IOT based Smart Irrigation and Field Surveillance System

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Abstract - *India has the largest land under cultivation compared any other country in the world, but the resources and the technological development still needs improvement. It is the main source of income for a vast population. Irrigation is an important factor that contributes a key role in productivity of agriculture. Improving the existing irrigation techniques can be a game changer in this field. In rainy season the plants are over irrigated and in summer season the plants are under irrigated. Field surveillance and monitoring is another major aspect for the farmers. To overcome these problems the plants must be irrigated smartly and this can be achieved by application of IOT technology. The main objective of this project is to build a IoT device to automatically irrigate the field and develop an autonomous rover to monitor the fields. The moisture, temperature and humidity sensor relate to the ESP8266 module which controls the flow of water in field. The moisture sensor checks the moisture content in the soil and if the moisture is less than the required amount, the pump turns open and the field is irrigated automatically. The autonomous rover monitors the field and with the help of cam module useful for video surveillance of crops and the field. The ESP32 module is used in the rover so that it can control the cam module and the motion of the rover. These actions can be monitored through android applications on smart phones.*

Key Words: **IoT, Soil Moisture Sensor, ESP8266 Microchip, ESP32 CAM Module, Autonomous Rover.**

1.INTRODUCTION

Agriculture is a major occupation in emerging countries like India. It is the primary source of livelihood for about 58% of India's population and its contribution in country's GDP is about 17-18%. As per 2014 FAO statistics India is the world's largest producers of fresh fruits like banana, mango, papaya, lemon, guava and spices like chili pepper, ginger. India is the second largest producers of wheat and rice in the world. The technological development helps the farmers in various ways of production and various techniques which increases productivity. Irrigation is paramount in agriculture. Rain is the main source of water for irrigating agricultural fields. With the help of smart irrigation system, we can utilize the water to its maximum content to increase the productivity of crops.

The crops should be monitored frequently, and the fields should neither be over irrigated nor under irrigated. With the help of an embedded system, we can control the water flow using sensors and monitor the field with the help of rover. The irrigation system collects the data from various sensors which include data such as temperature of the atmosphere, humidity content present in the air, soil moisture content and transmits this data to the ESP8266 microcontroller which processes this data. After processing and analyzing the data by comparing to the threshold parameters the requirement for irrigation of the field is accessed and irrigated if there is requirement. The autonomous rover can cover the entire field and provide data from the inaccessible regions of the field. The field is monitored using a rover fixed with an ESP32 cam module which can be operated to move around the field and collect the video footage of the inaccessible regions of the field. This can be helpful to scout for various threats like pests, disease and fungi ensuring the safety of the crop.

2. Related Works

There are many proposed systems previously for smart irrigation system and monitoring of agricultural fields. For this proposed project there are some papers which influenced to do it in an efficient and functional manner.

In "An IOT based Smart Irrigation System using Soil Moisture and Weather Prediction "a system has been proposed where the user can access the smart irrigation system via mobile application which can be connected to the control unit either by Wi-Fi or by mobile network. The system can forecast weather based on temperature, humidity, UV and precipitation data processed in the past three weeks by using machine learning algorithms.

In "Ameliorated Methodology for Automatic Irrigation & Crop Prediction System" the system proposed to develop a methodology automatic irrigation and predict the right crop with the help of a Bluetooth based microcontroller. The field is irrigated wirelessly and the farmer is notified by messages through mobile application.

In "Solar Power Based Smart Irrigation" the water is pumped from borewell to ground level tank based on the intensity of sunlight. The outlet valve of the tank is automatically operated by the controller which works according to the signals received from the soil moisture sensor placed in the field.

In "IoT Based Smart Irrigation System for Agricultural Field Using Lab View" the system proposed is similar to the project except for the LABVIEW software which is an windows software and is not applicable all areas of expertise.

In "Design and Simulation of a Rough Terrain Navigation Robot", to build the rover they have used the mild steel which will increase the weight and cost of the rover and it can't be used to keep the electrical components inside the rover.

In "Smart Irrigation with Field Protection and Crop Health Monitoring system using Autonomous Rover", the rover is controlled manually by a joystick controlled which increase the electrical components and the cost of the proposed system. But the video processing is done by MATLAB which converts the video clippings into image which is helpful in identification of diseases in crops.

3. PROPOSED SYSTEM

Many projects have arrived in agriculture based on IoT which captures soil moisture, temperature but this project is in different proportion as it includes an autonomous rover which monitors the field. With the help of the sensors and the rover the user can easily monitor the field. As it is the age of technological development and the usage of smartphones has increased rapidly, it has been made easier for the user as the system includes an android app to monitor the sensors and also to control the movement of rover. The users can also keep records of the field data for future purposes. The optimum requirements of moisture, temperature and humidity vary for different crops and climate. In this system the user can manually adjust these optimum values based on his requirements

3.1 AUTOMATIC IRRIGATION SYSTEM

The soil moisture sensor measures the moisture content in the field and compares the data with threshold value set on the measurement module of the sensor. The modified data of the field is sent to the ESP8266 module.
This module also receives other data like temperature and humidity from DHT22 sensor. Analyzing the data received and using the algorithm the requirement of irrigation is decided. If there is a necessity for irrigation a signal is sent to the relay module which controls the motor pump to irrigate the field.

