

## Automobile Spare Parts System – Web Solution

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### ABSTRACT

“With the right spare parts on hand, your business can continue without ceasing operations even after a major malfunction, allowing you to avoid loss of crucial time and profits as you wait for the right parts to be delivered”. This system which is specialized in trading automobile spare parts claims to provide sufficient spare parts throughout the life cycle of products, to the clients in need, so as to achieve sustainability. This research discusses how such a system can be designed and implemented to assist clients in search of the best automobile parts that fits their purpose. The research paper has been divided in such a manner to explore and comprehend each and every aspect of the system in detail. Initially, the introduction will provide a simple overview of the system with details regarding what the system will achieve; this will be followed by the methodology of the implementation process. The functionalities of the proposed system will then be discussed with the entails of the testing methodologies and the outcomes.

**Keywords--** Automobile Spare Parts, Order Management, Item Management, User Management, Question Management

## I. INTRODUCTION

This is a highly Internet dependent era we live in today. When you think of any problem, there are numerous solutions you can find from the Internet. However, there are still some sectors in Sri Lanka, that people hardly use the Internet to find solutions. One of them is automobile sector. When we investigated, we found out that even though there are many buying selling applications available, surprisingly, there are a very few of web solutions available in Sri Lanka related to automobile sector.

Most of the people hardly know about how their vehicle works and how to fix it when something is broken. Also, a lot of people are unaware of the vehicle spare parts and what they intend to do, that come with their vehicle. They depend on technicians to take care of everything related to vehicles.

So obviously a typical buying and selling application

will not be enough if people are not aware of what those spare parts are and how they intend to work. To overcome this problem, a solution has to be implemented in a way that people will not be confused seeing unfamiliar automobile items in the application. We are going to introduce a new web app solution for people to use as a platform not only to buy and sell automobile spare parts, but to share knowledge with each other by asking questions from other people and seeing question that has been already solved within a platform. Also, user experience is a must to think about when developing such application.

This research paper has been divided into separate sections to discuss about our solution more thoroughly. In the related work section below, existing automobile spare parts buying selling web app solutions are discussed. In the methodology section, the technologies and how they are used to develop our solution are discussed. The main functionalities of our solution and how they work are discussed in the proposed system section. How we have developed our main functionalities in a way to overcome the issues with existing web applications are discussed in the discussion section. Conclusion of the paper is discussed at the end of the paper in the conclusion section, and all references we have used are listed in the references section.

## II. RELATED WORK

Following are some web applications we have found which are related to our work.

### A. *Ikman.lk*

Ikman.lk is a web application developed to buy and sell items based on many categories. “Ikman has the widest selection of items across Sri Lanka and over 50 different categories. Whether you're looking for a car, mobile phone, house, computer, or pet, you will find the best deal on ikman.” [1] Anyone can post any item by choosing its category in this platform to sell. But according to our findings, we found that every item is treated as the same

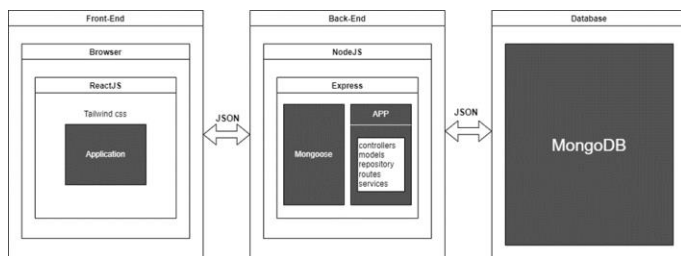
despite of its category, each item has a title, description, image, price and the contact of the seller. Even though anyone can look for vehicle parts and sell vehicle parts using this application, people have a hard time finding the perfect vehicle related items because, there is no specialized description and other necessary details for the respective vehicle part they're looking for, and most importantly there is no rating section for a respective item.

