DEVELOPMENT OF WEB APPLICATION FOR CUSTOM HIRING AND TRACTOR MAINTENANCE

PROJECT REPORT

Submitted to College of Agricultural Engineering and Technology in Partial Fulfilment of the Requirements for the Award of the Degree of

BACHELOR OF TECHNOLOGY
IN
AGRICULTURAL ENGINEERING

By

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(2023)

CERTIFICATE

This is to certify that the project work carried out and recorded in this report entitled "**Development of Web Application for Custom Hiring and Tractor Maintenance**" submitted by **Samiran Biswas (Roll No- 1904101047 , Registration No - B/AE/304/2019-20)** and **Shashank Singh (Roll No- 1904101041 , Registration No - B/AE/302/2019-20)** to the College of Agricultural Engineering and Technology, Dr. Rajendra Prasad Central Agricultural University, Pusa in the partial fulfilment of the requirement for the award of the degree of **Bachelor of Technology in Agricultural Engineering** is hereby approved.

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ACKNOWLEDGEMENTS

First and foremost we would like to express our gratitude to "The Almighty"who has been the most beneficent and merciful since the allotment of the project till completion of it had been puzzled by several obstructions but today we realize that 'nothing is difficult' no need to be frustrated.' Everything happens for a reason.

It is a matter of great pleasure for us to gratefully acknowledge and express our profound gratitude to our project advisor, **Dr. S.K Patel**, Associate Professor, Department of Farm Machinery and Power Engineering, for his support, dexterous guidance, and perpetual encouragement during the investigation, preparation of the manuscript and providing necessary facilities during the period of project work.

We also record our gratitude to **Dr. Ambrish Kumar, Dean**, College of Agricultural Engineering and Technology, Pusa, RPCAU who provided all facilities for undertaking this project during B.Tech Programme.

With the same spirit we would like to express our deep feeling of gratitude to**, Dr. P.K Pranav**, Associate Professor and HoD, Department of Farm Machinery and Power Engineering (FMPE), C.A.E.T, and **Er. Kranti Kumar,** Associate Professor, FMPE, **Dr. Subhash Chandra,** Assistant Professor, FMPE and **Er. Manoranjan Kumar**, Assistant Professor, FMPE, and **Dr. Jaya Sinha**, Assistant Professor for continuous inspiration, guidance, suggestions, persistence encouragement, and constant supervision throughout project work.

I am equally indebted to **Er. Shailesh Kumar (**Assistant Professor**), Er Manoj Kumar, Dr. Sanjay Kumar**, **Er. Sunil Kumar,** for their inspiration, support, and valuable suggestions. I am also thankful to FMPE staff members, CAET, Pusa for providing the necessary facility for conducting experiments and providing necessary information.

We have a grace of thanks again extended to all the faculty members of CAET for their cooperative behavior, valuable suggestions, positive attitude, and encouragement during the entire period of the project work.

We also acknowledge the help of the staff of the Department of Farm Machinery and Power Engineering. My words fell short to acknowledge the love, blessings, support, encouragement, and affection of my noble and pious parents, that helped me in overcoming all hurdles in my life,

Last but not least we also thank all my batchmates (especially Devansh, Ulka, Ajay, Rohit, Saket, Rahul, Purusottam, Vivek, Ashish, Sujit, Pratyush, Senior Tanmoy Das) who constantly encouraged us in more than one way in the completion of the Project.

I shall fail in my duties if I don't mention the source of my inspiration, encouragement, love, and moral support of my family (mother, father, my elder Sister ,my elder brother).

Finally, sincere thanks to all who helped me in completing this work.

Date: ***Place: Pusa***	--------------------------------- ***(Samiran Biswas)*** --------------------------------- ***(Shashank Singh)***

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LIST OF FIGURES AND FLOWCHARTS

LIST OF ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS AND SYMBOLS		DESCRIPTION
JS	:	JavaScript
DOM	:	Document Object Model
ES	:	ECMAScript (JavaScript standard)
Npm	:	Node Package Manager
JSON	:	JavaScript Object Notation
GPS	:	Global Positioning System
GNSS	:	Global Navigation Satellite System
UTM	:	Universal Transverse Mercator
Lat & Long	:	Latitude & Longitude
NMEA	:	National Marine Electronics Association
HTML	:	Hypertext Markup Language
URL	:	Uniform Resource Locator
HTTP	:	Hypertext Transfer Protocol
DOCTYPE	:	Document Type Declaration
<tag>	:	HTML element tags (e.g., <div>, <p>, <a>)
CSS	:	Cascading Style Sheets
ID & class	:	Identifier (CSS selector) & CSS class selector
px & %	:	Pixels & Percentage
!important	:	CSS declaration modifier
RGB	:	Red Green Blue color model
CMS	:	Content Management System
PHP	:	Hypertext Preprocessor (programming language)
WP-CLI	:	WordPress Command Line Interface
API	:	Application Programming Interface
CDN	:	Content Delivery Network

Chapter -1

Introduction

I. INTRODUCTION

Agriculture plays a vital role in the global economy, providing food, raw materials, and employment opportunities. With the growing demand for agricultural products, there is a need to optimize farming processes to enhance productivity and reduce costs. One of the critical aspects of efficient farming is the use of appropriate machinery and equipment. Tractors and their implements are essential tools in modern agriculture, enabling farmers to perform various tasks efficiently.

Traditionally, farmers have faced challenges when it comes to acquiring tractors and implements for their farming operations. The process often involves time-consuming manual searches, negotiations, and coordination with multiple suppliers. Additionally, the maintenance and repair of these implements pose further difficulties, with farmers lacking a centralized system to track and manage the upkeep of their equipment effectively.

1.1 Custom hiring: Needs and constraints

Custom hiring refers to the practice of renting or hiring specialized machinery, equipment, or services on-demand for specific tasks or projects. It allows individuals or organizations to access resources they require without incurring the costs associated with owning and maintaining them. The primary need and advantages of custom hiring include the elimination of the need for upfront investment in expensive equipment, machinery, or skilled labour. It helps individuals and small businesses access resources on a pay-per-use basis, reducing capital expenses and operational costs. It offers the flexibility to choose the right equipment or services for specific tasks or projects. It allows users to access a wide range of machinery or specialized tools that may not be economically feasible to own permanently. It often includes the provision of skilled operators or technicians who are proficient in handling the equipment or carrying out the required tasks. This ensures efficient and professional execution of the work.

By opting for custom hiring, organizations can quickly scale their operations based on project requirements. They can rent additional machinery or resources when needed and return them once the project is complete, avoiding the need for long-term commitments. Finding the specific tractor implements they require for their farming operations can be challenging, especially during peak seasons. Farmers often struggle to locate available implements when they need them the most, leading to delays and decreased productivity.

Traditional custom hiring systems may offer a limited range of tractor implements, limiting farmers' options. This lack of choice can hinder their ability to select the most suitable machinery for their specific tasks and field conditions. The process of finding, contacting, and negotiating with implement owners for custom hiring can be time-consuming. It involves multiple phone calls or personal visits, making it inefficient and burdensome for farmers who already have busy schedules. Farmers may encounter variations in the quality and performance of hired tractor implements. The lack of standardized maintenance practices across different implement owners can lead to reliability issues, breakdowns, and additional downtime.

Traditional custom hiring practices often involve intermediaries or middlemen, leading to higher hiring costs for farmers. These intermediaries may charge commissions or fees, increasing the financial burden on farmers. Coordinating the hiring process and communicating with implement owners can be challenging, particularly in remote areas. Lack of clear communication channels can lead to misunderstandings, delays, and difficulties in resolving issues related to hired implements.

Farmers often struggle to find reliable maintenance and repair services for the hired tractor implements. The lack of accessible maintenance options can result in prolonged downtime and decreased efficiency. Traditional custom hiring practices may lack proper documentation and record-keeping mechanisms. This can lead to disputes or misunderstandings regarding the duration of hire, costs, and responsibilities for maintenance and repairs. These problems in traditional custom hiring processes highlight the need for more efficient and user-friendly solutions, such as a web application, to address the challenges faced by farmers and enhance their hiring experience.

To address these issues, this web application offers a comprehensive solution that empowers farmers to conveniently rent tractor implements tailored to their specific needs. By harnessing the power of the internet and digital technologies, this project aims to simplify the hiring process, making it more accessible and efficient for farmers, ultimately enhancing their productivity and reducing operational costs.

The web application provides farmers with an intuitive and user-friendly interface to browse through a wide range of tractor implements available for hire. They have access to detailed information about each implement, including specifications, availability, and rental prices. This allows farmers to make informed decisions based on their requirements and budget.

Furthermore, the web application facilitates seamless communication between farmers and implements owners or rental agencies. It offers features such as online booking, real-time availability updates, and secure payment gateways to streamline the entire rental process. This eliminates the need for time-consuming phone calls or physical visits, making it more convenient for farmers to access the equipment they need.

Additionally, the web application includes a maintenance management system to ensure the proper upkeep of the implements. Farmers also get notified to schedule maintenance, timely reminders for regular maintenance tasks. This proactive approach helps optimize the performance and longevity of the equipment, minimizing downtime and improving overall farming efficiency. In summary, the development of this web application for custom hiring of tractor implements and maintenance represents a significant step towards digital transformation in the agricultural industry. By providing a centralized platform that simplifies the rental process and facilitates efficient maintenance management, we aim to empower farmers with the tools they need to enhance their productivity, reduce costs, and contribute to sustainable agriculture practices.

1.2 Justification and Objective:

The development of a web application for custom hiring of tractor implements and maintenance is essential for several reasons. It addresses significant challenges faced by farmers and provides a practical solution that offers numerous benefits to both farmers and implement owners. A web application can automate and streamline the custom hiring process.

It can provide a centralized platform for both service providers and customers to connect, communicate, and negotiate terms. This reduces the administrative burden and improves efficiency. It allows users to access the hiring and maintenance services from anywhere, at any time. It eliminates the need for physical presence or lengthy phone calls, making the process more convenient for both parties involved. By offering a user-friendly interface, the web application can enhance the overall customer experience. Customers can easily browse through available options, compare services, view ratings and reviews, and make informed decisions. This leads to higher customer satisfaction and retention.

The web application can help service providers optimize their resource allocation. They can manage their availability, schedule appointments, and allocate resources effectively, ensuring that they can cater to customer demands while maximizing productivity. It includes features for maintenance tracking and reminders. Customers can schedule routine maintenance tasks, receive notifications when maintenance is due, and keep track of their service history. This helps in ensuring the longevity and reliability of their custom equipment. Automating the hiring and maintenance process through a web application can lead to cost savings. It reduces manual paperwork, minimizes administrative tasks, and optimizes resource allocation. This can result in lower operational costs and increased profitability for both service providers and customers.

Overall, the development of a web application for custom hiring and maintenance offers numerous advantages, such as streamlining processes, improving accessibility, enhancing customer experience, optimizing resource allocation, enabling transparent communication, providing maintenance tracking, leveraging data analytics, and generating cost savings. These justifications highlight the value and potential impact of such a project.

1.2.1 Objectives:

1. To develop the Web Application for Custom Hiring and Tractor Maintenance
2. To analyse the features of web application's accuracy.

Chapter -2

Review of Literature

II. REVIEW OF LITERATURE

This review of literature explores existing research, studies, and related work in the field to understand the significance of such a project and identify key insights and trends.

