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Tea Collector: Web Based Data Tracking Solution for Tea Smallholders

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ABSTRACT

The sustainability of a tea factory also depends on the trustworthiness of the data collection and finance management. Collection of tea leaves and tea processing are the main two processes done by a tea factory. In the process of tea collection, they must handle a large set of data about the tea collection, selling, and payments. Data processing and summarizing can be identified as critical process because these summarizations finally sent to the factory for further analyzes. All these documentation processes are still handled mostly in a manual way. This manual process may lead to malpractices sometimes, especially when handling payments. So, there is a need to develop an easy way to manage all the documentation processes online. In this specific research, our idea is to implement a web application with features like adding, updating, and deleting data with a generation of summary reports. The main reason we need to shift from a normal manual process to an online managed process is that they can consume their time by managing the data more secure and trustworthy way. We have implemented this by using MERN stack as the technology where we use react.js for the frontend and express.js for the backend developments. We used MongoDB as the database and Heroku to host the application.

Keywords-- Web Application, Database Management, Agriculture

I. INTRODUCTION

ICTs have improved in terms of strength, accessibility, and ubiquitous contributing significantly to the overall growth in the effectiveness of labor investments. [1,2] Operations in the tea supply chain could also benefit immensely by adopting ICTs.

Before, the tea collection and other related data such as tea weight measurements, and finance details were gathered into books and papers. Now, this electronic online system does not need books or papers. All authorized and eligible persons can register online and can manage data by logging into their personal accounts. This process is not time-consuming for the users. The major advantage of this system is that the user does not need to spend money on paper and pens, as they can save as much as data into the database without worrying of protecting logbooks. It has more features compared to the normal data collection system. In this way, most tea leaves sellers, collectors, and managers can keep their data organized and safe without missing anything.

As per the research that has been done, the major finding was that this tea collection process does not have any mobile or web application to get a support. Most of data related processes in this scenario is being done manually. Therefore, the solution was to develop a web application to help the process of tea collection.

The application will serve for selected 4 main characters of this tea collection scenario. They are tea seller, lorry driver, manager, and system admin. Some major drawbacks of the manual tea collection process are the struggle of keeping data safe, the lack of a proper way to get updates on tea collection dates, and difficulties in summarizing data. Out of the above-mentioned basic need of the tea collection process is to keep track of data. Therefore, the main focus of the web application is to develop a proper and safe way to track the data. For all these 4 characters the data tracking facility has been provided through this web application. A timetable facility is also provided to get updates for sellers and lorry drivers on tea collection times and routes. Summarizing the monthly and daily details is another facility provided. To generate reports and summarize daily data this facility will provide help. All these facilities in

one application will solve the major drawbacks of the manual process of tea collection.

The upcoming parts of the document will clearly elaborate on the solution under several meaningful titles. The elaboration will start with a literature review, then will discuss more about the technical aspect under methodology, and thirdly will discuss about the functions and features of the proposed system. There will be a discussion on the built project related to the requirements and will conclude with a proper conclusion.

II. LITERATURE REVIEW

A. Requirements of tea smallholders in the tea leaves supply chain

Tea landowners who have less than 10 acres (4 hectares) of land are considered tea smallholders in the tea industry in Sri Lanka. [3]. They are the root of the tea supply chain in Sri Lanka. From the tea supply chain, we deeply consider about the tea leaf collection process. During this tea leaf collection process, the smallholders must link up with several intermediaries to sell the tea leaves to the factory. [4]. Smallholders, tea collectors, or lorry drivers, and several managers are actively involved in this process.

The development of technology has an impact on the tea-making industry as well. get in touch with leaf collectors and suppliers directly, seek authorizations for financial advances, fertilizer purchases, and other plantation requirements, and monitor gross weight, deductions, and net weight information by the supplier. [5] Inventory control, production, accounting, budgeting, and human resource management [6] inside the factories are currently managed using the technology. Smallholders and lorry drivers further request to have a proper connection between them in the process of tea collecting. Secondly, the lorry drivers or the collectors request to have automated monthly report generation facilities to make their work more time-saving and accurate. Further, the poor road connection in some areas is another problem which can be handled by having a proper route-assigning process for lorries.[7] Lastly, the finance handling process done by the tea collector, or the lorry driver needs more accurate and trustworthy solution.

B. Existing systems and their approach

Direct communication with suppliers and tea leaves sellers, adding a request to get approval for fertilizers, cash advances and other needs for the plantations, and tracking the gross weight, moisture deductions and net weight-related details can be recognized as some of the determinants of information availability and technological adoption into the tea production field.

