A smart solution for in farm complete tractor activity tracking system over cloud

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***Abstract*— The majority of the agricultural operations performed by the farmers day by day are using heavy mechanized equipment. The mechanized equipment's such as tractors cultivators and plough are used for performing the agricultural operations of the farmers. Most of the farmers can't afford the tractors and heavy mechanized equipment on their own. Hence they have to take the equipment's on rental and perform the necessary tasks required for the agriculture. The major problem faced by farmers today is keeping the track of the work done by these rented equipment's . The Rental provider will charge for rent on day basis and there is no systematic way to keep a track of the actual work done by the tractor in the field. This results in farmers paying more for lesser amount of work done which is financial burden for farmers. Our work proposes an innovative concept of smart automatic work tracking system for agricultural activities using GPS and IOT. This system consists of smart sensor based device which will be fit on the tractors performing the operations in the field. The device will continuously monitor and track the work done by the tractor right from the starting of the tractor to the actual work done. The sensors are present to detect the start time of the tractor, Exact geographical location of the tractor, the Fuel consumed, which particular task is performed for how much time and complete tracking of the work performed in the field. The system monitors the complete tracking data and then logs the same to the IOT based server which can be monitored remotely to keep a track of the same. Thus implementation can solve the problems faced by the farmers as they can track the actual work done in the farm and pay only for the amount of the work done.**

***Keywords*— IOT, GPS, Cloud & Sensor**

I. INTRODUCTION

Agriculture plays a significant role in most countries and there is an enormous need for this industry to become "Smart". The Industry is now moving towards agricultural modernization by using modern smart technologies to find solutions for effective utilization of scarce resources there by meeting the ever increasing consumption needs of global population. With the advent of Internet of Things and Digital transformation of rural areas, these technologies can be leveraged to remotely monitor soil moisture, crop growth and take preventive measures to detect crop damages and threats. Utilize artificial intelligence based analytics to quickly analyse operational data combined with 3rd party information, such as weather services, expert advises etc., to provide new insights and improved decision making there by enabling farmers to perform "Smart Agriculture".

Several approaches have been used to monitor farming operations, including writing notes manually, using agricultural equipment with an automatic recording function, and monitoring operations with information technology (IT)-based tools. Keeping a farming diary is a common method, but it is troublesome to farmers and inefficient to share or use their hand-lettered information. Some facilities and machinery can be appended to have an automatic recording function, but it requires considerable effort and cost to make these improvements.

However it is also important to track agricultural operations performed on tractor and using tractor for calculation of operational costs. The tractors are rented on per day basis or per hour basis and there is no solution to track the actual work performed by the tractor or the work hours required. This project proposed an Unique concept of Complete agricultural tracking system for tractors using Smart system over IOT Using GPS and smart sensors[1].

Since the introduction of the global positioning system (GPS) in 1994, GPS-tracking has become widely used in many application area ranging from military ,security system , logistics and healthcare . In agriculture, GPS tracking is going to become a revolutionary tool for modernization of agriculture today. GPS combined with other navigation technologies, such as laser path finding and accelerometer, has been a central part for agricultural vehicle guidance and farming automation. However, adoption of such system in developing countries is rare due to relatively high installation cost. In addition, most commercially available tracking and guidance systems are developed based on the agricultural infrastructure in the manufacturer countries that may require further customization for the imported countries. Hence, development of a low-cost version of this system domestically could be beneficial for the local farmers. Tractor tracking is the most primitive functionality within the on-tractor precision agriculture. This function can be used per se to monitor the tractor uses in farm, which can lead to optimization of resources applied in the field. The technology allows the farm owner to know in real-time the current location of a tractor. Analysis of the tractor path helps farmer plan proper schedule, verify field operation and investigate driver's behaviour. For example, in the large farm, farmer can use GPS tracking to verify gasoline use in one day or control and check worker activities. In addition all the activities can be tracked to verify the actual amount of work done to the claimed work to avoid any false claims and wastage of money[7].