- Maintenance for Farm Implement
- Custom Hiring of Agricultural Machinery
- Web Applications for Farm Equipment

2.1 Maintenance for Farm Implement:

Ojolo and Unigwe (2018) focused on maintenance practices for tractors and their impact on farm productivity in southwestern Nigeria. The authors examined the relationship between maintenance activities such as regular servicing, repairs, and component replacements, and the overall performance of tractors in agricultural operations. It highlighted the importance of proper maintenance in ensuring efficient tractor operation and improved farm productivity.

Prasad and Singh (2018) provided an overview of maintenance management for farm machinery. It discussed various aspects of maintenance, including preventive maintenance, corrective maintenance, and condition-based maintenance. It emphasized the importance of proper maintenance practices in ensuring the efficient functioning and longevity of farm implements. It also highlights the role of technology and data-driven approaches in optimizing maintenance processes.

***Bhargava and Khakhar (2019*)** studied the maintenance practices of farm equipment in India. The authors discussed the common maintenance issues faced by farmers, such as improper lubrication, worn-out parts, and inadequate servicing. The article emphasized the need for regular maintenance schedules, proper training of operators, and access to genuine spare parts. It also highlights the role of extension services and awareness campaigns in promoting effective maintenance practices.

Byamugisha and Raem (2019) examined the challenges faced in tractor maintenance, such as limited access to spare parts, inadequate technical skills, and financial constraints. The authors highlighted the need for effective maintenance strategies, including preventive maintenance, training programs, and availability of spare parts, to ensure reliable tractor performance in the region.

Mahmood and Kasim (2019) examined farm machinery maintenance practices and farmers' satisfaction in Pakistan. It investigated the factors influencing farmers' maintenance behaviors, such as access to spare parts, availability of repair services, and technical assistance. The article highlighted the relationship between maintenance practices and farmers' satisfaction with machinery performance, productivity, and overall farm profitability. It emphasized the need for improved maintenance support services and farmer training programs.

Alim, et al. (2020) focused on the maintenance management of agricultural machinery in developing countries. The author discussed the challenges faced in these contexts, such as limited access to spare parts, inadequate technical expertise, and financial constraints. The study explored various maintenance strategies and approaches, including outsourcing maintenance services, promoting self-help groups, and adopting ICT-based solutions. It also highlighted the importance of capacity building and knowledge sharing among farmers.

Kacar and Aydin (2020) investigated the impact of maintenance on tractor downtime in a medium-sized farm in Turkey. It analyzed the relationship between maintenance activities, downtime duration, and overall farm productivity. The study emphasized the role of regular maintenance, timely repairs, and effective spare parts management in minimizing tractor downtime and maximizing operational efficiency.

Abraha and Hitt (2021) investigated maintenance practices, challenges, and coping strategies for tractors in East Africa, focusing on Ethiopia and Kenya. The author identifies the common maintenance practices adopted by tractor owners and operators, examines the challenges faced, and explores the coping strategies employed to overcome these challenges. The study provided insights into the importance of regular maintenance, training programs, and access to quality spare parts in sustaining tractor performance in the region.

Djokic and Barak (2021) focused on the analysis of maintenance costs for agricultural tractors in Serbia. It examined the different components of maintenance costs, including spare parts, labor, and downtime. The study highlighted the importance of cost-effective maintenance strategies, such as preventive maintenance and effective spare parts management, in reducing overall maintenance expenses and improving tractor performance.

Iqbal and Rafik (2021) investigated maintenance practices for farm machinery and factors influencing farmers' decisions regarding maintenance activities, including their perceptions of maintenance importance, costs, and availability of resources. The research highlighted the variation in maintenance practices among different types of machinery and the impact of maintenance on machinery performance and farmers' income. The study suggests policy recommendations to enhance maintenance support and promote sustainable farm machinery management.

2.2 Custom Hiring of Agricultural Machinery:

Ayaz et al. (2018) provided a comprehensive review of the custom hiring of farm machinery, including tractors, in Pakistan. It analyzed the patterns of tractor rental services, their role in enhancing agricultural productivity, and the economic implications for farmers. The study also discussed the challenges faced by the custom hiring sector in Pakistan and suggested strategies to promote its sustainable growth.

Jat and Datta (2018) presented a comprehensive overview of the status, issues, and prospects of custom hiring of agricultural machinery in India. They reviewed the current scenario of custom hiring services and analyzed the challenges faced, such as limited availability of machinery, high costs, and inadequate training of operators. The authors discussed potential solutions and policy recommendations to promote the sustainable growth of custom hiring services.

Singh and Gupta (2019) focused on the role of institutions in promoting custom hiring services of farm machinery in India. The reviewed the institutional framework and analysed the functioning of various stakeholders involved in providing custom hiring services. The authors emphasized the importance of strengthening institutional linkages, capacity building, and policy support to enhance the accessibility and efficiency of custom hiring services.

Dar and Walsh (2020) discussed the custom hiring of tractors in India, analyzing its impact on agricultural productivity and farm incomes. It examined the benefits of tractor rental services, such as increased access to mechanization, reduced labor requirements, and cost savings for small-scale farmers. The study also highlighted the challenges faced by custom hiring services, including high initial investment, operational costs, and issues related to service quality.

Farooq, et al. (2020) focused on the impact assessment of custom hiring services of tractors on crop productivity in Pakistan. It examined the relationship between tractor rental services and key agricultural performance indicators such as yield, input use efficiency, and profitability. The study emphasized the positive impact of tractor rental services on crop productivity and recommended policies to enhance their accessibility and effectiveness.

Jat and Murti (2020) examined the adoption and impact of custom hiring of farm machinery in India. It discussed the factors influencing farmers' decisions to adopt custom hiring services and analyzed the socio-economic impact of these services on farm productivity, profitability, and rural employment. The authors also highlighted the potential for scaling up custom hiring services to achieve sustainable agricultural development.

Singh and Kumar (2020) provided an in-depth review of the impact of custom hiring services of farm machinery in India. It highlighted the benefits of custom hiring services such as increased access to modern machinery, reduced drudgery for farmers, and enhanced agricultural productivity. The authors discussed the challenges faced in implementing custom hiring services and suggested measures to improve the efficiency and effectiveness of these services.

Singh, et al. (2020) provided an overview of the custom hiring services of tractors, specifically focusing on the tractor rental business in India. The study examined the factors influencing the adoption and utilization of tractor rental services, such as farm size, availability of credit, and cost-effectiveness. It also discussed the challenges faced in the tractor rental business and suggested strategies for improving its efficiency and profitability.

Yasin, et al. (2020) discussed the custom hiring of tractors and its impact on agricultural productivity in Bangladesh. It reviewed the literature on tractor rental services, analyzing their role in mechanization, labor savings, and farm efficiency. The study also examined the challenges faced by the custom hiring sector in Bangladesh and suggested policy interventions to promote its sustainable development.

Mishra and Kamboj (2021) analyzed custom hiring services of farm machinery in India is the focus of this review article. The authors evaluated the cost-effectiveness of custom hiring services compared to individual ownership of machinery. They analyzed factors influencing the adoption of custom hiring services and discussed the implications for farmers' income, resource use efficiency, and overall agricultural development.

2.3 Web Applications for Farm Equipment:

Vatankhah and Mohanty (2017) presented an IoT-based web application for farm equipment management. It explored the integration of IoT devices with web technologies to monitor and manage farm equipment remotely. The authors discussed the benefits of real-time data collection, equipment tracking, and predictive maintenance offered by the web application. The study emphasized the potential of such applications in improving farm equipment efficiency and reducing operational costs.

Ali, et al. (2018) presented a cloud-based web application for remote monitoring and control of precision agriculture systems, including tractor operations. It discussed the integration of IoT devices, sensors, and web technologies to collect and analyze data on tractor performance, field conditions, and crop health. The authors highlighted the benefits of the web application in enabling remote access, real-time monitoring, and control of tractors for precision agriculture management.

Huang, et al. (2018) focused on the design and development of a web-based farm machinery management system. It highlighted the features of the system, including equipment inventory management, scheduling, maintenance tracking, and resource allocation. It discussed the benefits of the web-based platform in optimizing farm machinery usage, reducing downtime, and improving overall farm productivity.

Panda, et al. (2018) focused on the development of a web-based decision support system for smart farming, which includes tractor management. It explored the integration of IoT devices, sensors, and web technologies to collect and analyze data related to tractor operations, soil conditions, weather, and crop growth. The authors discussed how the web application provides farmers with real-time insights and recommendations for optimizing tractor activities in the context of precision agriculture.

Akbar and Mahmood (2019) introduced the concept of a "Smart Tractor" and presented a web application for tractor performance monitoring and optimization. It discussed the integration of sensors and IoT technologies to collect data on various tractor parameters, such as fuel consumption, engine performance, and maintenance requirements. The authors demonstrated how the web application enables real-time monitoring, performance analysis, and decision support for tractor operators.

Srikanth and Kankal (2019) presented the design and development of a web application specifically for precision agriculture. It explored the integration of various technologies, including GPS, sensors, and web-based platforms, to provide real-time monitoring and control of farm equipment. It discussed the capabilities of the web application in optimizing inputs, improving yield, and reducing environmental impacts through precise and targeted farming practices.

Brust and Mack (2020) discussed the integration of IoT sensors and web technologies to collect real-time data on tractor performance, fuel consumption, and location. It highlighted the benefits of the web application in optimizing tractor usage, improving operational efficiency, and enabling remote monitoring and control.

Pan, et al. (2020) focused on the design and implementation of a web-based platform for farm machinery sharing. It discussed the features of the platform, including equipment listing, availability tracking, and user management. It explored the benefits of facilitating equipment sharing among farmers, such as reducing equipment idle time, lowering costs, and enhancing resource efficiency. The authors highlighted the potential of web-based platforms in promoting collaborative farming practices.

Sikder and Tiles (2020) focused on the development of a web-based IoT application for precision agriculture, including tractor management. The authors discussed the integration of sensors, GPS technology, and web platforms to collect and analyse data related to tractor operations, field conditions, and crop health. It emphasized the role of the web application in optimizing tractor usage, improving resource efficiency, and enabling data-driven decision making.

Li, et al. (2021) presented a web-based farm machinery monitoring system utilizing Internet of Things (IoT) technologies. It discussed the implementation of IoT devices for real-time data collection, equipment tracking, and performance monitoring. The authors highlighted the advantages of the web-based system, including remote accessibility, data analytics, and decision support. It emphasized the potential of such systems in improving farm equipment management and operational efficiency.

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Chapter -3

Material and Methods

III. MATERIALS

This chapter deals with the selection of material such as domain, SSL certificate, database, pop up notifier etc. for the development of web application. Further, the methodology adopted for development of various features and its evaluation to achieve the objectives of the study is also elaborated in this chapter. Hence, this chapter has been divided into the following sub-headings.

- Project plan and Requirements gathering
- Development of features and flowcharts
- Different authentication system
- Testing procedure

3.1 Project Plan and Requirements Gathering

Project plan includes writing about features and designing of the basic structure in Figma UI/UX app, after that on the basis of structure writing code with programming language (HTML, CSS, javascript, wordpress) at IDE (Visual Studio Code). Next steps include testing of web application in terms of functioning and testing of web application's accuracy by farmers. The flow chart of the project plan is shown in Fig. 3.1.

3.1.1 Material required for development of web application

For web development, given softwares was required.

3.1.1.1 Domain

The application domain was purchased to register and acquire the website's unique name (https://chcm.caet.co.in/).

3.1.1.2 Hosting

Web hosting is the service that allows the web application to be accessible and available on the internet. The hosting cost covers the server space, bandwidth, and resources required to store and deliver the website's content to users.

3.1.1.3 SSL Certificate

An SSL (Secure Sockets Layer) certificate ensures secure communication between the web server and users' browsers. It encrypts data transmitted between the website and visitors, for example personal details of farmers and CHC owners. It provides essential security for online transactions and user data protection.