"Odoo" has been involved in this process as the tea factory has hardly suffered from supply and demand mismatches. [5] The communication process with leaf collectors and suppliers was managed via messaging or telephone. The leaf collector's and supplier's less inclined to share and receive information, which may be a result of their poor communication skills. Thus, the pandemic situation changed the involvement of people in the information technology field which gave them a big chance to engage with the informative world.

Collection date, routes, collection officer details, vehicle and driver details, measurement details, supplier details, and route details are the data fields that are being managed by "Odoo" within their system developed for "Hidellana tea factory".

C. Weaknesses identified in the existing systems

The following existing gaps were identified:

The system only solves matters related to the factory. "Odoo" has created this system specifically for "The Hidellana tea factory". The specific factory requirements have been prioritized while working on the solution. Communication with the suppliers and sellers, collection of measurement details of leaves, and other request approval processes have been handled by the system.

The factory gets the chance to connect with the sellers and the collectors, but the collectors and the sellers do not have a proper way to have a valid connection. The connection between sellers and collectors is only happening via phone calls.

The data collection and analyzing facility have not been provided for the sellers and the collectors. The factory has been given the ability to manage the data. They have been given the facility to manage data under several categories such as financial data, daily tea collection data, and driver details.

Not providing any notifying system to make the sellers aware of the tea collection time. As per the research done the tea leaves must handover to the factory in a fresh condition. Therefore, to get notified of the proper collection times is a major need that has not been given a solution.

As the pandemic situation makes people focus more on technological solutions, the tea smallholders, the collectors and drivers have expected some support from the technology. The needs of the external parties are not paid any attention by the "Odoo" solution. That is where our solution fits in.

The sellers and the collectors require to have, direct communication with the company in any concern, a simple data-saving solution for tea leaf collection and selling, an option to get notified on the driver timetables, a proper route allocation for drivers and to keep contact on finance details with the company. The solution we created provides answers to all the above problems of the external parties of the tea factory.

III. METHODOLOGY

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In this project, an information system to address the information demands of tea sellers and collectors were designed, developed, and put to the test. To provide software products quickly and with flexibility through iterative feedback loops and time-boxed sprints, the researcher used the Agile system development technique with Scrum. [8,9] Microsoft Azure DevOps tool has been used for a smoother planning process [10]. Planning, Analysis, Design, Implementation, Unit and Acceptance testing were all components of the Scrum cycle.

Identification of stakeholders, selection of a population sample, preparation and execution of document reviews, questionnaires, and interviews were all included in the planning phase.

The tasks that needed to be completed were determined using Visual Studio Code. The analysis, presentation, and interpretation of the gathered data were carried out using Microsoft Excel from Microsoft 365 during the requirement analysis phase. This helped determine the tea leaves seller's and collector's information needs, the flaws in the current system, and the characteristics that the system must have. During the Design phase, a conceptual model of the information system that included the necessary characteristics was developed.

Architectural design, UML diagrams, databases, and wireframes were designed using Figma.com and draw.io. During the Implementation phase, the modules and components of the information system were created. To make sure that the final product satisfied the demands of the consumer, these processes were carried out again. GitHub, Bootstrap, and MongoDB were among the tools employed. Finally, the functional testing, usability testing, and compatibility acceptance testing phases were completed, with the findings being reported. Selenium IDE and SonarQube have been used to make the testing process easier.

Postman Client and a survey to get user input were the tools utilized. To ensure that the system was able to solve the problem as intended, a validation was carried out. To find out how satisfied users were with the program, survey questions were employed.

A. System analysis and design

a. Requirement analysis

The study concluded from the findings that Tea sellers and collectors need better communication, time management, data handling and data summarizing. Therefore, a system that could assist in information handling and provide enough communication and time management facilities was required by the users. This solution will handle the challenges that can be seen currently, lack of data handling for sellers and collectors, delays in delivery schedules, and limited connection between sellers and collectors.

b. System architecture

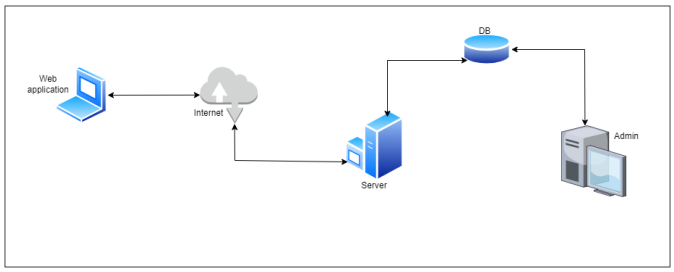

Figure 1: System architecture

As illustrated in Figure 1, the system's overall architecture consists of a web application and database server for data processing and storage. Users must register to use the program, which they download and install on any device with the windows operating system requires registration to access information.