**B. Greezemonkey.lk**

Greezemonkey.lk is a web application specialized for automobile section. However, Greezemonkey.lk not only has a section to buy automobile part, but it also has other services as well. "From car care products and spare parts to automobile vehicle accessories, Grease Monkey got everything you need for amazing prices! You can take advantage of Grease Monkey's "Mechanic at Your Doorstep" service, by scheduling a qualified mechanic to come visit you and service or repair your vehicle with 3 months service warranty!" [2]. However, Greezemonkey only sells items they own. People can't use this web application to sell the automobile items they have with them.

**III. METHODOLOGY**

The technology stack used for this system is MERN Stack where we use MongoDB which is a NoSQL component for the database, ExpressJS which is a backend web application framework used for NodeJS, ReactJS which is a JavaScript library for developing UIs and NodeJS which is the runtime environment. The main reason for selecting this technology stack is due to the rich client experience, security and evolvment brought through React Native, and the versatile advancement of React Native in the industry was also a plus point [3]. Application process is described below (Figure 1).



**Figure 1:** Application Process

Initially, in order to start the project, the requirements had to be well-defined. Therefore, meetings were held to discuss the requirements, and these were well-described and allocated to different members in the group using the Azure Board. The tasks were divided for two sprints and priorities and estimated time durations were assigned to each task in order to manage time and flexibility.

The assignee of the ticket will work on the tasks assigned to him/her and any doubts regarding them will be discussed once meetings are held. Once a developer decides to work on a ticket, the state of the ticket will be changed to "in progress" and once the functionality is completed, it will be moved to the "developer testing" stage. Once testing is completed as well, a pull request will be sent to the developer branch and another developer who is in charge will review and merge the changes.

As ReactJS relies heavily on component-driven programming, everything is componentized, including the dashboard, landing page, navigation bar, login, registration, and profile. The advantage of this is that the component-driven method facilitates the movement of components and speeds up development. React hooks, are a new technique for constructing ReactJS applications, allowing components to be abandoned in favor of pure functional components. Tailwind CSS was used for styling in order to create a fully responsive application.

When successfully registered with MongoDB, the mongoose package is used to connect to a Mongo URI. MongoDB URI is connected by mongoose, and it allows access to all collections in the database. The .env file is an environment variable which stores this. All endpoints are accessible in index.js, and all endpoints occur in the application's front-end. Postman is used to test the backend APIs as it is a client tool used for API integration testing. API testing includes gathering APIs and determining whether they fulfill requirements for functionality, dependability, performance, and security, as well as returning the proper result [4].

As code quality is also one of the main aspects that should be covered, it was decided to use SonarQube. Once the code is reviewed and the issues are shown, these will be fixed by the developers. Selenium was used as the testing tool for functional and automation testing. The above covers the main methodology that will be followed during the project cycle. All the functionalities which are used in the application as below (figure 2).

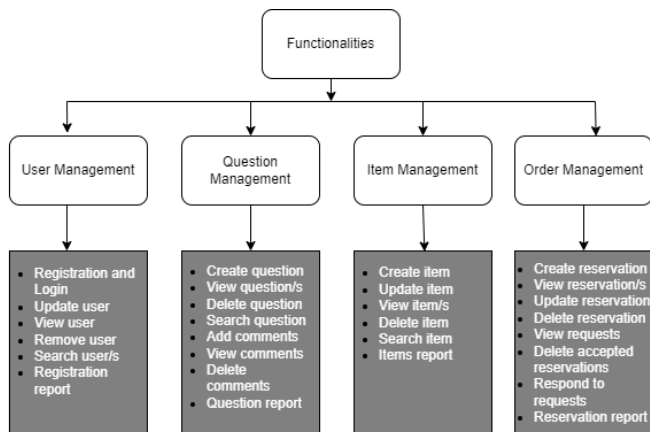


Figure 2: Application Functionalities

### IV. PROPOSED SYSTEM

We have proposed a web application for people to use as a platform to not only to sell and buy automobile parts, but to gain knowledge and discuss automobile related problems with other users. When we started to implement this solution, we divided the whole web application into four major functionalities or sections. They are namely, User management, Question management or Question Thread management, Item management and Order management. How there four major functionalities intend to work are further discussed below as separate sections.