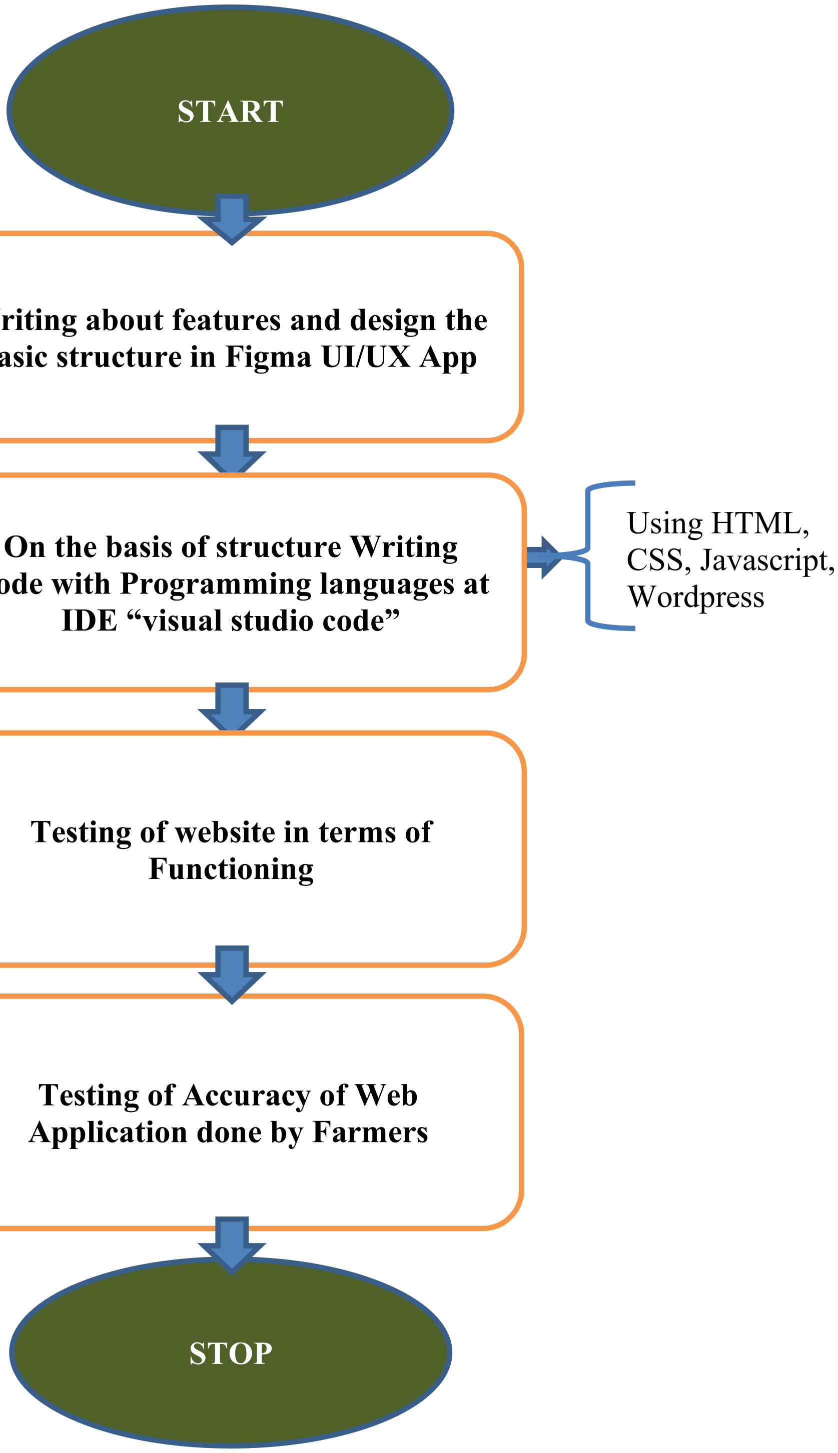


Fig 3.1 Flowchart of project plan

3.1.1.4 Connector

In the application connector was placed to get email of users registration, form data, contact data etc. It is used in integrating various modules, databases, or third-party services such as Google Map API.

3.1.1.5 Database

The database covers the setup and management of the database system that stores and manages the web application's data. It plays a crucial role in storing information about farm implements, rental orders, user accounts, and other essential data.

3.1.1.7 Pop-up Notifier

In application the pop-up notifier is a feature that provides reminders for tractor maintenance schedules or other important events related to the farm implements. This includes the development and implementation of this notification system in application.

3.1.1.8 Google Map API:

The Google Map API allows the integration of interactive maps of google into the web application, enabling users to accurately calculate the area of farmland or specific plots.

3.2 Development of features and flowcharts:

3.2.1 Farm implement and revenue calculator:

The code starts with the declaration of the HTML document structure, including the necessary CSS and JavaScript libraries. This code is an HTML document that includes JavaScript code to implement a farm implement revenue calculator. Here's a breakdown of the working procedure:

- The script includes the Google Translate API to provide language translation functionality for the website. It initializes the translation element and sets its options.
- The code defines a navigation bar at the top of the page with links to different sections of the website.
- The main body of the page contains a section for the farm implement revenue calculator. It includes a form with dropdown menus and input fields to select the farm implement, calculation method (time or area), and enter the corresponding value.
- The JavaScript function calculateCost() is defined to calculate the cost based on the selected implement, calculation method, and input value. It retrieves the values from the form elements and performs the cost calculation based on the implement type.
- The calculated cost is displayed in the <div id="result"></div> element on the page.

The page also includes necessary JavaScript libraries (jQuery, and Bootstrap) for the navigation bar and styling.

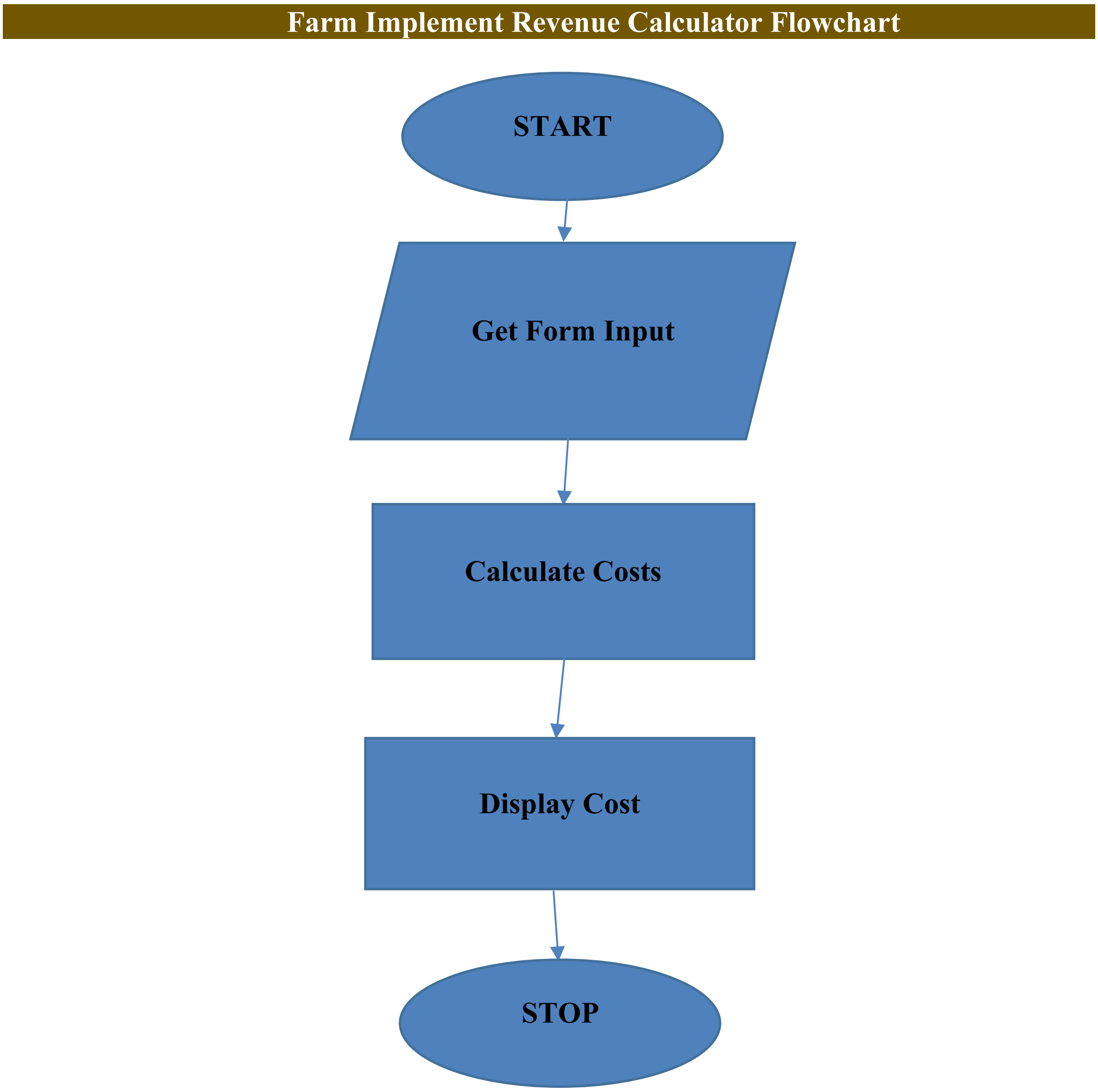


Fig.3.2 Revenue calculator flowchart

Overall, the code creates a webpage with a navigation bar and a farm implement revenue calculator that allows users to select an implement, choose a calculation method (time or area), and enter the corresponding value. The cost is calculated based on the user's input, and the result is displayed on the page.