The relay module sets the motor pump 'ON' until the required amount of soil moisture content is achieved in the field. As the required amount of moisture content is achieved in the field, the relay module turns the motor pump OFF. This process of constant irrigation continues takes and required water levels are maintained consistently.

Other than automatic irrigation of the field the system can also be monitored from anywhere in the world as the system is connected to the ThingSpeak server. The data on the server is updated at regular intervals of time. The entire system is connected to the server with the help ESP8266 module which is a Wi-Fi based microcontroller.

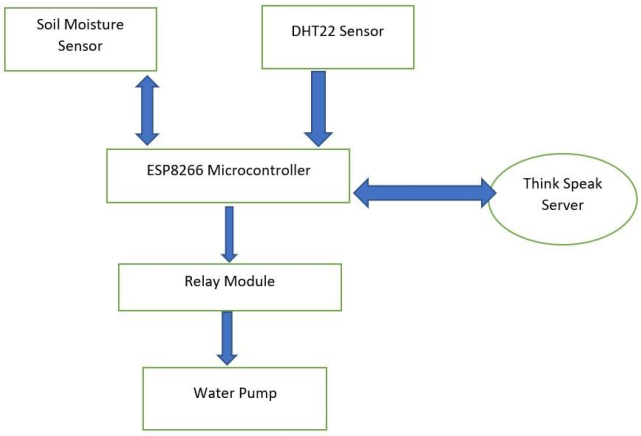

Fig -1: Flow chart representing the irrigation system

3.2 AUTONOMUS ROVER

The construction of the autonomous rover is made with the help of UPVC pipes as it can withhold more stress compared to other PVC pipes. The rover is an additional system which helps the user to monitor the field using the esp32 cam module.The rover is made with the following measurements and components:

1. PVC PIPE MEASUREMENT:
- 18cm (2)
- 15cm (2)
- 13cm (4)
- 10cm (2)
- 9cm (2)
- 5cm (2)
- 4cm (2)

2. 90-degree UPVC bend (6)

3. 45-degree UPVC bend (4)

4. Bolt and Nut

5. Hard Plastic Plates (4)

6. Brass Coupling (6)

7. PVC cap (2)

The construction of the rover is simple as we need to fix the 18cm pipe in one end of the 10cm pipe, where the 45-degree bend is placed on both sides of the 10cm pipe and in other end of the 10cm pipe, we have to fix a 5cm pipe attached with PVC cap. Then drill one hole at the center of the 10cm pipe of one set and drill two holes for the other set of pipes. And drill two holes at the PVC cap of the 10cm pipe. Follow the same procedure for the other 18cm and 10cm pipes.

Then take two 13cm pipes and fix each end with the 90-degree bend and drill holes at the center of the bend. Now take the hard plastic plates and drill three holes, one hole at one end and two holes at the other end. Then take the 13cm pipe and fix it with nut and bolt using the hard plastic plates at the PVC cap end of the 10cm pipe. Follow the steps for the other two 13cm pipes. Now the legs of the rover are completed.

Now take two 15cm pipes and two 9cm pipes, drill holes at the center of the 15cm pipes according to the legs of the rover. Then take four 90-degree bend and fix the ends top make a rectangle shape top for the rover. Then fix the legs and the top with the help of wooden pieces and bolt and nut. The complete structure of the rover is now finished. Then make small cut at the legs of the rover so that we can fix the coupling.

The esp32 cam module comes with a camera of 2mp which helps to the users to monitor the field with live data and recorded video. The esp32 cam module is compatible for both Bluetooth and WI-FI connectivity, and with the help of programming codes that are installed in the cam module the movement of the rover is also controlled and the view of the camera is also adjusted with the help of MG995 servo motor attached to the cam module.

The installation of the electrical components is done on the top of the rover with a wooden plate fix on top. The motor is fixed with the help of coupling fixed and the wire connections is done and the connection is taken to the top of the rover. The L298N motor drive module is fixed and then the battery is fixed, followed to that the bread board is fixed. Then the servo motor and the esp32 cam module is mounted to a servo mount and camera stand and the connections are done.

The codes are already installed using the Arduino application in the computer with the help of cp2102 module and the local IP address is copied on the smartphone device and once the connections are done using the IP address we can control the rover with the cam module.

4. CONCLUSION AND FUTURE WORKS

The automatic irrigation system resolves the common irrigation problems such as water scarcity by proper and timely watering of field thereby conserving water. As the system performs timely and scheduled irrigation it reduces the electricity usage.

The farmer can easily monitor the irrigation activities through his mobile phone from any region reducing load on him. Scouting the field using rover helps the farmers to survey and monitor the entire field easily and also access the remote areas of the field. The rover also proves to be helpful to examine the crop and field condition via video surveillance.

The work discussed in this paper can further be extended to application of renewable sources like solar power for water pumping and application of machine learning techniques for processing the video footage from the rover to examine disease and pest attacks on crop.

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