#### A. User Management

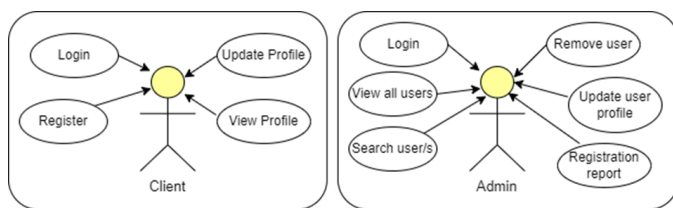


Figure 3: User Management

This is the prime functionality of the system which covers the client and administrator parties. Initially, in order to use the system, clients are required to register themselves for the system, if they have not created an account already. The user should enter the details required by the registration form and the system will register them as clients, if validation test cases have passed. After registering, the clients can use their username and password which was used during the

registration process, to login to the system. Figure 3 explains the user management functionality briefly.

The login functionality has been implemented in such a manner with authentication to ensure that bots cannot impersonate the user. Encryption has also been used in the backend to store the passwords in a secure manner. JWT authorization grants were used with client authentication and identification here (Figure 4). As client credentials are present in the request sent to the server, the authorization server will validate them and respond with the appropriate output [5]. Figure 4 explains how JWT token works in the application.

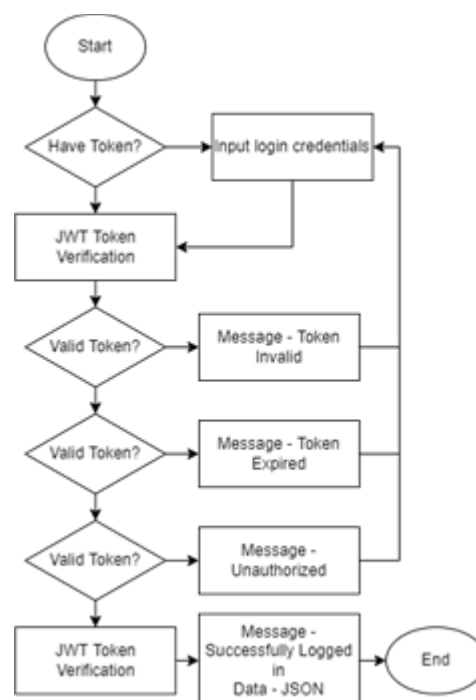


Figure 4: JWT Token Validations

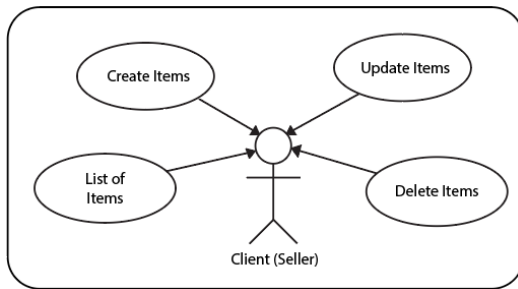
Once a profile has been created, the client can view his profile and make any changes as required. The user profile consists of a profile image of the user and their details which were supplied during the registration process. However, secured information such as the user’s password will not be displayed here. Clients can update their profile information and save it so that they can view the updated profile later.

The other most prominent user of the system is the administrator, and he has privileges to view details of all the registered users, update their details and remove any user from the system as needed. There is a particular interface that is dedicated for this purpose of viewing, updating, and deleting user details. Furthermore, the admin can also create reports on the clients in the system. The purpose of this report

is to view how many users are registered to the system in a specific period. These reports can be viewed, downloaded, and printed as required. The date range for the client registration time required should be initially selected and a filtration option is also included in the report interface.