c. Use case Diagram

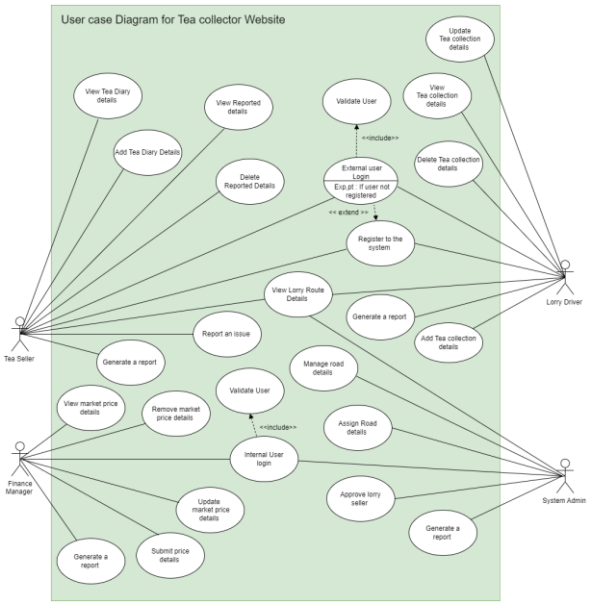

Figure 2: Use case diagram

Use case diagrams are a system analysis technique for locating, outlining, and organizing system needs.[11]

The functions that the four main actors can obtain are shown in the use case in Figure 2. This contains all the functions of the tea leaves seller, collector, price and lorry manager, and system admin.

Firstly, for the tea leaves seller Adding and Viewing Tea Diary details, reporting an issue, Delete and View Reported detail are the main functions. Moreover, the seller can, register to the system, log in as an external user, and generate a report.

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Secondly, the collector or the lorry driver can Add Tea collection details, update tea collection details, delete tea collection details, and View tea collection details. They can also generate reports and do sign-in and sign-up processes.

On the other hand, the system administrator adds, modifies, and views the route details. Have the ability to sign in as an internal user.

The seller, lorry driver/collector and the system admin have the access to view the lorry route details as well. Finally, the manager adds, modifies, and views payment and price-related details. He also can sign in as an internal user.

d. Database design

The database has been designed as a non-relational database. MongoDB was used as the database management tool. MongoDB has no tables. It has collections. Therefore, separate collections have been created for each function.

Figure 3 shows the collections that have been created and the current data limits in each collection. This also clearly represents the number of documents inside each collection and the different size measurements related to the collections.

The reason for choosing MongoDB as the database management tool for this project is because it provides lower execution time compared to relational databases such as MySQL. [12]

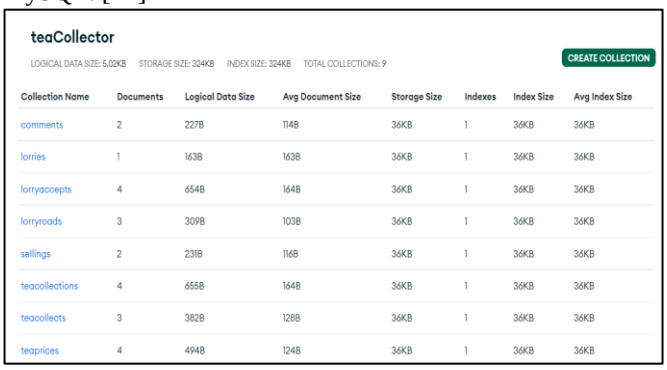

Figure 3: database overview

Figure 3 depicts all the collections that we have created for our application. A number of documents inside the collections and the storage details related to the collection details.

e. Application backend

We have selected MERN Stack to develop our solution. We used the express.js framework which is based on node.js to build the backend. Nodemon has been used to run the back end as it facilitates auto-refreshing / updating the running project after any update.

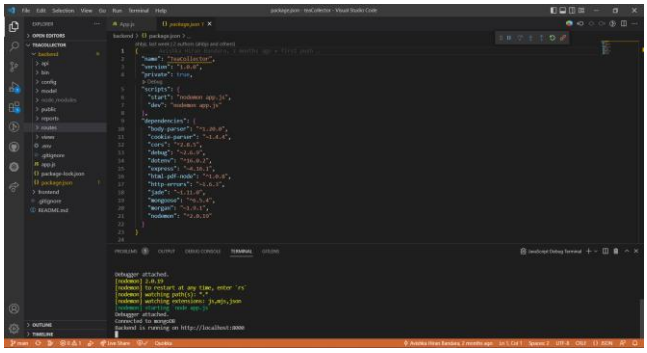

Figure 4: Application backend

Figure 4 illustrate the backend file structure which we used to implement the application backend. This also shows how the backend is functionally work by connecting to the MongoDB database.

