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Automated Agriculture Supervision and Smart Irrigation System Using IoT: A Survey

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***Abstract*: IoT and automation are the two emerging technologies revolutionizing the world today. Agriculture, being a major and important part of India's economy, needs to go hand in hand with the technology in order to save water and increase efficiency. The proposed system provides an efficient way to do this.**

***Keywords*: IoT, Automation, Agriculture, Efficiency.**

1. Introduction

Agriculture sector has been a major part of India's economy and it still is. It contributes to 26% of the Gross Development Product (GDP) [1]. Be it raw material for industries or a source of income for grocery store agriculture plays a vital role. Such a vital sector should be given adequate focus. Crops such as rice need adequate amount of water. So, proper management is needed so that water wastage is least. Moreover, with the decrease of level of groundwater, it has become necessary that we focus on efficient use of water. With the world trending towards advanced and new technologies, agriculture should also take its advantage. Use of modern technologies reduce the chance of human error which can reduce problems like crop damage, soil erosion, leeching of nutrients, spreading of pesticides, unwanted vegetative growth, loss of valuable water to the water-table [2]. Various researches done in the past show that there are various environmental factors that may affect the yield of the crops. These factors include temperature, humidity, soil moisture, fire, etc. The issues faced due to these factors can be resolved by using sensors. Much of the work is currently done manually. With the help of sensors we would not only increase efficiency but can also reduce the cost. Appropriate Sensors can be used for resolving the issues that need to be resolved by the farmers. By placing the sensors at appropriate places we can collect the data and monitor our field remotely.

Hence, the paper proposes solution to some of the issues by the use of smart irrigation system. This system checks the soil moisture and accordingly irrigates the field.

2. Literature Survey

In [3], the author describes an automated irrigation system that monitors the crop-field using light sensor, temperature and humidity sensor and soil moisture sensors. Wireless transmission is used for sending the data to web server and data encoding is done using JSON format to maintain the server database. The irrigation system gets automated as soon as the temperature or moisture of the agriculture field falls below the brink/limit. The notifications are sent to the user's mobile periodically so that user can monitor the field conditions at any given time from anywhere. Various sensors such as soil moisture sensor, light sensor, temperature and humidity sensor are used as parameters and web server – NRF24L01 is used for transmitter and receiver. The areas with water scarcity can beneficiate more through this kind of system. Moreover, it is 92% more efficient than the conventional approach. PHP script is used for storing data produced by automation of irrigation system. The total average power consumption for a single motor pump is 2 Ah per day.

In [4], the author describes Wireless Sensor Networks. The network acquires the data, collects it and runs analysis on data such as temperature and soil moisture. There are many benefits of irrigation process in agriculture such as decreasing water consumption and other environmental aspects. With Cloud Computing, large amount of data can be stored and processed with the help of Wireless Sensor and Actuator Network. The architecture is divided into three main components namely, a cloud platform component, a WSAN component and a user application component. There are three different types of nodes: a sensor node, a sink node and an actuator node. WSAN implementation is done in a cluster tree topology with the help of a simple protocol SimplitiTI. The amount of water needed is assessed by monitoring the soil moisture so as to assure proper development of plants as well as optimization of natural resources.

In [5], the author proposed work on IoT based smart agriculture. The paper aims to make use of automation and IoT and utilize smart agriculture. The operations such as weeding, spraying, moisture sensing are performed by a remote controlled robot using GPS. It uses accurate real time field data and smart warehouse management for smart irrigation with the

help of smart control and intelligent decision making. It monitors temperature, humidity and also provides theft detection in the warehouse. The smart devices control all the operations by interfacing the sensors, ZigBee modules, camera and actuators with microcontroller and raspberry pi. This paper provides solution to irrigation problems and storage problems using remote controlled robot for smart irrigation system and smart warehouse management system respectively.