II. OBJECTIVE OF PROPOSED WORK

The main objective of this implementation is to develop an intelligent solution for complete tracking of the actual work done by the tractors in the farm in comparison to the claimed work done by developing a smart solution for complete tracking of agricultural work done by the tractors in the field. The objectives of the project are:

1. To develop an smart system which can be incorporated in the tractor to determine and track every individual work activity of the tractor
2. To implement RTC based system to keep a time track of the Work done by the tractor
3. To implement GPS based tracking system which can be used to track the Exact geographical location of the tractor
4. To implement Smart Fuel consumption monitoring system to keep a track of the Fuel Used
5. To Implement Task detection system so that the time when the tractor started working on actual task like plough or cultivation can be tracked.
6. To develop an IOT based system on the cloud which consist of a software to keep a track of live as well as history activities of the farmer and can be visualized on the internet.
7. To Implement Automatic Weeding system which can be used to perform weeding operation in the field
8. To implement Fixed pitch seed sowing system in the developed prototype which will permit the use of the system for automatic seed sowing system
9. To add Spraying system which be used to spray the Insecticides and pesticides in the farm
10. To make the system economical to be implemented in every tractor.

III. METHODOLOGY

To keep the flow of our implementation simple and to complete with minimum errors the it is divided into number of modules or phases which can be carried out step by step to minimize the errors at the end. The different phases of the implementation are:

1. Market survey and material Selection
2. Hardware Design
3. Interfacing of GPS modem to develop tracking system
4. Smart Fuel Consumption monitoring system development
5. The Agricultural Task Tracking system development
6. The Distance tracking system Development
7. Cloud Software development and Deployment
8. The IOT protocol Development and implementation
9. Development of Weeding mechanism
10. Development of fixed pitch seed sowing mechanism
11. Implementation of spraying mechanism
12. Assembly
13. Testing and Optimization

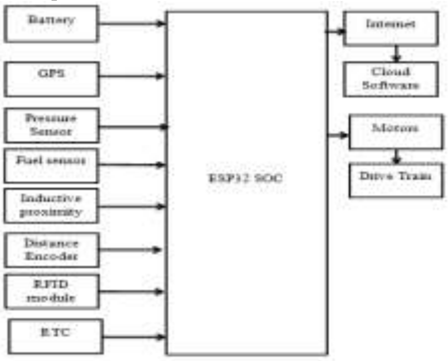


Fig. 1 Block Diagram

As shown in the block diagram the system consists of development of complete agricultural task tracking system for tractors. The system consists of Wi-Fi SOC controller interfaced with different sensors which will perform the tracking task. As shown in the block diagram the system consists of the GPS modem interfaced to the Wi-Fi SOC which will track the location as well as the distance travelled by the tractor over the period of time. The sensors such as fuel level sensors will track the fuel consumed for performing a particular task. The RFID system interfaced will detect type of task the tractor is performing and will record the task time using RFID and RTC. The pressure sensors and position sensors will detect if the attachment like plough or cultivator or any other attachment pertaining to the task in in the ground or idle in top position. The distance is also tracked using the distance sensor and GPS. Collectively all tracking data pertaining to the particular tractor ID is pushed to cloud using IOT based system where it can be tracked using the software developed as part of implementation[1].

The system also consists of multiple mechanism mounted to the machine. The machine is also capable of performing day to day agricultural operations such as weeding to remove the weeds using the mechanism implemented on the system. The system also implements fixed pitch seed sowing system which can be used for sowing the seeds at constant pitch. The Spraying mechanism is also implemented in the project which can be used to perform the spraying operation through the field[2].

IV. HARDWARE IMPLEMENTATION

The hardware implementation consists of development of the electronics hardware required for the project and then fabricating the printed circuit boards can be completed successfully. The schematic or the circuit diagram are done in easyEDA and then the PCB is taken for fabrication after routing the PCB using the schematic developed. The printed circuit board (PCB) acts as a linchpin for almost all of today's modern electronics. If device needs to do some sort of computation-such as is the case even with the simple digital clock. Chances are there is the PCB inside of it. PCBs bring electronics to life by routing electrical signals where they need to go to satisfy all of the device's electronic requirements.

The hardware is designed using an EDA software and PCB for the same is fabricated:

The figure below shows the schematic and the pin Diagram:

There are two PCBs. One for the transmitter side and one for the receiver side.