IV. PROPOSED SYSTEM

A. System development tools

The creation of a web application for both backend and frontend administration was required for the installation of the solution for the tea leaves selling and collecting. Any kind of web browser can be used to run the web application. Visual studio code and postman are the tools used in the development process.

We used GitHub for version control for our project, we hosted our website in Heroku, and as a pipeline, we have connected Heroku to GitHub, whenever the main repository got an update our Heroku will deploy it automatically. The platform as a service (PaaS) called Heroku allows programmers to create, launch, and manage apps fully in the cloud.[13] This allows us to host our applications free of charge in cloud.

The database management system for the system was MongoDB.

B. Application frontend

The application frontend has been developed using React.js. Bootstrap was used to give more attractiveness to the UI creations.

The modules that make up the following screenshots show how the system was put into use.

The frontend for system admin has been designed as below.

The web app solution has been created focusing on 4 main actors. Tea leaves sellers, tea leaves collectors, Lorry and price managers, and system admins are the actors that can use this application. They have separate functions created within the web application according to their specific needs. As public pages, we have created a login and sign-up pages.

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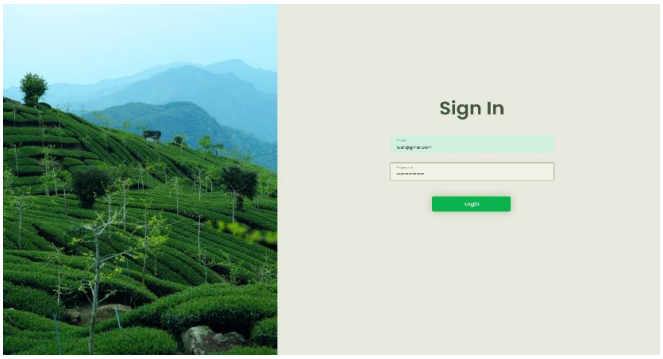

Figure 5 : Sign in page

Figure 5 illustrate the public sign in page that has been designed to use by all the 4 actors of the system. Not asking separate usernames. It allows you to simply enter the email and the password for the log in.

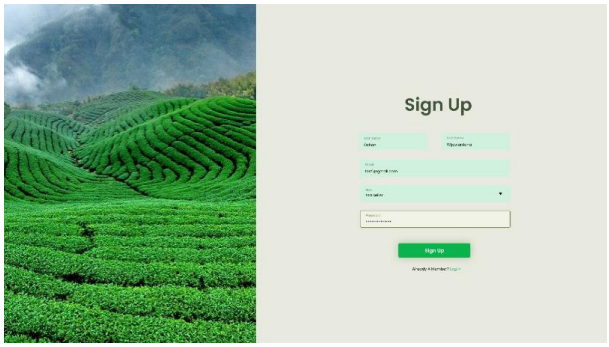

Figure 6: Sign up page

Figure 6 illustrates sign up page created to use by the user. All the users must create an account before the sign in process.

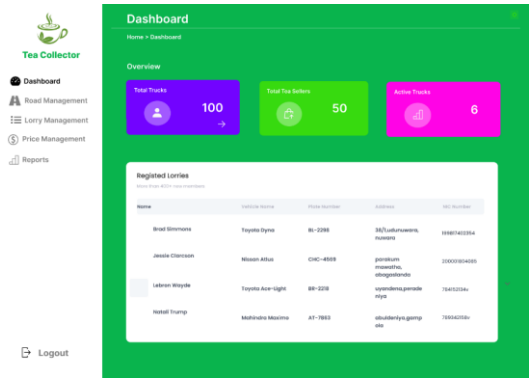

Figure 7: Admin_dashboard

Figure 7 illustrates admin dashboard page. This has designed to give a summarized idea on the registered lorries in advance.

Frontend UIs design for the system admin is mentioned below.

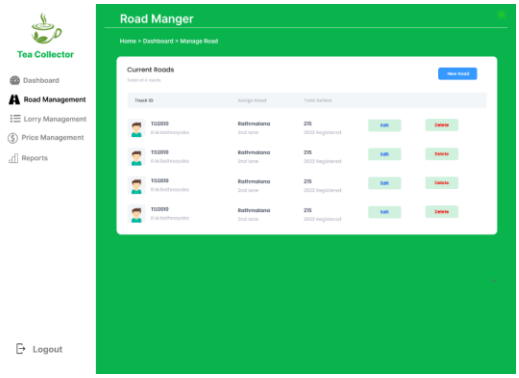

Figure 8: Admin_View Road details

Figure 8 illustrate road management function where the admin who is an employee of the factory side has been given the ability to manage the lorry routes and timetable for tea leaves collection