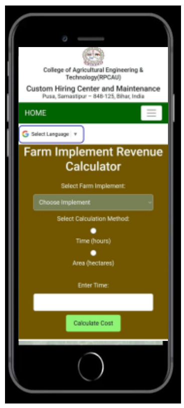


Fig 3.3 Revenue calculator

3.2.2 Tractor maintenance feature:

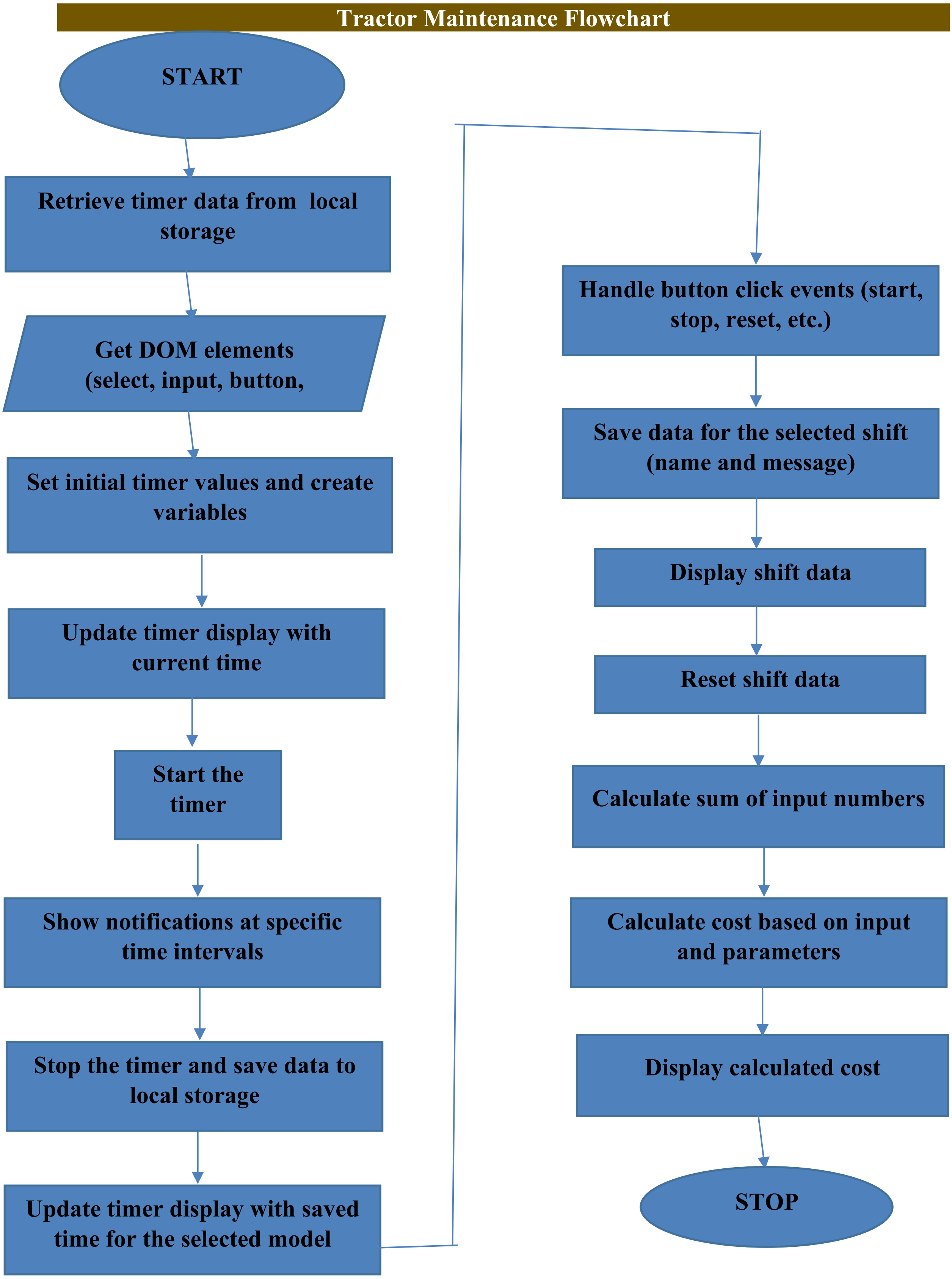


Fig 3.4 Tractor maintenance flowchart

The HTML code includes a navigation bar, a timer section with start and stop buttons, a form for shift-wise data saving, a section for calculating total hours, and a section for calculating revenue. It also includes references to external JavaScript libraries like jQuery and Bootstrap.

The JavaScript code handles the timer functionality, including starting and stopping the timer, updating the timer display, and saving the timer data to local storage. It also includes functions for saving and resetting shift-wise data, calculating total hours, and calculating revenue for a farm implement.

Timer for specific button page: To use the timer for a specific button, you need to choose a tractor model from the drop-down box and click on the start button.

For example, let's assume three tractor models in the drop-down box: MODEL-A, MODEL-B, and MODEL-C.

On DAY 1, select MODEL-A from the drop-down and start the timer by clicking the start button. After the end of the work for that day, you stop the timer. Let's assume the tractor worked for 4 hours on that day.

On DAY 2, you choose MODEL-B and start the timer, and after the end of the work for that day, you stop the timer. Let's assume the tractor worked for 3 hours on that day.

On DAY 3, you choose MODEL-A again and start the timer, and after the end of the work for that day, you stop the timer. Let's assume the tractor worked for 5 hours on that day.

For MODEL-A, the total running hours would be 9 hours. When the tractor's running hours reach 8, the app user would receive a notification with a message like, "Tractor running complete 8 hours. You need to check the tires of tractor MODEL-A."
Similarly, the user would receive notifications after completing 8 hours, 80 hours, 250 hours, and so on for each tractor model.

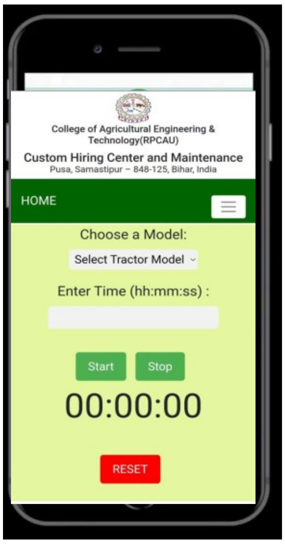


Fig 3.5 Tractor Maintenance feature

3.2.3 Cost estimation feature:

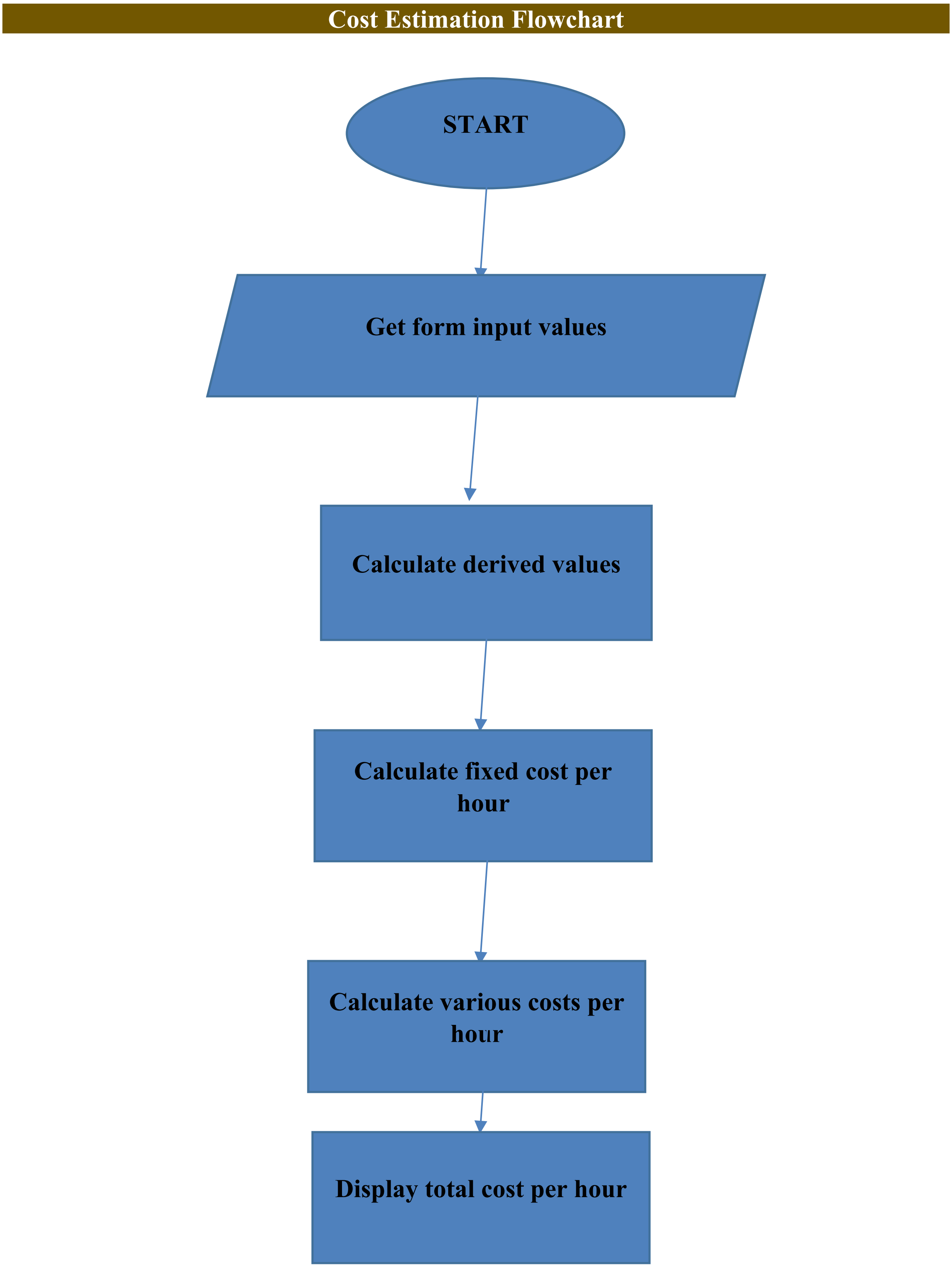


Fig 3.6 Cost Estimation flowchart

Step-by-step breakdown of the code's working procedure:

1. The script starts by selecting the form element with the id "pruning-machine-form" and attaching an event listener to it.
2. When the form is submitted, the event listener callback function is executed.
3. The callback function begins by preventing the default form submission behaviour using `event.preventDefault()`, which prevents the page from refreshing.
4. The function retrieves the values entered by the user from various input fields in the form, such as "machine-cost," "salvage-value," "life-years," etc. The `querySelector` method is used to select the input elements by their id, and `parseFloat` is used to convert the input values to floating-point numbers.
5. Next, the code calculates the cost per hour for various factors related to the pruning machine.

- It calculates the driver cost per hour by dividing the total driver cost by 8 hours.
- It calculates the labour cost per hour by dividing the total labour cost by 8 hours.
- It calculates the depreciation per year by subtracting the salvage value from the machine cost and dividing it by the number of years of machine life.
- It calculates the interest per year by multiplying the sum of machine cost and salvage value with the interest rate (as a percentage) and dividing it by 200.
- It calculates the insurance, taxes, and housing cost per year as 3% of the machine cost.
- It calculates the fixed cost per hour by dividing the sum of depreciation, interest, and insurance, taxes, and housing cost per year by the number of annual use hours.
- It calculates the repair and maintenance cost per year as 10% of the machine cost.
- It calculates the fuel cost per hour by multiplying the fuel cost with the fuel consumption.
- It calculates the lubrication cost per hour as 30% of the fuel cost per hour.
- It calculates the driver and labour cost per hour by summing the driver cost per hour with the labour cost per hour multiplied by the number of laborers.
- It calculates various costs per hour by dividing their respective costs per year by the number of annual use hours.
- It calculates the total cost per hour by summing up all the calculated costs per hour.

6. Finally, the code updates the content of the HTML element with the id "total-cost" to display the calculated total cost per hour, formatted as "Total cost per hour: ₹" followed by the rounded total cost value.

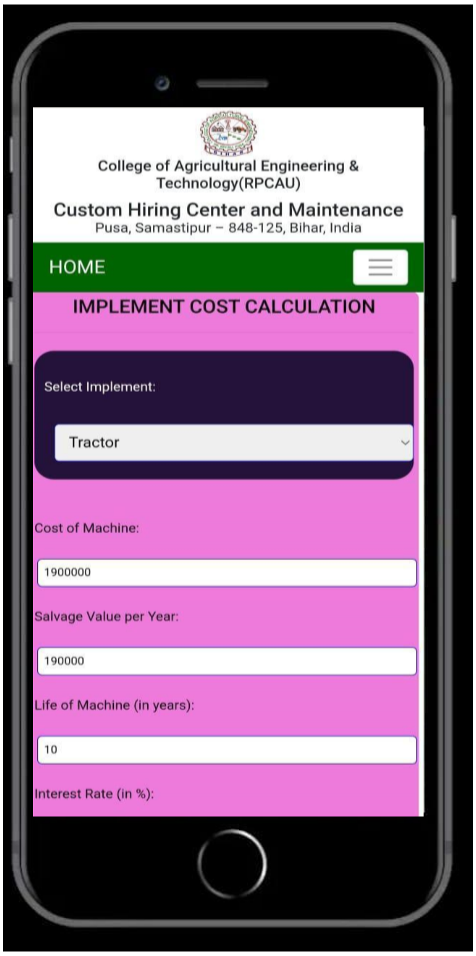


Fig 3.7 Implement Cost Calculation feature

Please note that the code snippet provided does not include the HTML form elements or the input fields that the JavaScript code references. To get a complete understanding of the code's functionality, the surrounding HTML markup and the form structure would be required.