**B. Item Management**

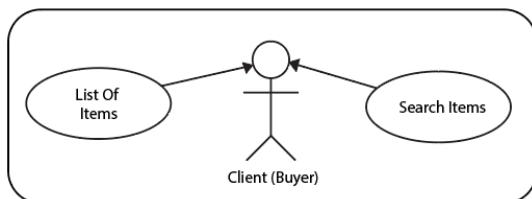
In this feature, users will be able to buy or sell automobile parts / spare parts. A person needs to register into the system to perform the tasks. The user no need to register as buyer and seller separately. A single registration is enough to buy items as well as to sell your own items. After successful login, the user will navigate to the Items list page. That user interface shows all the items available in the system.



**Figure 5: Item Management (Seller)**

A user can create an item by clicking “Create your Item” button, which appears on the Item List page. It will navigate to another user interface where the user can create and add an item to the system. There are several fields that the user needs to fill in order to create an item. Users need to enter the Item name, which is the name of the spare part. Then the description should be filled with the details of the automobile spare part along with contact details. Item quantity and price should be also inserted. Item price should be in Sri Lankan Rupees. Then the user needs to upload an image of the automobile spare part. After that, the user can save the item, to insert the item into the system.

Then the user will be again redirected to the Items list page. Each Item contains an image, description, quantity, price and add to cart option. The items created by the currently logged in user contain edit and delete options too.



**Figure 6: Item Management (Buyer)**

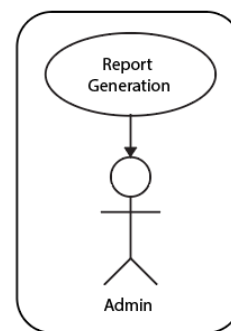
The user can click “Add to cart option” to buy an item from the list. This will redirect to the item reservations user interface.

In Item List page, there is another option to search items, with filter options. One of the filter options is to search for the items, which were created by the currently logged in user. After searching the items, the user can edit or delete the item as per the need. We have used several icons in the system, such as edit, delete, close etc. These icons have tooltips when the user moves the mouse around the icons. It is a user-friendly option we have in our system.

If the user needs to edit an item detail, then the user can click edit icon. It opens a modal type of user Interface to edit the item details. To make the action easier, the existing details are shown in the text fields. After editing the details, the user can either click update button to update the details or click cancel button to discard the changes.

If the user needs to delete an item, then the user can click on the delete icon. It prompts a confirmation message to confirm the user action because the action cannot be undone. The user can either click yes button to confirm the action, or no button to cancel the action.

Every successful action prompts a success message, and every error prompts an error message, in every action inside the system. Those messages are shown as toast messages. So, the user gets a clear idea about the actions performed by him/her. Also, the item creation form and item updating form, have validations to reduce the mistakes that happen during item creation or updating. They have some supporting sentences on how to fill the required fields.



**Figure 7: Item Management (Admin)**

A report related to Automobile spare parts, can be downloaded in the Admin User Interface. The report contains the mostly sold item details, percentages, and seller details. This will be helpful to notify the sellers regarding their sales and increase productivity.

**C. Question Thread**

This is a forum or a question thread section where people can post questions regarding automobile parts, so that

other people can give answers to those questions by posting comments.

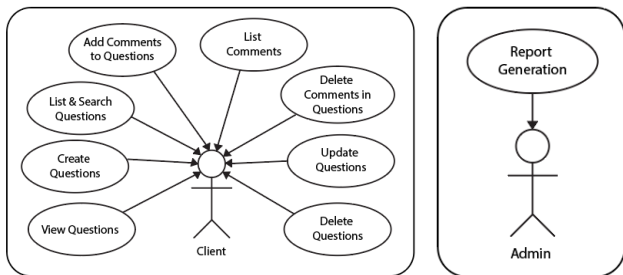


Figure 8: Question Thread Client

A question can contain a title to summarize what the question is about, a description to explain the question in detail, one image, and tags which are useful to categorize the type of the question. Also, the date and time of the question posted and number of views for a question is also saved. Also, the person who created the question thread has the authority to edit or delete it from the system.