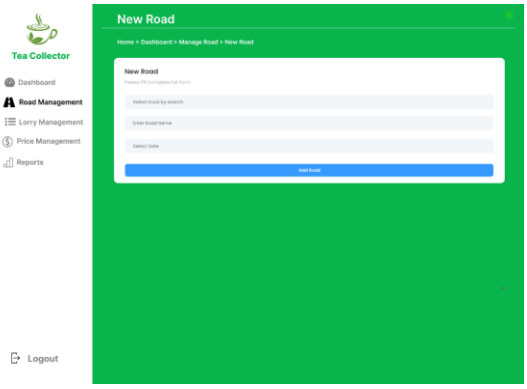

Figure 9: Admin_add route details

Figure 9 has the route adding form which gives the admin to add route data. Admin is allowed to assign the lorries for separate routes.

Frontend design for the manager has several UI figures as mentioned.

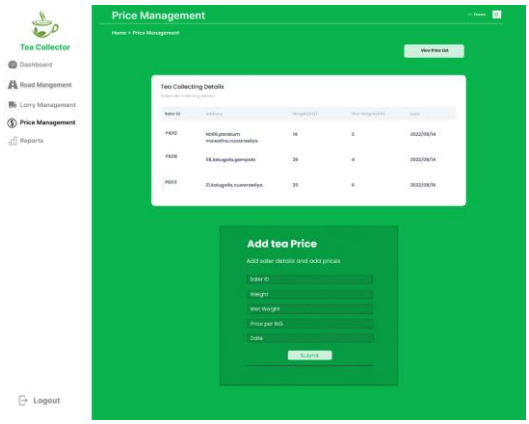

Figure 10: Manager_add tea price page

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Figure 10 depicts a page related to price management. This page manages the add price function. A simple form has been created for the adding function.

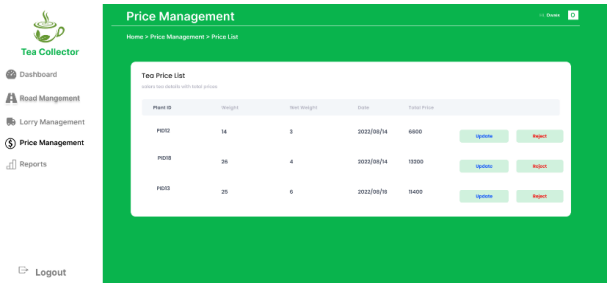

Figure 11: Manager_ View price details page

Figure 11 also illustrate some functions related to price management. Data is planned to retrieve in a grid view and each row has provided the update and delete options separately to create a user-friendly environment

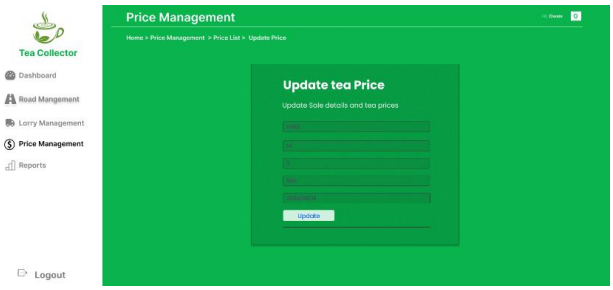

Figure 12: Manager_ update price details page

Figure 12 depicts how the update function works. Update process also designed to be done using a form.

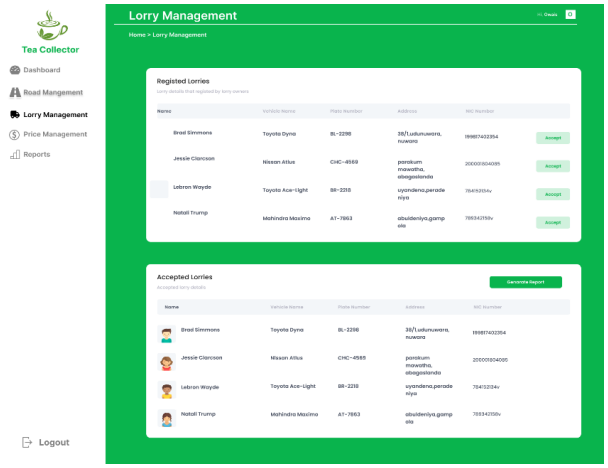

Figure 13: Manager_ lorry management

Figure 13 depicts the pages related to lorry management. Functions related to lorry management are accepted registered lorries and generate report monthly on accepted lorry details. Report generation done by the system with a one button press which added more user-friendliness to the system.

Frontend design for the lorry driver has following UI figures.