In [6], the author provides a solution for securing and protecting agricultural products from attacks of rodents or insects in the fields or grain stores. Security systems sense the problem and provide real time notification. The algorithm is designed so as to accurately notify the user and activate the repeller based on the information collected. Testing is done in an area of 10 sq. m. and the device is placed at the corner. The PIR sensor identifies heat and starts webcam and URD sensor. The system can further be extended to prevent rodents in grain stores.

Pratibha S R et al., [7] proposed work on automated smart agriculture. The paper aims to automate agriculture using different sensors. There is a Wi-Fi unit, microcontroller and network processor in the proposed system. The system uses temperature infrared thermopile sensor- TMP007 which contains built in digital control and math engine, and senses the temperature values in real time. The system also contains humidity sensor- HDC1010 which tracks the relative moisture of air within the farming field. Current images of a particular field are captured by interfacing camera with CC3200 camera booster pack via PCB using MT9D111 camera sensor which are then sent to the farmer through GPRS.

T. Vineela et al., [8] proposed a basic IoT based system for irrigation. The system uses DHT11 sensor to detect humidity and temperature and a soil moisture sensor to check the moisture content of the soil. It uses ThingSpeak to store and retrieve data. The system works on raspberry pi.

Ravi Kishore Kodali et al., [9] proposed a system that consists of two sections: sensors and MQTT server which receive and process data for decision making. In the first section, the Esp8266 is connected to soil moisture sensor and relay using wired connection. It is used as a network gateway. In the proposed system data is secured using cryptographic protocol for secure data transfer between server and microcontroller. The Esp8266 module helps in connecting to the Internet by acting as a gateway server. MQTT Server continuously stores the data. No ambiguous data is stored along with the required data because of MQTT protocol and transport layer security (TLS) cryptographic protocol. Along with encryption proposed system uses username and password for providing authorized access to the data.

Andreas Kamilaris et al., [10] proposed a system composed of multiple layers. At each layer, specific operations are performed by various software components for tasks such as data acquisition, modelling, analysis or visualization. A flexible distributed architecture is achieved as each software component acts as a single entity.

K. A. Patil et al., [11] proposed a system with three modules farm side, server side and client side. It senses local agricultural parameters, identifies sensor location and collects data. This data is transferred for decision making. Actuation and control is based on this decision. A camera module is also used for crop monitoring.

Shruti A Jaishetty et al., [12] proposed a novel IoT sensor network for monitoring an agriculture field. Several environmental parameters are monitored and the collected data is transferred to the cloud through a secured IoT hub (Thingspeak), and then a predictive analysis is done on the gathered data (matlab deployed at Thingspeak). Several protocols like MQTT and secured HTTP are used to overcome the limitations of traditional GPRS based system. It not only ensures that the data is safe and secured, but also provides immense security to the data as the entire communication is over an authorized secured socket layer.

Minwoo Ryu et al., [13] proposed an automated farming system which consists of three main components monitoring sensors and controllers, IoT gateway (called &Cube), and IoT service platform (called Mobius). Sensors and controllers are used for monitoring and controlling the environmental conditions of the farm. &Cube acts as a middleware which can be installed into IoT gateways. The Mobius is an IoT service platform which helps to create virtual representations of physical IoT devices. Each device is registered into the Mobius using &Cube so that every IoT device can have its virtual representation in the Mobius in the form of a resource type.

3. System Overview

The project consists of various components such as Raspberry Pi, relay, sensors etc.

A. Hardware Requirements

1) Raspberry Pi

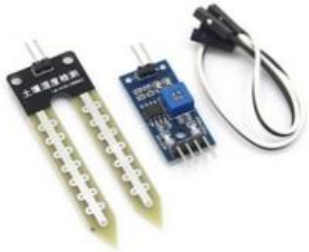
Raspberry Pi is a powerful device. It is a low cost, small hand sized computer used for various computing purposes. It is one of the most important element in the field of IOT. It contains features such as Wi-Fi and internet which makes it to possible to remotely access the system. It helps in collecting the data coming from the sensors and accordingly performing the appropriate actions.