There is a search field to search questions from the system. To make searching easy, people can type the tags in the search field to find related question threads or, can type the title of the question thread. Also, there is a filtering option to filter the question threads based on who has posted them. In this section, anyone is able to see the count of view for a question thread and see the time which question thread has been created.

If someone is interested in a certain question thread, they can view question thread just by clicking on it. Once it is viewed, the comment section is also visible. Anyone registered to the system can add comments in a question thread. Also, the person who added the comment can also delete the comment anytime they want.

**D. Order Management**

This feature is used by both buyers and sellers who are using the system. Basically, what this feature does is that it helps buyers to place orders to the items they wish to buy, and it allows sellers to properly organize their items sales. In order to access either of these options the user should be logged in.

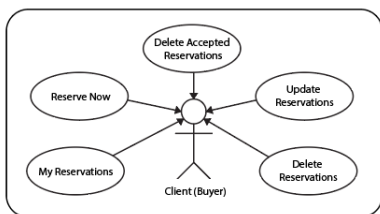


Figure 9: Order Management (Buyer)

In the buyers’ point of view (Figure 9), they can browse through the items in the site and select an item they wish to buy and click on the “Add To Cart” button which will navigate them to a page called “Reserve Now”. There they can enter the item quantity they prefer and place the order, while all the user’s details and the item details will be filled automatically. Once the order is placed automatically the order status will be updated to “Pending”. These orders can be later viewed by the buyers in the “My Reservations” page, which displays all the orders that were placed by the logged in user. They are able to filter those orders that were placed by them using the filter button or by entering the item name or order Id in the search field. Each order will display the order details along with an “edit icon” and a “delete icon”. The buyer can click on the edit icon and begin updating the item quantity in the placed order or, by clicking on the delete icon they can delete the placed order as per their liking. However, these actions can only be performed when the order is in the “Pending” status or “Rejected” status.

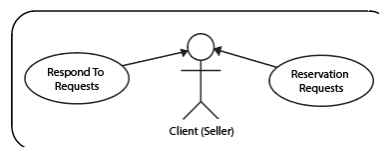


Figure 10: Order Management (Seller)

In the seller’s point of view (Figure 10), in the “Reservation Requests” page the sellers are able to view the order requests that were placed to items they have listed in the system. They can filter the order requests using the filter button or search using the search field that is available by entering the item name. The sellers can select an order request and review the order request content and compare the available item quantity and requested item quantity and decide whether to “Accept” or “Reject” the order request. This will update the order request status to “Accepted” or “Rejected”. Once this is done the buyers can contact the seller and have the items delivered or collect the reserved items by themselves.

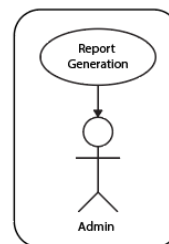


Figure 11: Order Management (Admin)

There is an order report generation (Figure 11) section in this feature. This can only be accessed by the

admin of the system. They can generate a report where it will display the users who have placed the most number of orders within a provided timeline. This will assist them in identifying how useful the order placement feature is to the system and also it would assist in identifying what kind of promotions would motivate or help the buyers to further use the system effectively and satisfactorily.

## V. DISCUSSION

When we investigated automobile sector in Sri Lanka, we noticed that there is a very few web solutions available even though this is an Internet dependent era we live in. Because of this most people are used to visit technicians to fix their vehicle even it is a very basic problem anyone can fix. Although visiting a professional is not a bad thing, we believe people should have some knowledge regarding this area, so that they do not have to depend on technicians for even basic things. To make this happen we are going to introduce a web app solution for people to use, so that they can not only just buy and sell same parts, but to share knowledge with others as well. Our main goal is to create a platform for people buy and sell automobile spare parts as well as to share knowledge by asking questions from other users of the application. As mentioned in above this web solution is implemented as four major sections. Those sections are further discussed in below.