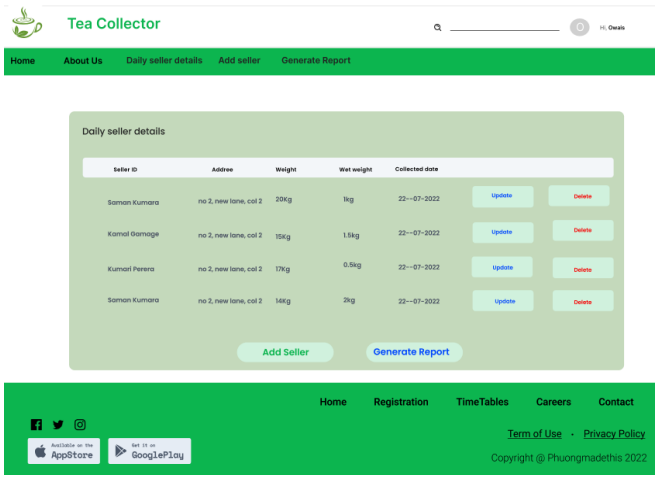

Figure 14: Daily seller details page

Figure 14 contains a tabular view of all the collection details. As per the requests of the lorry drivers they have provided with the functions to view, update, and delete the tea leaves collection details in a single page.

As per the majority request automatic report generation facility has also been added. Used limited number of pages to give easy access and more user friendliness.

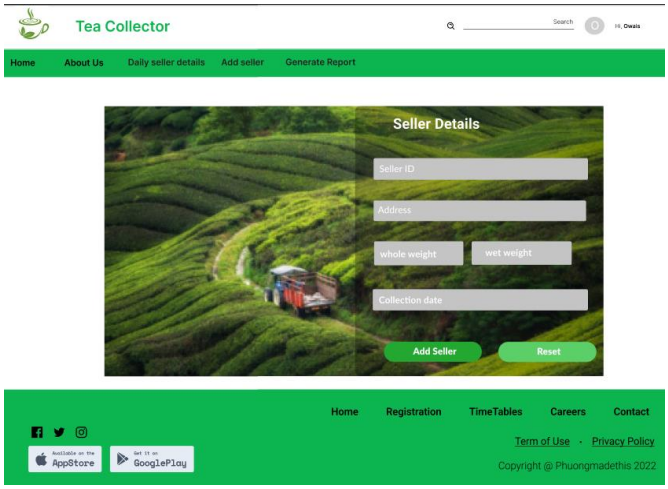

Figure 15: Add seller & collection detail page

Figure 15 illustrate the page that has been designed to add the tea leaves collection details. A simple form with only the required fields has been created for the data entry.

We have added a limit to the tea leaves weight that can be added at once. A reset button has been added for easy

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refreshing of the form. This will help the collectors as they have to do the entries quickly as possible during the collection process.

Frontend design for the tea leaves seller has several UI figures as mentioned.

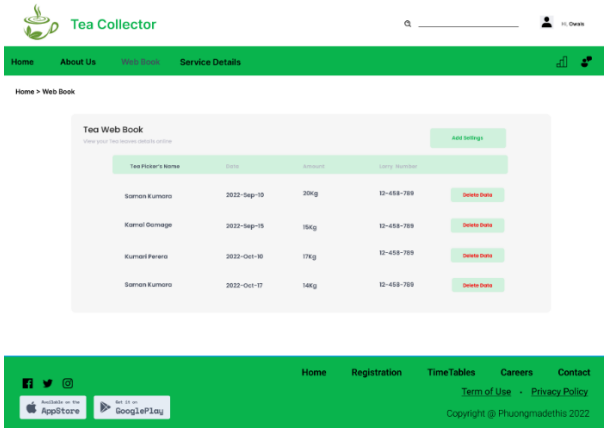

Figure 16: Tea web book page

Figure 16 represent the seller web book functions. This seller web book provides deleting and viewing the sold tea leaves details.

The update option has been removed since after done the selling all other process including the payments are handle according to these details

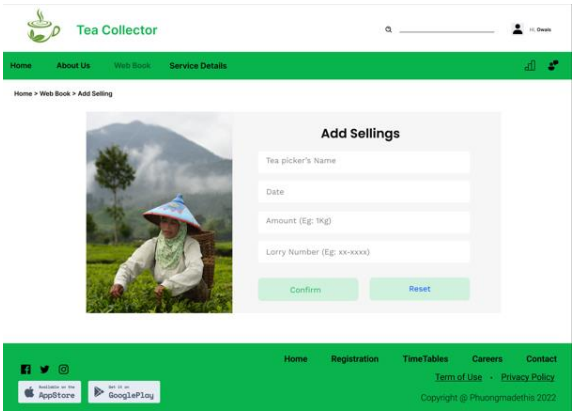

Figure 17: Add selling details page

Figure 17 represent the selling detail adding page. Limited numbers of entries have been added according to the requirements of the user to give more user-friendly usage.