3.2.4 GPS area measurement feature:

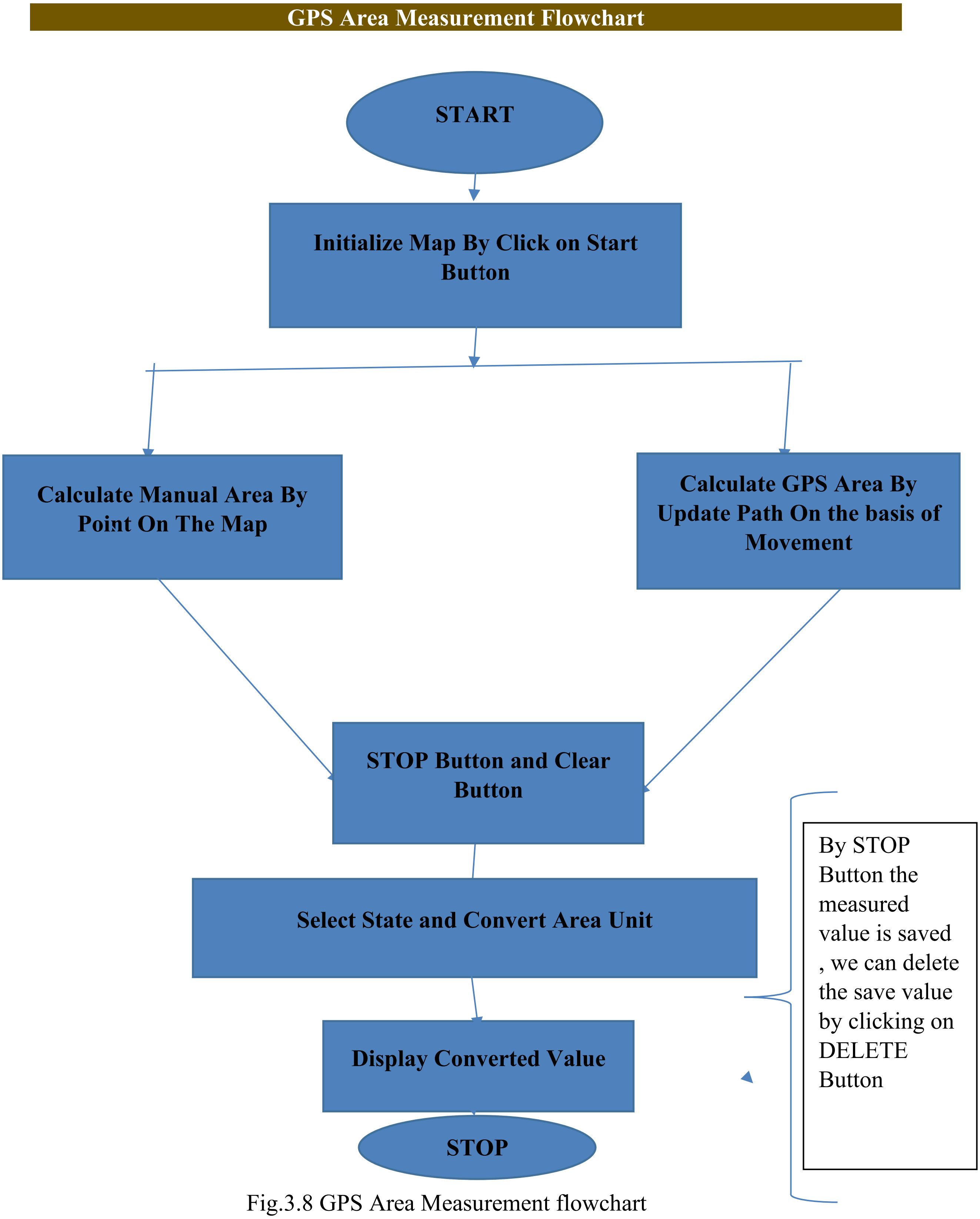


Fig.3.8 GPS Area Measurement flowchart

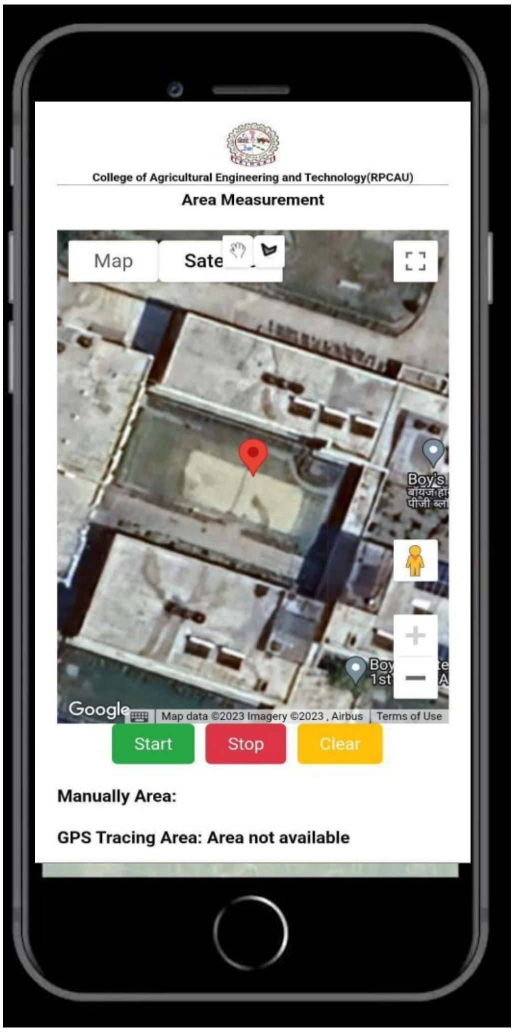


Fig.3.9 Area Measurement feature

Measuring the area using GPS on mobile devices involves utilizing the GPS capabilities of smartphones or tablets to track movement and calculate the covered area. By enabling GPS tracking on a mobile device and walking around the desired area, the device can record and track the coordinates of the user's location. The collected GPS data is processed using applications that calculate the area based on the recorded coordinates. This method provides a convenient and accessible way to measure the area of a specific location without the need for traditional measuring tools.

3.3 Different authentication systems:

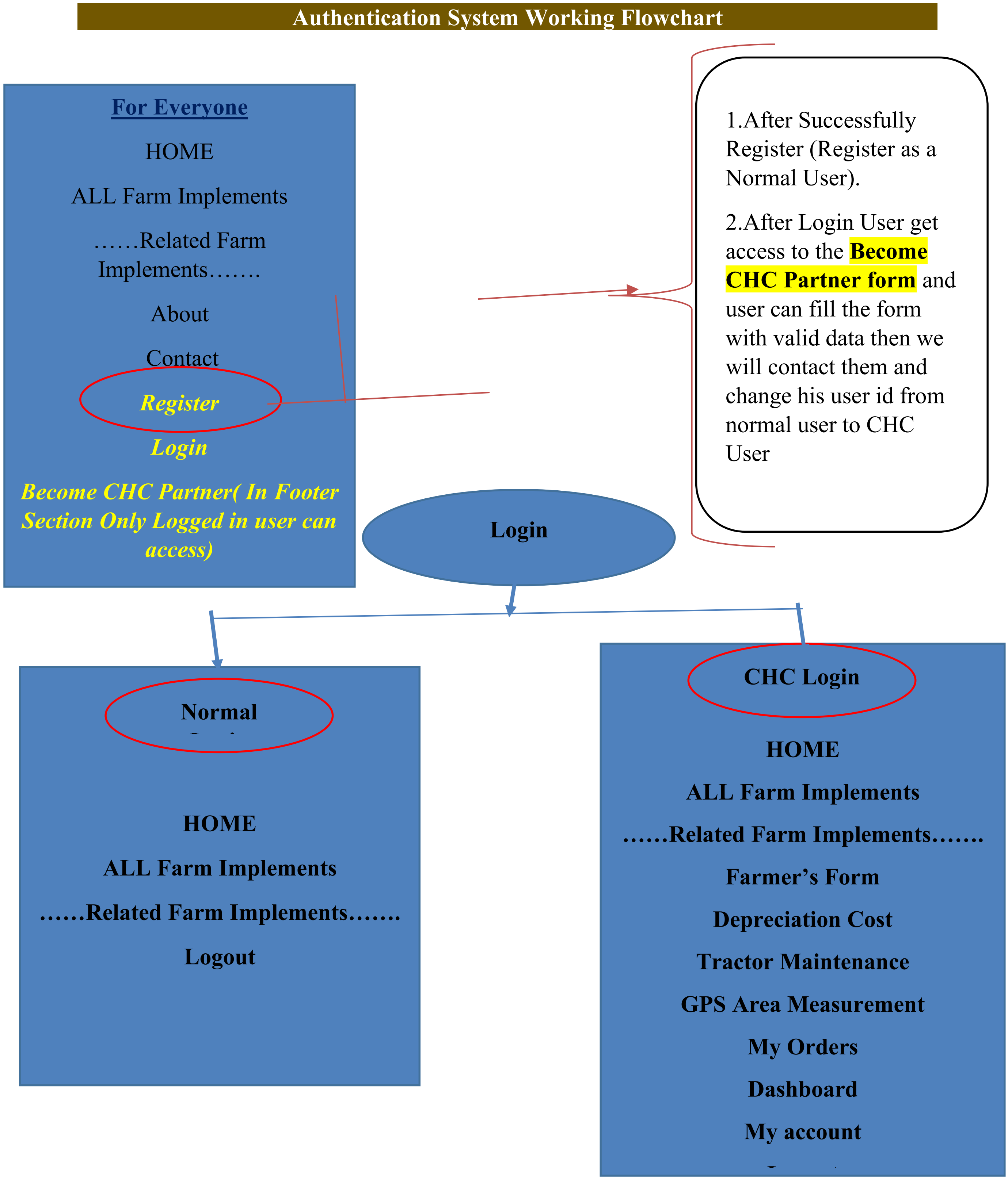


Fig. 3.10 Authentication System Working flowchart

Normal Authentication System Flowchart

Normal authentication is developed for Farmers who want to hire farm implements basically.