2) Relay

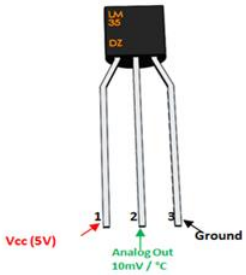
A relay is an electrically operated switch. It is used when it is necessary to control a circuit by an independent low-power signal, or when several circuits must be controlled by one signal.

3) YL-69 Moisture Sensor

The YL-69 sensor or hygrometer is used to detect the moisture of soil. This sensor enables our system to know whether the moisture level is within the threshold value or not.



4) Temperature Sensor (LM-35)



The LM-35 sensor or temperature sensor is used to detect the temperature. It returns the analog value which is then converted to digital form with the help of formula.

5) ESP8266 Wi-Fi Module

It is a low cost microchip that helps in sending data remotely to the system. It is responsible for sending data from the sensor to the user so that he/she can monitor the field remotely.

B. Software Requirements

1) Python

Python is an interpreted programming language that was created by Guido van Rossum. It is commonly used in artificial intelligence projects. The Raspberry Pi single-board computer project has adopted Python as its main user-programming language [14].

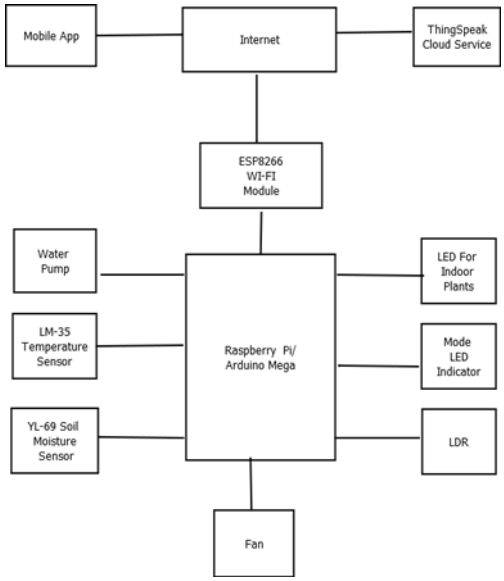
2) ThingSpeak

ThingSpeak is an IoT platform that provides different services such as aggregating and analysing data. With the help of thingSpeak we can collect data from sensors and analyse it.

4. Proposed Work

We propose a novel method to solve the problem of water and electricity wastage. Our IoT based irrigation system would not only help in reducing the manpower but would also help in estimating cost of water and electricity.

Our irrigation system would basically work in two modes: automatic and manual. The manual mode would allow the user to enable and disable the pump and fan as per their choice. The user would be provided with the real time data from the sensors which would help in making the decision.



In automatic mode, the user will be asked to provide a threshold value for the data being collected. If the value goes beyond the threshold value, the appropriate function would be performed. Moreover, the data obtained from the sensors could be used to analyse the cost of water and electricity. This would help farmers to analyse the profits and the investment. We can also use the data from weather forecasting services for more efficient use of water.

Our irrigation system can be used for managing more than one field. This would result in better hardware utilization. This system can be applied for open field as well as green house. This system could be easily used for green house with the help of temperature sensor (LM-35), fan, LDR. Artificial lighting could be used for promoting plant growth.

The data obtained from the sensors will be transferred to the ThingSpeak cloud platform. This data will then be provided to the user through an android app. The app will update the data at regular intervals of time.

5. Conclusion

The sensors work successfully along with the raspberry pi module and wireless communication is achieved.

This project provides a solution to the problems in irrigation system. The implementation of such a system reduces water wastage and also increases the yields of crop.

6. Future Scope

This project can be further improved by using different other sensors to check the humidity and soil pH value. Further the data obtained from these sensors can be used to analyse the system and estimate the water usage. The soil pH value can help the farmer to use the fertilizer much efficiently. Thus, reducing the money spent on fertilizers.

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