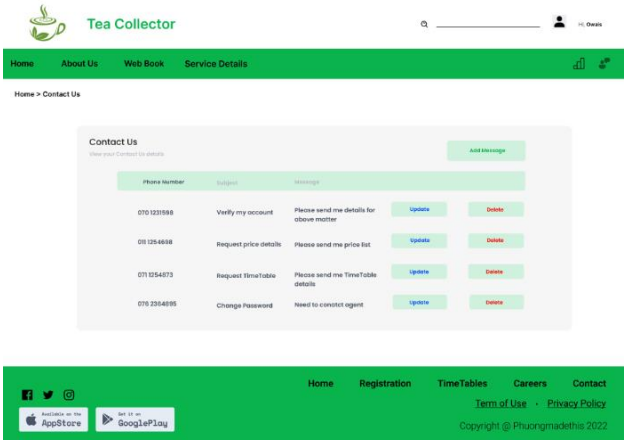

Figure 18: Contact us page

Figure 18 illustrate the contact us page. This page allows the user to see the messages that has been send previously. Any edit or deletion can be done to the previous messages.

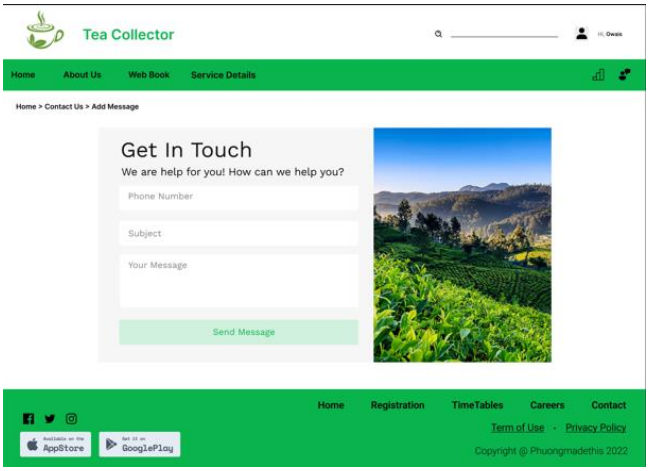

Figure 19: Send message page

Figure 19 represent the contact us function. This contact us function provide facility for sellers share messages with the admin side. This form allows the user to add messages to the admin side.

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V. DISCUSSION

Our findings were mainly based on site visits and Google forms. Tea smallholders and lorry drivers in the area called Karagoda-Uyangoda, located in the southern province was selected for the research. The “Wilpita Tea Factory” was used as the factory for the research. As there were small number of people, we gave them some google forms to get their ideas on the system we planned.

Our basic plan for the application was to give solutions for data handling, communication between sellers and collectors, and email communication with the factory.

According to the results we got we had to change some of our plans according to the user's needs. Figure 20, 21, & 22 depicts some results of the forms we created.

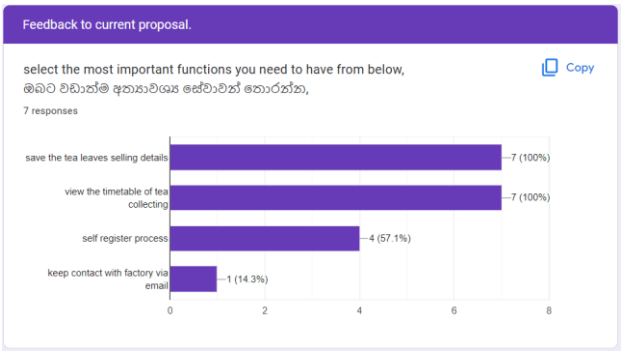

Figure 20: Select important functions

Figure 20 show how the users have voted to the basic functions that we have planned to add into the system in the planning process. There the majority has been voted to have the facility to save details function and view timetable function. The least number of votes has been got by the email communication system we planned.