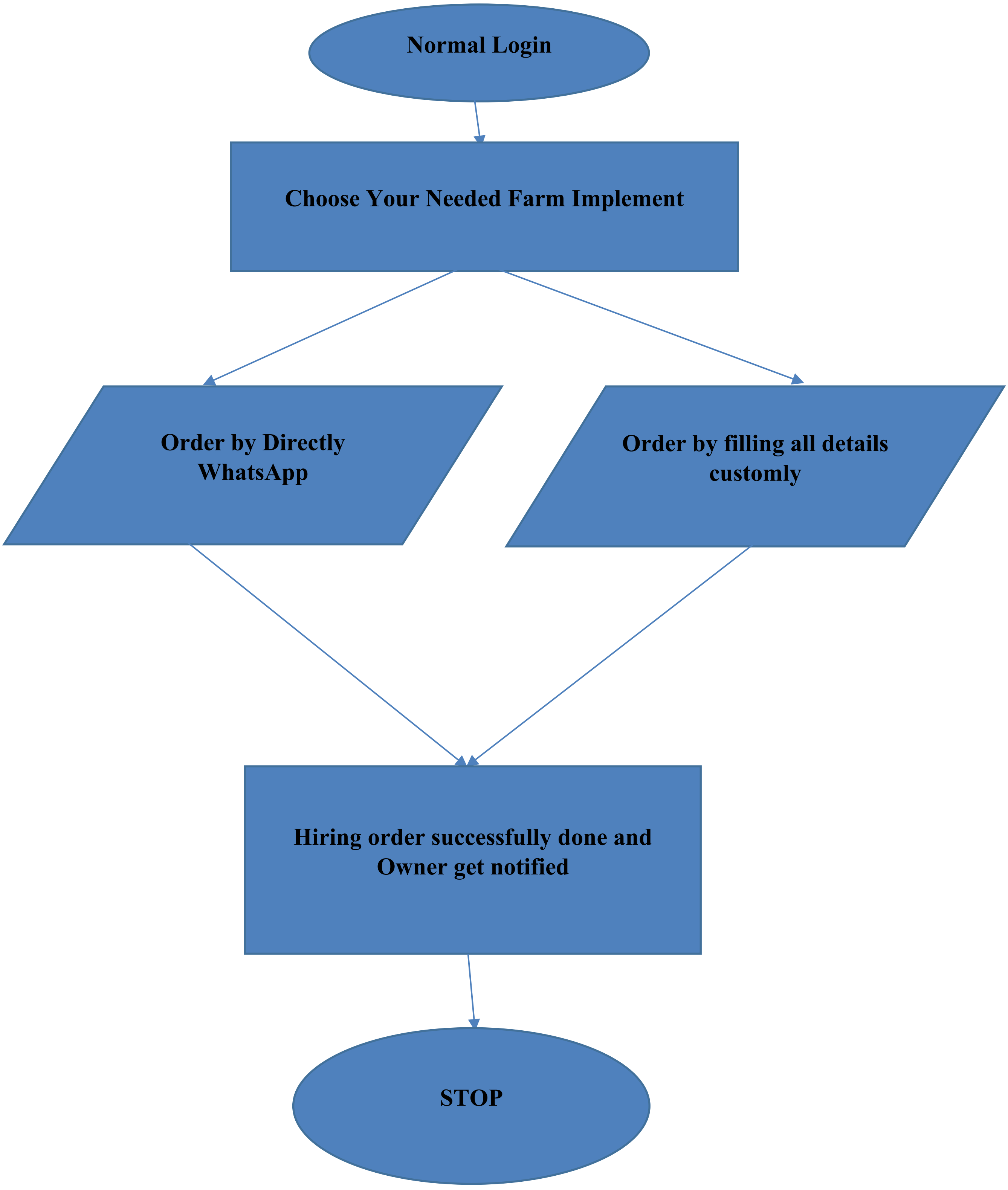


Fig. 3.11 Normal Authentication System flowchart

CHC Authentication System Flowchart

CHC authentication is developed for CHC Owners, who basically run a CHC Centre or A Farm Implements owner who gives his machinery by rent to the farmers.

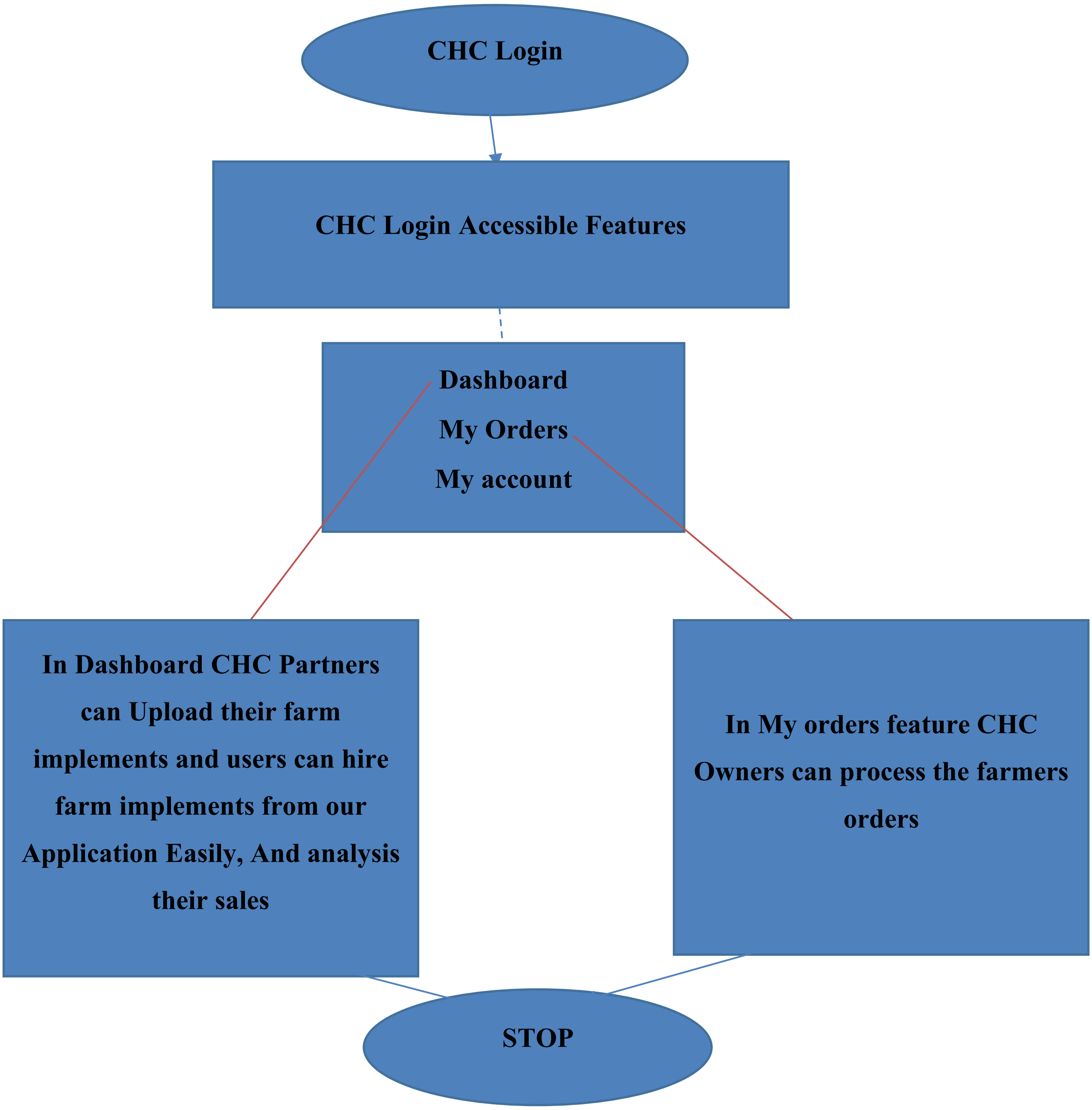


Fig.3.12 CHC Authentication System flowchart

3.4 Testing procedure:

The purpose of this testing of features is to provide an overview of the performance and its outcomes for the farm implement hiring and maintenance applications. The testing was conducted with 10 users who signed up on the application and performed various field operations. For the second part of the testing, we change the role of those 10 users from farmer to CHC owners for the testing of features that are exclusively for CHC owners, like farm implements uploading for hiring purpose, tractor maintenance, work record information, cost estimation, and area measurement. The testing process involved recording shift wise data, calculating operating costs, and generating final cost reports to be sent via email to the registered users. Additionally, the area calculator feature was tested by comparing the calculated farm area through the application with manual measurements.

During the testing period, 10 users successfully signed up on the application by filling out the provided farmer form. The form included various personal details such as name, email, and other relevant information.

Chapter –4

Results and Discussion

IV. RESULTS AND DISCUSSION

The objective of this project was to develop a web application for custom hiring and maintenance of farm implements. The application aimed to provide a platform for farmers to easily hire farm equipment and schedule maintenance services. In this section, we will discuss the results of the project and provide an analysis of the implemented features. This chapter will include:

- Feature analysis
- Testing of features of web application
- Performance report of application by google

4.1 Feature analysis:

A web application for custom hiring and maintenance of farm implement provides various features to enhance user experience and increase efficiency. Here's a feature analysis of such a web application:

4.1.1 Farm Implement uploading by CHC partner :

It provides a catalog of available farm implements for hiring which include detailed information about each implement, such as type, specifications, and availability status.

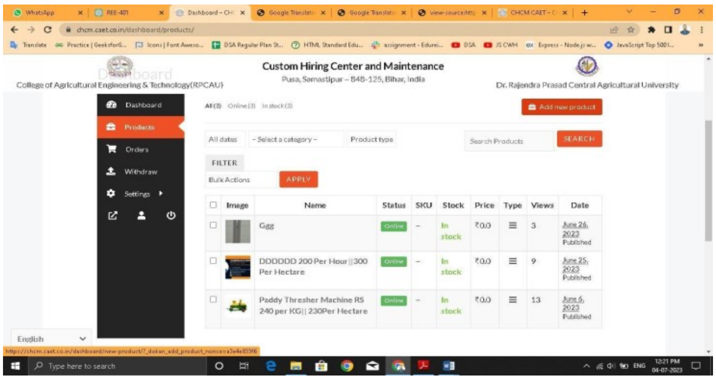


Fig.4.1 Farm Implement uploading by CHC partner

Customers can also search location wise and select according to their convenience. CHC partners can add new products by adding a picture of the respective implement. Multilingual support had also been added to cater to users from different regions.

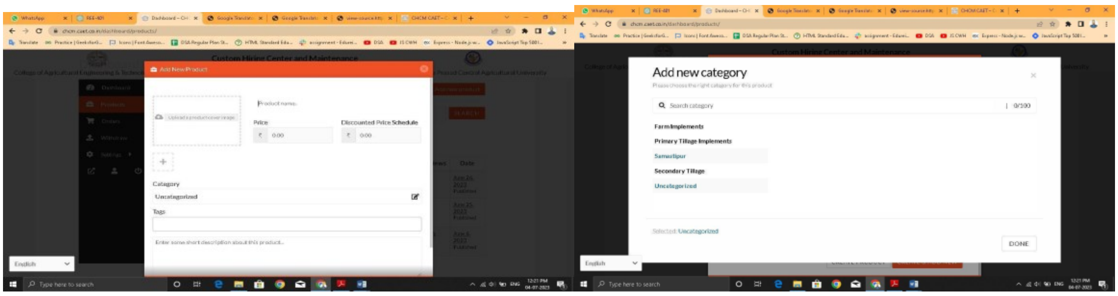


Fig.4.2 Farm Implement uploading by CHC partner

4.1.2 Implement cost calculator

Implement cost calculator for custom hiring and maintenance of farm implements is a crucial feature that can greatly benefit farmers and farm equipment service providers. It allows farmers to input details such as the type of implement needed, the area to be covered, duration of hiring, and any specific requirements. Based on the input parameters, calculate the total cost for hiring the specific implement. It displays a breakdown of the cost, including hourly rates, fuel charges, operator fees (if applicable), and any additional charge.