The transmitter side schematic:

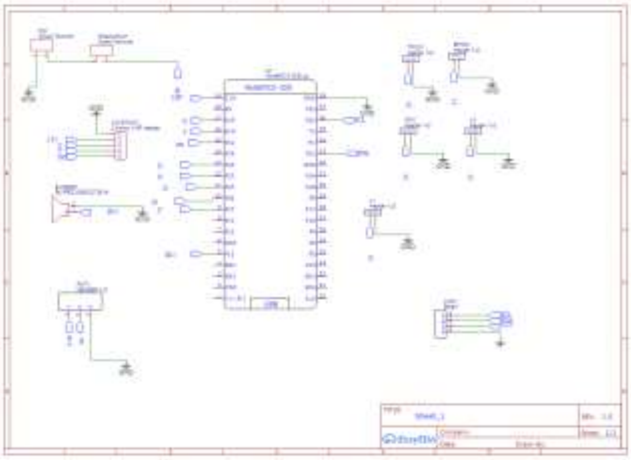


Fig. 2 Transmitter Schematic

The receiver side schematic:

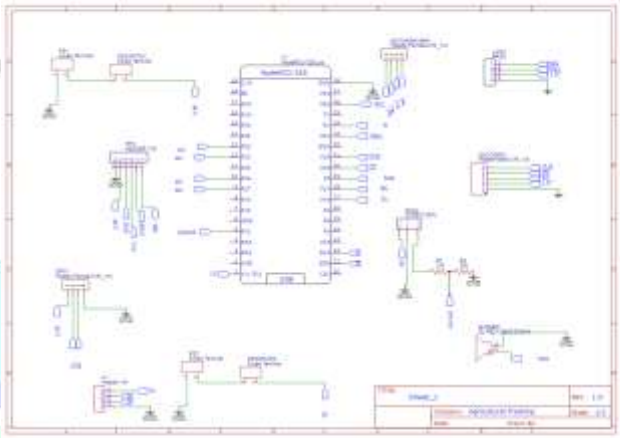
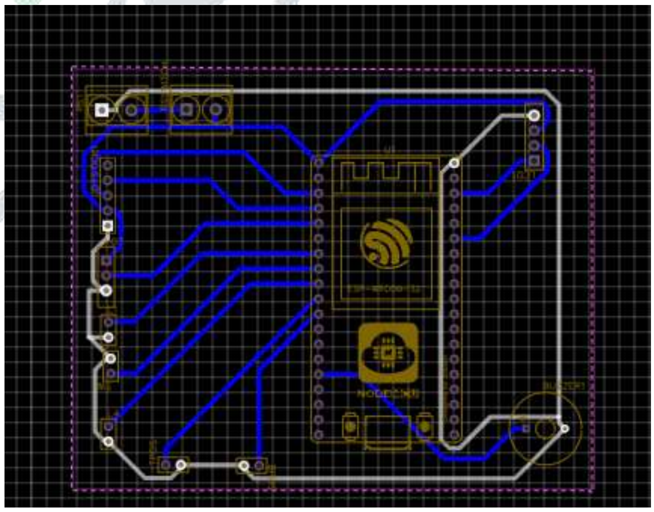


Fig. 3 Receiver Schematic

After the schematic was developed the PCB layout was designed and then PCB was taken for fabrication:

The PCB:

The Transmitter PCB:



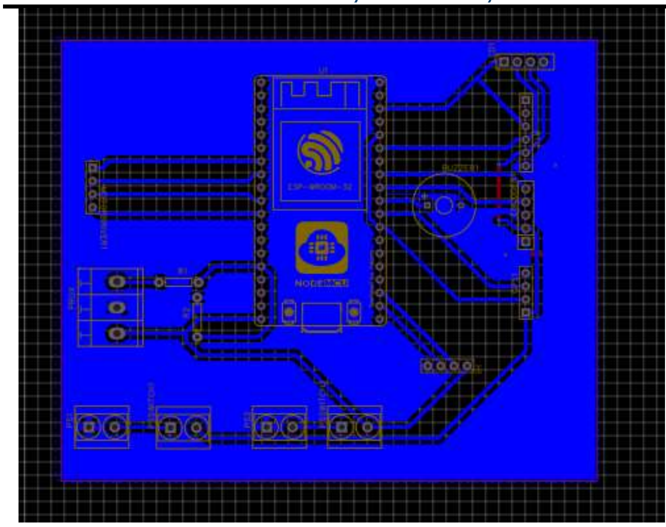


Fig. 4 Transmitter&Receiver PCB

The Transmitter Part:

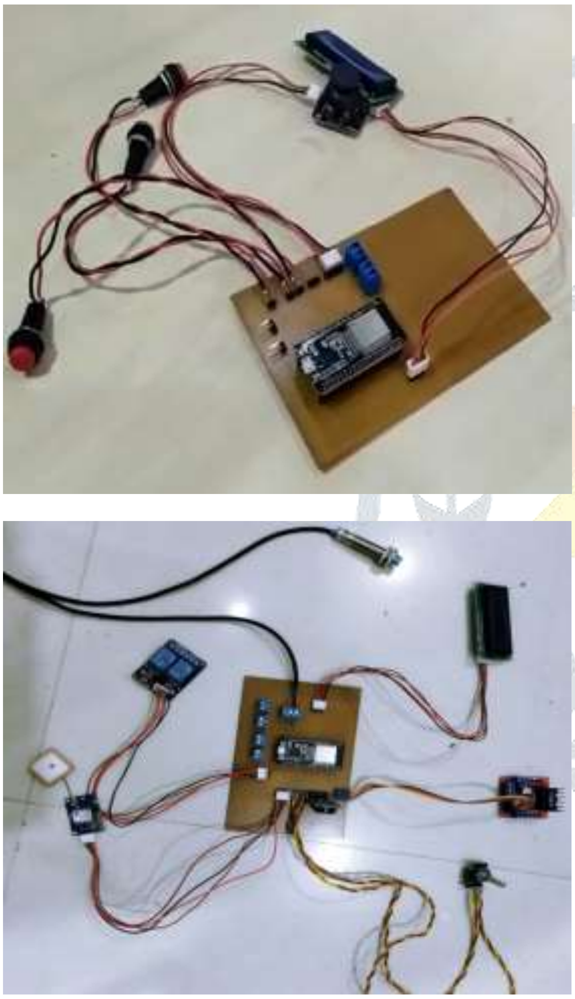


Fig. 5 Transmitter & Receiver

V. SOFTWARE IMPLEMENTATION

The software implementation consists of development of an Agrotrack application which can be used for complete agricultural work tracking. The software part is completely developed in HTML , PHP and bootstrap. The Microcontroller programming is done in C++.

Language Description

We used Subset of C language which is Arduino C which is based on the C/C++ and is used to program the microcontroller. Arduino, natively, supports a language that we call the Arduino Programming Language, or Arduino Language.This language is based upon the Wiring development platform, which in turn is based upon Processing, which if you are not familiar with, is what p5.js is based upon. It's a long history of projects building upon other projects, in a very Open Source way. The Arduino IDE is based upon the Processing IDE, and the Wiring IDE which builds on top of it[3]. When we work with Arduino we commonly use the Arduino IDE (Integrated Development Environment), a software available for all the major desktop platforms (macOS, Linux, Windows), which gives us 2 things: a programming editor with integrated libraries support, and a way to easily compile and load our Arduino programs to a board connected to the computer.

The Arduino Programming Language is basically a framework built on top of C++. You can argue that it's not a real programming language in the traditional term, but I think this helps avoiding confusion for beginners. A program written in the Arduino Programming Language is called **sketch**. A sketch is normally saved with the .ino extension (from Arduino). The main difference from "normal" C or C++ is that you wrap all your code into 2 main functions. You can have more than 2, of course, but any Arduino program must provide at least those 2.One is called setup(), the other is called loop(). The first is called once, when the program starts, the second is repeatedly called while your program is running.

We don't have a main() function like you are used to in C/C++ as the entry point for a program. Once you compile your sketch, the IDE will make sure the end result is a correct C++ program and will basically add the missing glue by preprocessing it.

Everything else is normal C++ code, and as C++ is a superset of C, any valid C is also valid Arduino code. One difference that might cause you troubles is that while you can spawn your program over multiple files, those files must all be in the same folder. Might be a deal breaking limitation if your program will grow very large, but at that point it will be easy to move to a native C++ setup, which is possible. Part of the Arduino Programming Language is the built-in libraries that allow you to easily integrate with the functionality provided by the Arduino board.

PHP (Hypertext Preprocessor):

PHP is a general purpose scripting language originally designed for web development to produce dynamic web pages. For this purpose, PHP code is embedded into the html source document and interpreted by a web server with PHP processor module, which generates the web page document. It also has evolved to include a command line interface capability and can be used in standalone graphical application.

PHP code is usually processed on a web server by a PHP interpreter implemented as a module, a daemon or as a Common Gateway Interface (CGI) executable. On a web server, the result of the interpreted and executed PHP code – which may be any type of data, such as generated HTML or binary image data – would form the whole or part of a HTTP response. Various web template systems, web content management systems, and web frameworks exist which can be employed to orchestrate or facilitate the generation of that response. Additionally, PHP can be used for many programming tasks outside of the web context, such as standalone graphical applications[9] and robotic drone control. Arbitrary PHP code can also be interpreted and executed via command-line interface (CLI)[4].