### A. User Management

This is the core functionality of the system where the users of the system must register themselves, in order to use the system. Therefore, this functionality deals with authentication and authorization processes which also involve identity management and access controlling.

According to the “Proceedings of the 11th WSEAS International Conference on COMPUTERS”, Identity management is a core implementation which promises users to be equipped with a single identity and administrators with better user management environment. An authenticated user is authorized to access a resource if he/she is a member of a group and if the group is a member of a role and the role has positive permissions on that resource. [6]

As a client, he/ she will be privileged to access his/ her account, view the details and update any as required. However, the administrator, who has more control can delete client’s profile view or update their details and generate user-based reports. In this manner, the roles are given accessibility for different functionalities. This is a crucial part of the system as clients are the most valuable asset to the system, therefore, it should be maintained in a proper manner. Thus, it is evident that user management feature contributes to the system heavily, therefore, test cases were developed to test

this functionality to ensure that the implementations work as required (Table 5).

Postman was the test client used to do API testing. The input data and test results are shown below. SonarQube was used to evaluate and maintain the code, while Selenium was utilized for automated testing.

Table 1

ID	Test Description	Test Input (API, JSON)	Expected Output	Actual Output	Result
01	User Login	POST - <a href="https://automobile-spare-parts-web.herokuapp.com/api/users/login">https://automobile-spare-parts-web.herokuapp.com/api/users/login</a> { "email": "testauth@gmail.com", "password": "Test123" }	Display message "Logged in Successfully"	Display message "Logged in Successfully"	Pass
02	User Registration	POST - <a href="https://automobile-spare-parts-web.herokuapp.com/api/users/register">https://automobile-spare-parts-web.herokuapp.com/api/users/register</a> { "firstName": "Test", "lastName": "Auth", "email": "testauth@gmail.com", "contactNo": "123", "password": "Hellothere123", "address1": "Address1", "address2": "Address2", "city": "City", "state": "State" }	Display message "User Registration Successful"	Display message "User Registration Successful"	Pass
03	Update User	POST - <a href="https://automobile-spare-parts-web.herokuapp.com/api/users/62fbb962d2afb08bccdaff69">https://automobile-spare-parts-web.herokuapp.com/api/users/62fbb962d2afb08bccdaff69</a> { "firstName": "Test12", "lastName": "Auth12", "email": "testauth@gmail.com", "contactNo": "123", "password": "Hellothere123", "address1": "Address12", "address2": "Address23", "city": "City12", "state": "State12" }	Display message "User Updated Successfully"	Display message "User Updated Successfully"	Pass
04	Get Users	GET - <a href="https://automobile-spare-parts-web.herokuapp.com/api/users">https://automobile-spare-parts-web.herokuapp.com/api/users</a>	Display message "isSuccessful = true" and display all user details in JSON format.	Display message "isSuccessful = true" and display all user details in JSON format.	Pass
05	Remove User	DELETE - <a href="https://automobile-spare-parts-web.herokuapp.com/api/users/630a4a72927c2829bbc7231a">https://automobile-spare-parts-web.herokuapp.com/api/users/630a4a72927c2829bbc7231a</a>	Display message "Successfully removed user"	Display message "Successfully removed user"	Pass

### B. Item Management

This feature inside the system helps the users to easily search and buy automobile spare parts as per their need. In the other part, a good feature to publish our own spare parts details into the system, to sell in easiest and fast manner. Simply we can call it a Customer to Customer (C2C) business model. C2C represents a market environment where one customer purchases goods from another customer using a third-party business or platform to facilitate the transaction [7].