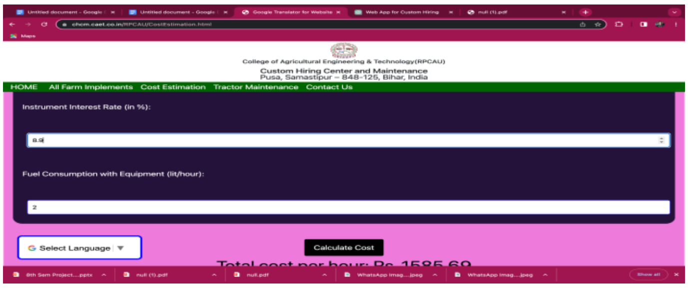


Fig. 4.3 Implement Cost Calculator

4.1.3 Area measurement

This feature allows users to accurately calculate the area of their farmland or specific plots, which is essential for various agricultural activities. To implement area measurement, you'll need to integrate with a geospatial API that provides the necessary functionalities for measuring areas. The web application has a user-friendly map interface where users can interact and draw the boundaries of the area they want to measure. The map allows users to zoom in/out, pan, and mark points to define the boundary. Also after the area is calculated in terms of meter square then by selecting state we can convert it to any selected area unit.

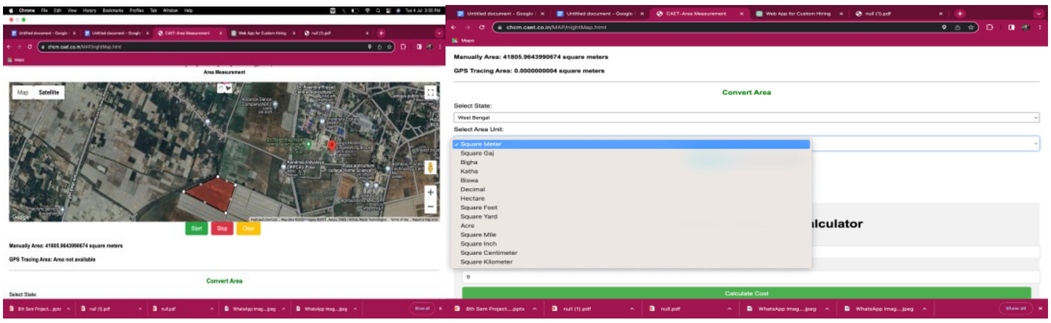


Fig.4.4 Area Measurement Feature

4.1.4 Pop-up Notifier for tractor maintenance

The application allows users to set up periodic maintenance reminders based on time or usage (hours of operation). These reminders can be in the form of pop-ups or notifications, ensuring that customers never miss crucial maintenance schedules. Each pop-up include a checklist of essential maintenance tasks that need attention, such as checking oil levels, battery water levels, air filters, coolant levels, etc.

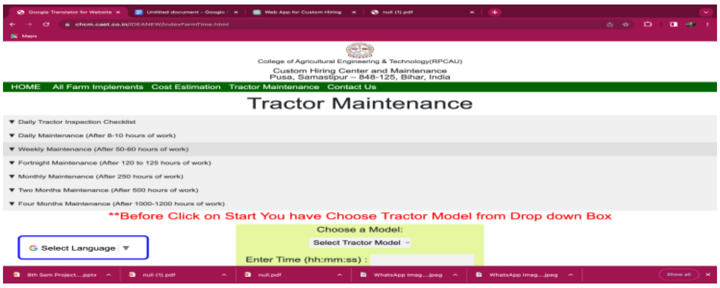


Fig.4.5 Pop-up Notifier

4.1.5 Revenue Calculator for farm implements

It allows farmers to make an informed decision about the hiring/ buying of specific product. In the application, timer feature allows users to choose a tractor model, enter a time in the format "hh:mm:ss," and start or stop the timer. The timer displays the elapsed time in the "00:00:00" format. There is a section where users can enter numbers separated by commas and click on the "Add" button to calculate the sum of the numbers which is time of field operation. After that users can select a farm implement (e.g., tractor, combine harvester, plough) and choose a calculation method (time or area). Users can enter a value and click on the "Calculate Cost" button to calculate the cost. If required a button is available that allows users to download their work data as a Word file.

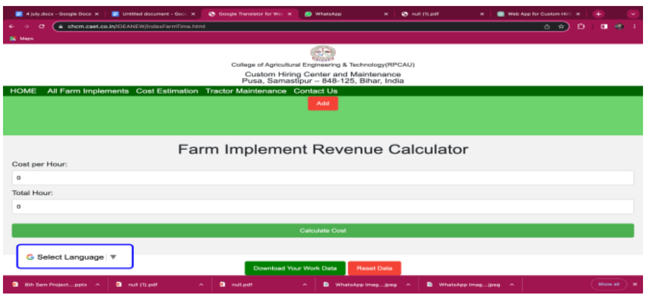


Fig.4.6 Revenue Calculator for farm implement

4.1.6 Implement hiring process

This feature allows the customer to select the equipment they require. The application provides a comprehensive catalog of available farm implements, categorized by type and specifications. Users can browse through the catalog and select the specific implement they need for their farming activities. The catalog includes detailed information about each implement, such as its features, availability status, and rental charges. Once the customer has selected the desired equipment, they have two options to proceed with the rental process. The first option is to send a rental inquiry via WhatsApp. The website provides a WhatsApp button or contact number for users to directly communicate their rental requirements to the service provider. This option offers a quick and convenient way for users to initiate the rental process and inquire about availability, pricing, and any other details. The second option for renting equipment is to fill out an order form available on the website. To access the order form, users are required to log in to their accounts. If they don't have an account, they can create one easily by providing the necessary details. Logging in ensures a personalized experience and allows users to track their orders and manage their rental history.

The order form prompts users to provide specific details related to their rental requirements. This may include the desired rental duration, start and end dates, delivery preferences, and any additional instructions or customization requests. After filling out the order form, users can review their rental details and make any necessary changes. Once they are satisfied with the information provided, they can proceed to confirm the order.

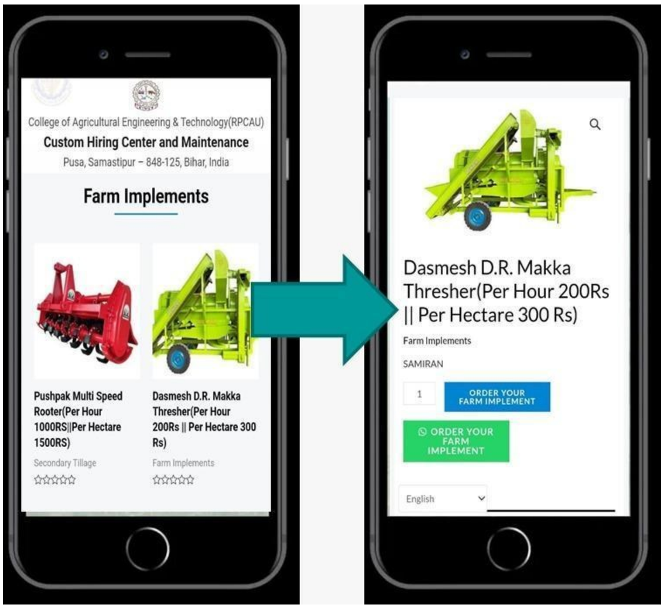


Fig.4.7 Implement hiring process

4.1.7 Work information recorder

After completing the work, users are required to fill out a form and submit it. In the email section of the form, users enter the email address of the CHC (Custom Hiring Center) owner. The filled data is automatically sent to the CHC owner's email, ensuring that all work details are received without any data loss. This process facilitates seamless communication and allows the CHC owner to access and review all the relevant work information. The CHC owner is required to log in before filling out the form.

Fig.4.8 Work information recorder

4.2 Testing of features of web application:

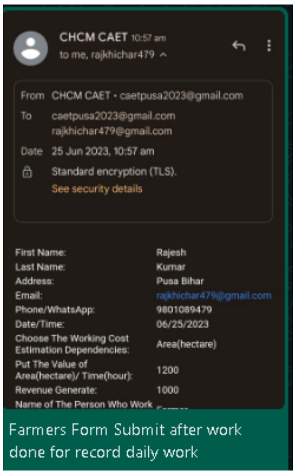


Fig.4.9 Confirmation after work done

The farmers were able to input their data without any issues. The application effectively recorded shift wise data for each farmer's field operations. The start and stop times of the operations were accurately captured, and the data was summed up at the end of each day. This feature functioned as intended and provided an accurate record of the farmers' work hours. The application successfully generated automatic cost calculations based on the recorded shift wise data. The cost calculation algorithm accurately determined the operation costs for each farmer, considering factors such as labour, machinery, and other relevant parameters.

Original Hours	Original Seconds	Testing Seconds
8-10	28800	20
50-60	180000	25
120-125	432000	30
250	900000	35
500	1800000	45
1000-1200	3600000	55

Fig 4.10 testing result

After the cost calculation, the application automatically sent detailed cost reports to the registered users via email. The email notifications included the farmers' personal details as well as the calculated cost. Verification of the received data via email confirmed that the information matched the recorded data within the application. This feature ensured transparent communication and provided users with accurate cost breakdowns.During the testing period, any discrepancies identified in the application's functionalities were diligently noted and addressed.

The area calculator feature of the application was tested by having the farmers cover the corners of their respective farms using the provided feature. The application accurately displayed the farm area in hectares, along with the shape and location of the farm. This information was then compared to the area calculated manually. The accuracy of the area measurement feature was found to be 99.80%.

In conclusion, the testing process for the farm implement hiring and maintenance application was successful, with the application demonstrating reliable functionality and accurate calculations. The email notification system, data recording, and area calculator features performed as expected, delivering the intended results. Any identified discrepancies were promptly resolved, ensuring a robust and user-friendly final product.

Size class	Breakpoints	Typical screen size	Devices	Window Sizes
Small	up to 640px	20" to 65"	TVs	320x569, 360x640, 480x854
Medium	641 - 1007px	7" to 12"	Tablets	960x540
Large	1008px and up	13" and up	PCs, Laptops, Surface Hub	1024x640, 1366x768, 1920x1080

Fig 4.11 Responsiveness

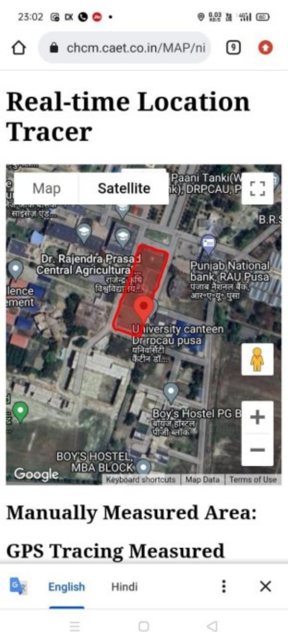
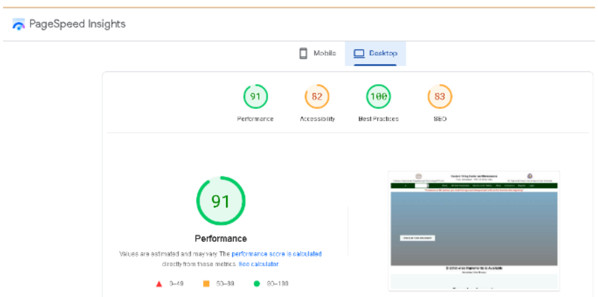
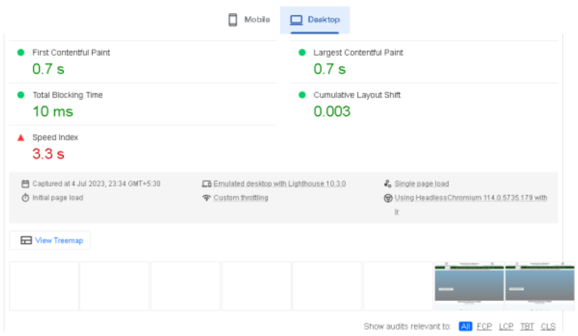