The standard PHP interpreter, powered by the Zend Engine, is free software released under the PHP License. PHP has been widely ported and can be deployed on most web servers on almost every operating system and platform, free of charge.

The PHP language evolved without a written formal specification or standard until 2014, with the original implementation acting as the de facto standard which other implementations aimed to follow. Since 2014, work has gone on to create a formal PHP specification.

The Software Implementation consist of using of web services to trigger the requests form the hardware side to the software side and then update the backend accordingly and interact with the MySQL database. The sample web service of our project is as shown below:

http://worktrackinghit-com.stackstaging.com/api/index.php?request=tractorEngine&tractor_id=10&fuel=0&distance=0

The output of the webservice will be a response from the server. The response is as shown below:

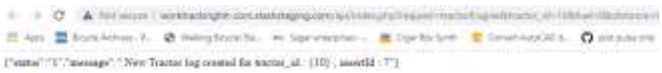


Fig. 6 Webservice Output

A separate webservice is triggered for each and every track record or GPS logging to the agrotrack work panel.

VI. RESULTS

Implemented work Tracking software:

Login Page:

Fig.7 Login Page

Admin Panel:

Fig. 8 Admin Panel

Standard Price Declare panel:

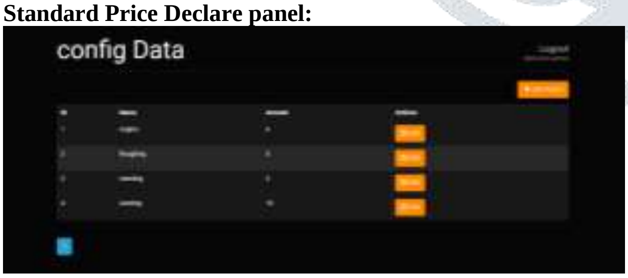


Fig. 9 Standard Price Declare Panel

Tractor Registration panel:

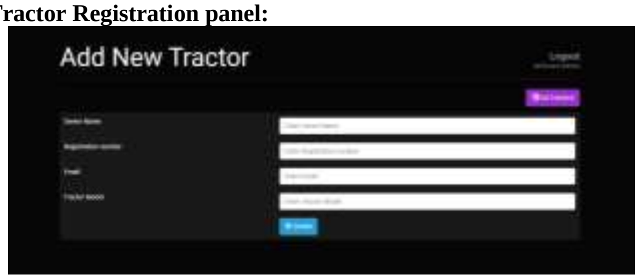


Fig. 10 Tractor Registration Panel

Tractor Start Stop Track Panel:

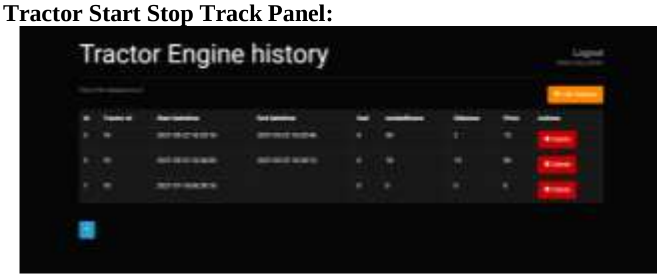


Fig. 11 Tractor Start Stop Panel

Work Tracking Panel:

Fig. 12 Work Tracking panel

VII. ADVANTAGES AND APPLICATIONS

Advantages and Applications :

- Provides complete tractor tracking system
- Farmers can pay for the actual work not the claimed work which will save their money
- Farmers will get a deep insight analysis of the task tracking in the field
- Farmers can also get to know the fuel consumed for a particular task
- GPS tracking can give exact location of the tractor and the work hours
- The IOT system can be used for monitoring from anywhere in the world.
- Can be used in all small scale and large farms.

Disadvantages:

- Requires Internet to work properly.
- Some Initial investment required.

VIII. FUTURE SCOPE AND CONCLUSION

This implementation deals with the development of complete agricultural work tracking for farmers. It can track the location as well as complete activity of the tractor in details including start stop and fuel consumed for each and every activity. It can also track the GPS location . The tracked work is updated in the cloud panel so that the farmers who are renting the tractor can get correct tariff for the work done. Thus we can conclude that the implemented system will not only help the farmers pay right price but also help the owners to track the work of the tractor along with fuel consumed and location. This will keep a transparent dealing approach while renting tractors.
Our implementation has wide scope for future modifications. At present we have implemented it on a prototype. In future we can implement it on actual tractor to make the system real world as well as launch a commercial model of the same.

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