypotheses H1 and H2 that the website is easy to navigate and has good interface design as the PEOU Questions E1 to E6 show high rating for the UI elements such as colours and font used in the design. In addition, the responses indicated that the website is simple to navigate

which supports hypothesis H1. On the other side, the assessment is the PU measured by quantitative questions U1 to U6. Regarding hypothesis H3, the survey feedback shown in Figures 22 and 23, demonstrates that the high number of users who tested the website found its features useful and they may use it again when needed.

Conclusion

Studying the automotive components market and looking at the issues currently affecting this business are the goals of this research. Following the COVID-19 epidemic in 2020 and the Russian-Ukrainian war in 2022, the supply chains suffered. Customers who need to buy auto components are moving from local to online marketplaces as a result of the growing costs of automobiles and spare parts. Spare part markets on social media platforms like Facebook cannot offer the best marketing approach since spare parts require comprehensive categorization to enhance the purchasing experience and shorten search times. OEMs in the automotive sector must rely heavily on spare parts to be profitable, thus they are constantly looking for methods to improve their production techniques. Furthermore, complex logistical arrangements are required because products must be dispersed and shipped across large distances under strict deadlines and delivery dependability requirements. The technical and functional needs of an online marketplace that connects buyers and sellers of affordable spare parts have been investigated and identified as part of this project. The website will offer a usable interface and a user experience that prioritises the needs of car owners. As concluded in the pilot study, there is a need for an automotive consultancy service. Both the vehicle experts who may offer advice or recommendations and the potential automobile buyers who may pay for expert counsel would benefit from this service. To test the software using the technology acceptance model, the generated prototype is designed and shaped based on applicable quantitative and qualitative research, reviewed results from research papers, and a final survey. The survey served as an evaluation of the programme that had been created. Because the PEOU Questions E1 to E6 show high ratings for the UI elements such as colours and typeface used in the design, the results of the TAM model of the PU corroborate hypotheses H1 and H2 that the website is easy

to navigate and has a strong interface design. The responses also revealed that the website is easy to use, supporting hypothesis H1. On the other hand, the quantitative questions U1 through U6 are used to assess the PU. In support of hypothesis H3, data show that a large proportion of users who tested the website thought its features were helpful and might use it again in the future. Finally, the software I created seems to have more functions than the apps now in use, and the research questions are resolved. I was able to bridge the gap between car owners and industry experts by offering car parts at reasonable costs.

Future work

I am going to develop another version of the application with improved features and additional functionality such as notification by email when a job request is submitted to an advisor. The application has a thorough analysis of the user interface, there could improve in the interface in terms of buttons' positions and colours. As shown in the survey result the majority of the website user is in age between 20 to 40. Thus, I will focus my next research on this age group. I will include also a live video call feature that could offer an enhanced way of communication and would make the responding time fast, the feature is missing in many car parts online stores as discussed in the pilot study table comparison and could have a significant positive impact on the car owners. I will also test marketing techniques that could fill the gap between the car owner and the online stores which may result in offering better deals and prices for the car parts.

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