Fig 4.12 Comparison of area measured from different application

4.3 Performance report of application by Google:

4.3.1 For Desktop:





4.3.2 For Mobile:

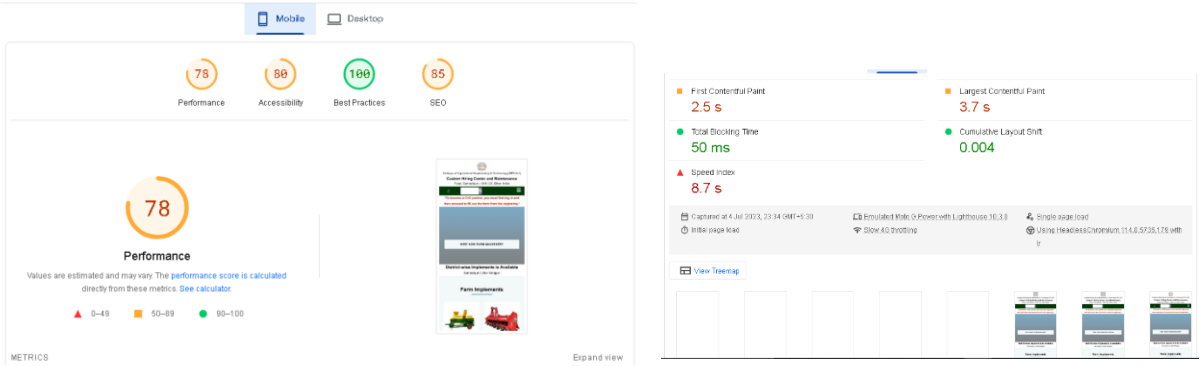


Fig 4.13 Performance report of application by Google for desktop and mobile

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Chapter -5

Summary and conclusions

V. SUMMARY AND CONCLUSIONS

Tractors and their implements are essential tools in modern agriculture, enabling farmers to perform various tasks efficiently. Traditionally, farmers have faced challenges when it comes to acquiring tractors and implements for their farming operations. The process often involves time-consuming manual searches, negotiations, and coordination with multiple suppliers.

The development of web application for custom hiring of tractor implements and maintenance helps to tackle the challenges faced by farmers, enhance accessibility and affordability, streamline maintenance management, and integrate technology into the agricultural sector. The project aimed to create a user-friendly platform that connects farmers and CHC owners for rental services while also offering maintenance of tractors and support services for the agricultural equipment. Materials used in the development of web application are SSL certificate, web domain, hosting, connector, database, pop up notifier, Google Map API. Process of development included writing about features and designing of the basic structure in Figma UI/UX app after that on the basis of structure, coding with programming languages (HTML, CSS, JavaScript, WordPress) at IDE(Visual Studio Code).

The web application includes various features like area measurement, implement cost calculator, pop up notifier for tractor maintenance, farm implement revenue calculator, implement hiring feature, farm implement uploading feature. Proper testing of these features was also done with help of a focus group. For the testing of features 10 users were required to sign up on the application by filling up various details provided on the farmers form and for testing of area calculator, users through application will cover the corners of their respective farms through the feature provided on the application, area in hectare will be shown which will get compared to area acquired through manual means.

Conclusions:

- The application allows farmers to input details such as the type of implement needed, the area to be covered, duration of hiring, and any specific requirements. Based on the input parameters, it calculates the total cost for hiring the specific implement.
- The platform allows users to accurately calculate the area of their farmland or specific plots, which is essential for various agricultural activities.

- CHC owners could list their available equipment on the platform, including details like specifications, hourly/daily rates, and location. Farmers could search and hire tractors that best suited their needs
- The platform facilitated the booking process, enabling users to schedule tractor services.
- In addition to hiring services, the application offered maintenance and support features. Tractor owners could request maintenance tasks, and authorized service providers could address the issues promptly.
- The application implemented real-time notifications to keep users informed about booking confirmations, maintenance updates, and other relevant activities.
- The accuracy of the area measurement feature was found to be 99.80%.
- According to performance report of application by Google, for desktop, the score awarded to the application on the basis of performance, accessibility, and SEO are 91,82 and 83 respectively.
- According to performance report of application by Google, for mobile, the score awarded to the application on the basis of performance, accessibility, and SEO are 78,80 and 85 respectively.

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Appendix

VI. APPENDIX

Tractor Maintenance:

```
var messages = {};
var initialMessages = {};
var currentDate1 = new Date().toLocaleDateString();
// Retrieve existing messages from localStorage
var storedMessages = localStorage.getItem("alertMessages");
if (storedMessages) {
initialMessages = JSON.parse(storedMessages);
}

// Copy initialMessages to messages object
messages = { ...initialMessages };


intervalId = setInterval(() => {
updatedTime = initialTime;
var selectedModel = document.getElementById("model-select").value;

if (!messages[selectedModel]) {
messages[selectedModel] = [];
}
// document.getElementById(
//   "MESSAGE"
// ).innerHTML = `Final ->${initialTime}     and  initial  ->  ${InputFarmTime}
Updated time ${updatedTime}`;
// get notification after 8 Hour
if (initialTime % 28800 == 0) {


var message = ` ${selectedModel}-> Daily Maintenance (After 8-10 hours of work)
->Date= (${currentDate1})`;
alert(message);
messages[selectedModel].push(message);
}

if ((initialTime + 1) % 28800 == 0) {
var audio = new Audio("alarm.mp3");
audio.play();
}

localStorage.setItem("alertMessages", JSON.stringify(messages));
}, 1000);
```

```
var messageElement = document.getElementById("messages111");
var textareaElement = document.getElementById("dataTextArea11");

function displayMessages() {
var selectedModel = document.getElementById("model-select").value;
var storedMessages = localStorage.getItem("alertMessages");
if (storedMessages) {
messages = JSON.parse(storedMessages);
messageElement.innerHTML = ""; // Clear previous messages

if (selectedModel && messages[selectedModel]) {
var modelMessages = messages[selectedModel];
for (var i = 0; i < modelMessages.length; i++) {
var messageItem = document.createElement("li");
messageItem.textContent = modelMessages[i];
messageElement.appendChild(messageItem);
}
}
}

}
setInterval(function() {
displayMessages();

textareaElement.value = messageElementToList();

function messageElementToList() {
var listItems = messageElement.getElementsByTagName("li");
var list = "";
for (var i = 0; i < listItems.length; i++) {
list += (i + 1) + ". " + listItems[i].textContent + "\n";
}
return list;
}


}, 1000);

setInterval(displayMessages, 1000);
}
```

GPS Area Measurement:

```
function initMap() {
    map = new google.maps.Map(document.getElementById('map'), {
      center: {lat: 0, lng: 0},
      zoom: 14
    });

    marker = new google.maps.Marker({
      map: map,
      animation: google.maps.Animation.DROP
    });

    path = new google.maps.Polyline({
      map: map,
      strokeColor: '#FF0000',
      strokeOpacity: 1.0,
      strokeWeight: 3
    });

    drawingManager = new google.maps.drawing.DrawingManager({
      drawingMode: google.maps.drawing.OverlayType.POLYGON,
      drawingControl: true,
      drawingControlOptions: {
        position: google.maps.ControlPosition.TOP_CENTER,
        drawingModes: [
          google.maps.drawing.OverlayType.POLYGON
        ]
      },
      polygonOptions: {
        fillColor: '#FF0000',
        fillOpacity: 0.3,
        strokeWeight: 2,
        editable: true,
        clickable: false,
      //   clickable: false,
        zIndex: 1
      }
    });
```

Cost Estimation:

```
// Get the dropdown element and input box elements
const dropdown = document.getElementById("additional-equipment");
const inputBoxes1 = document.querySelectorAll(".EquipmentDropDownBox");

// Hide the input boxes initially
inputBoxes1.forEach((inputBox) => {
  inputBox.style.display = "none";
});

// Add an event listener to the dropdown
dropdown.addEventListener("change", function () {
  // Get the selected option value
  const selectedOption = dropdown.value;

  // Show or hide the input boxes based on the selected option
  if (selectedOption !== "") {
    inputBoxes1.forEach((inputBox) => {
      inputBox.style.display = "block";
    });
  } else {
    inputBoxes1.forEach((inputBox) => {
      inputBox.style.display = "none";
    });
  }
});
```

Work Data Information:

```
<script id="tmpl-nf-field-textbox" type="text/template">

<input
type="text"
value="{{{ _.escape( data.value ) }}}"
class="{{{ data.renderClasses() }}} nf-element"
{{{ data.renderPlaceholder() }}}
{{{ data.maybeDisabled() }}}
{{{ data.maybeInputLimit() }}}

id="nf-field-{{{ data.id }}}"
<# if( ! data.disable_browser_autocomplete && -1 < [ 'city', 'zip' ].indexOf( data.type ) ){ #>
name="{{ data.custom_name_attribute || 'nf-field-' + data.id + '-' + data.type }}"
autocomplete="on"
<# } else { #>
name="{{ data.custom_name_attribute || 'nf-field-' + data.id }}"
{{{ data.maybeDisableAutocomplete() }}}
<# } #>

aria-invalid="false"
aria-describedby="nf-error-{{{ data.id }}}"
aria-labelledby="nf-label-field-{{{ data.id }}}"

{{{ data.maybeRequired() }}}
>
</script>
```

Farm Implement Upload:

```
<script type="text/html" id="tmpl-playlist-settings">
<h2>Playlist Settings</h2>

<# var emptyModel = _.isEmpty( data.model ),
isVideo = 'video' === data.controller.get('library').props.get('type'); #>

<span class="setting">
<input type="checkbox" id="playlist-settings-show-list" data-setting="tracklist" <# if ( emptyModel ) { #>
checked="checked"
<# } #> />
<label for="playlist-settings-show-list" class="checkbox-label-inline">
<# if ( isVideo ) { #>
```

```
Show Video List <# } else { #>
Show Tracklist <# } #>
</label>
</span>

<# if ( ! isVideo ) { #>
<span class="setting">
<input type="checkbox" id="playlist-settings-show-artist" data-setting="artists" <# if (
emptyModel ) { #>
checked="checked"
<# } #> />
<label for="playlist-settings-show-artist" class="checkbox-label-inline">
Show Artist Name in Tracklist </label>
</span>
<# } #>

<span class="setting">
<input type="checkbox" id="playlist-settings-show-images" data-setting="images" <# if (
emptyModel ) { #>
checked="checked"
<# } #> />
<label for="playlist-settings-show-images" class="checkbox-label-inline">
Show Images </label>
</span>
</script>
```

Become CHC Partner:

```
<script id="tmpl-nf-field-address" type="text/template">
<input
type="text"
value="{{{ _.escape( data.value ) }}}"
class="{{{ data.renderClasses() }}} nf-element"

id="nf-field-{{{ data.id }}}"
<# if( ! data.disable_browser_autocompletes ){ #>
name="{{ data.custom_name_attribute || 'nf-field-' + data.id + '-' + data.type
}}"
autocomplete="address-line1"
<# } else { #>
name="{{ data.custom_name_attribute || 'nf-field-' + data.id }}"
{{{ data.maybeDisableAutocomplete() }}}
<# } #>
{{{ data.renderPlaceholder() }}}
{{{ data.maybeDisabled() }}}

```

aria-invalid="false"
aria-describedby="nf-error-{{{ data.id }}}"
aria-labelledby="nf-label-field-{{{ data.id }}}"
{{{ data.maybeRequired() }}}
>
</script>

7.7 Formula used to calculate the accuracy of area measurement feature

Accuracy (%) = (Area measured by Google API/Area measured by manual means)*100

= (4492.36 sq. m/4501 sq.m) *100

= 99.80%

***