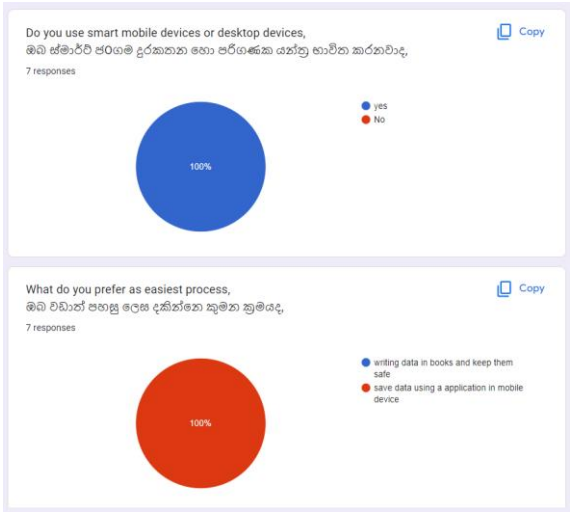

Figure 21: Questions on technology usage

As we are developing a technological solution, we planned to check the adoption of the users in the technology by asking them few questions. Figure 21 depicts how the users have reply to the questions.

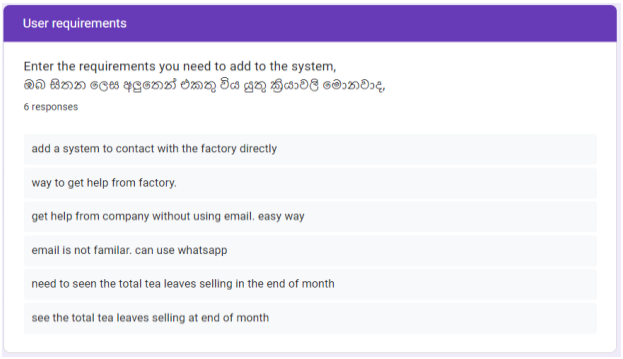

Figure 22: User feedbacks

Figure 22 shows how the user has shared his/her new ideas on the project. These were taken as the feedback of the users to make changes in the functions.

We have not planned a page named 'contact us page' to create a contact between sellers and the factory. We planned to keep a connection with the factory via email to make it more official. But after getting the feedback, the result shows that the users are not familiar with the emailing. They asked to add WhatsApp to build the connection. But we thought to give them a simpler solution. Therefore, we designed a contact us page where the sellers can directly present their problems to the factory.

This was the major change we have done in the basic plan for the application.

After the development which has been done according to the agile methodology, we came across the testing phase. We have used two basic tools to make the testing process easier. The code was tested using the SonarQube tool to detect the bugs in the code.

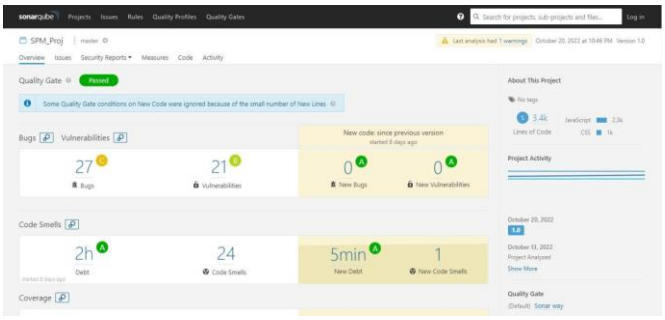

Figure 23: SonarQube results

Figure 23 shows how the bug detection has been done using the SonarQube tool.

For compatibility testing we tested the hosted application in several browsers including Google Chrome, Firefox, and Microsoft edge.

VI. FUTURE WORK

This can be brought to you as phase 1 of our project. We are planning to cherish you more by giving lot more features within the upcoming development phases.

We have planned to uplift the system by adding more features with the help of artificial intelligence and machine learning. we have also made a primary level plan for the next phase developments to add some automated scaling equipment that can be connected to the system directly. This will be helpful to record tea leaf weight more accurately. In addition, identify the tea leaf types by scanning.

As another plan, we want to get the help of a location tracking system to share the live locations of the lorries with both sellers, lorry owners, and the factory.

VII. CONCLUSION

Lack of communication facilities with the factory side, lack of data organizing methods to gather tea leaves collection and selling data, disorganized route allocations for lorries are some of the current difficulties external parties of the tea factory have while looking for technological help for tea leaves data collection. It was discovered that information gaps and a failure to accept accessible technologies are both strongly influenced by a lack of or insufficient knowledge. As a result, smallholder tea sellers and the tea leaves collectors face difficulties in providing quality tea leaves to the factories. A delay of a single hour is a reason to decrease the quality of freshly plucked tea leaves. To solve these challenges, our study created a web application solution including answers to the mentioned requirements. After the system underwent testing and validation, the respondents expressed their satisfaction that all of the capabilities performed as anticipated and served the intended purpose.

The user experience should be enhanced generally by further study, development, and improvement in this area. Considerations to be made in some areas include incorporating the Global Positioning System for accuracy, including additional languages like Sinhala, Tamil and other native languages of countries that has tea plantations, in order to reach more community, Further research should be done on impact assessment to determine the importance brought about by the usage of the tea collector data managing web application.

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