The total vehicle population in Sri Lanka around 2019 was recorded as 8,095,224, as per the reports provided by Ministry of Transport and Highways of Sri Lanka [8]. New Registrations are being processed to date. Due to the high

vehicle population around Sri Lanka, people face struggles in finding automobile spare parts. This feature of this system reduces the time and money on searching spare parts for their vehicles. Also, this feature helps the sellers to find the buyers easily in a short time.

Since most of us are using mobile phones and the internet in our day-to-day life, a user-friendly web application like this will be easiest than travelling to search automobile spare parts. Recent research shows that the quality of website increases customer satisfaction, which increases the purchase intention [9]. Another advantage of such a system is, the user can search and compare the items he/she needs to purchase, very easily [9].

Also, we can track the report of items sold, to notify the users about their sales and purchases. So that we can increase the usage of the web application.

### C. Question Thread

Even though this is a tech savvy and highly Internet dependent era we live in, we noticed that there are a very few automobile related web solutions available in Sri Lanka.

A survey conducted by CheapCarInsurance.net shows that 42.2% people were confident that they could change a flat tire, meanwhile 17% people were somewhat confident, 19% people were not confident and 21.8% people were clueless on how to change a flat tire out of 2000 car owners [10]. So we have identified that when it comes to automobile sector, a lot of people are not aware even about basic things that they should know about. Because of this reason there is no wonder why there are a very few web solutions available for automobile sector because there are a very few knowledgeable people live in the era to use those solutions.

So, creating just an automobile buying selling web application is not enough if no one is aware of what those automobile parts intend to do, and why those equipment are important. To overcome this problem, we have introduced a question thread section in our web application so that people can ask questions and share their knowledge regarding automobile parts with others. According to Asynchronous learning networks as a virtual class by Hiltz SR, Wellman B, "For online discussion boards and forums, people tend to respond at their convenience instead of waiting for a turn that could provide an opportunity for more reserved participants to contribute." [11] We hope people will find our question thread solution to the problem we have identified useful and will be helpful.

### D. Order Management

Order management is a feature that is crucial in an online buying and selling web application. It assists buyers who are using the application to place orders so that they would not miss items they want to buy. Handling the placed orders and being able to manage the inventory is also another aspect of the order management feature. This assists the sellers who are listing the items to manage their inventory

accordingly. With the busy lives of the users, order management feature becomes a suitable implementation to the proposed system.

When considering about Order Management System, in other words OMS, George Kokoris [12] mentions that OMS is a system that can manage all aspects of an order's lifecycle. Furthermore, in the IBM Supply chain website [13] explains that the order management system assists in managing every system and process in the supply chain virtually. Also, it explains that a feature such as an order management system has a direct impact on how a customer perceives a business or a brand. The OMS consists of basically three features [14]. Order placement, Inventory adjustment and order fulfilment.

An order management system itself is a powerful feature for a system. When combined with the proposed system it improves the usability of the system. Most automobile spare part vendors have unorganized inventory. Some vendors do not even know that they had a specific part until a customer comes asking for it. Our system eliminates that issue and helps our users manage their inventory and provide items to buyers through the implemented order system. This results in a much more organized inventory usage and an effective service.

As illustrated in the above paragraphs having an order management system is vital in a system such as the proposed system. The order management feature implemented in the proposed system has similar functionality to an ordinary OMS. When considering the importance of this feature we assume that it is a useful implementation to the proposed system.

## VI. CONCLUSION

This is a web app solution to create a platform for people to buy and sell automobile spare parts as well as share knowledge on automobile related things between each other.

With having a properly engineered user management, item management, question management and order management section, we believe this web application will become a success and people will find it easy not only to find the best suitable automobile spare part they want quickly, but to learn about things they need to know in an efficient and interesting manner.

With the use of report generating feature, we intend to analyze the data we can receive, after some time of introducing this web application, and try to find the good things and flows we have made and update the system in the future to make this application useful for people in a way they want it to be.

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