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Remote monitoring of Agriculture sector using IOT

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Abstract— Agriculture sector has been the backbone of India. The contribution of the agricultural sector in the GDP has been much higher than the world average. Though it has been falling gradually primarily because of climate change, increasing water shortage and unawareness of farmers about optimal conditions and precision farming. Smart agriculture, which includes automated and directed information technology implemented with the IoT (Internet of Things), is a solution to all these problems. IoT is advancing everywhere, leveraging the quality of products and increasing the production many yields. The agriculture sector has been lagging in being connected to IoT because of the current expensive solutions. In this paper, we introduce a concept for sector based smart and precision farming most importantly cheap in cost using IoT, which senses the weather and soil conditions of the farm like soil moisture, and temperature, which is then used to irrigate the field accordingly. It is connected to mobile app via the cloud service, which can be used to view the data and control the actuators accordingly.

Keywords— IOT, Farming, Agriculture

1. INTRODUCTION

Agriculture, and its affiliates, contribute to a significant figure in Gross Domestic Product (GDP). Sustainable agriculture, with regard to rural employment and sustainable environmental technologies such as land conservation, sustainable management of natural resources is essential for the full development of rural areas.The real time local weather monitoring prevents crop damage and is the first step in precision agriculture. Recent developments in soil moisture sensors, wireless technologies, and application equipment's provide a timely opportunity to develop a closed -loop systems. Along with this, measuring plant water status and improved soil moisture sensing technology will allow irrigation to be scheduled from plant responses rather than soil water availability.

The objective of this paper is that, deploying multiple sensors and actuator stations enable significant water conservation in open field agriculture production, and energy used for pumping. This paper aims at making a central node for analysis of the weather and soil conditions of an agriculture field, the data is received from every individual node in the agriculture field.

2. LITERATURE REVIEW

Changes in climate and rainfall has been unpredictable over the past decade. Due to this in recent period, many Indian farmers accept smart agriculture. Sensor technology with integration of IOT and wireless networks has been studied and reviewed based on the real situation of agricultural sector [1]

- **IRRIGATION**

Around 97% of the Earth’s water held by oceans and seas is salty and the remaining 3% is fresh water of which more than two-third is frozen in the form of polar ice caps and glaciers [2].
According to UN Convention to Combat Desertification (UNCCD) estimated in 2013 there were 168 countries affected by desertification and by 2030, almost half of the world population will be living in areas with high water shortage [2, 3].
Considering the statistics of water crises around the globe and its growing demand in agriculture and industries, it should be supplied only where it is needed and in required quantities. For this purpose, a method to increase the awareness has been applied to protect the existing under- stress water resources by using more proficient irrigation systems. The present situation of irrigation means is estimated to be changed by adopting the emergent IoT technology.

- **YIELD MONITORING, FORECASTING AND HARVESTING**

Yield monitoring is a mechanism to examine several features analogous to moisture level of soil and agricultural yield to evaluate the performance of crop. It is considered a key part of precision farming not only at the time of harvest but even before that, as monitoring the yield quantity plays an important role.
Currently, when we are dealing with more open markets, buyers around the word become more particular about crop quantity; hence effective production depends on the agriculture field size to the right market at the right time [13].
Crop prediction is the art of predicting crop yields before harvest. This prediction helps the farmer to plan and implement decisions in the future. This monitoring covers various stages of development. For this purpose predicting, the right time to harvest not only helps to increase crop quality and production but also provides an opportunity to develop a management strategy..

Fig.1 Yield monitoring system

In objects to wireless network via interfaces to the sensing nodes with intelligence, therefore realize the communication between the human and sensing nodes. Moreover, series of research and exploring works have been launched. There is certain blindness in the research and development of the IoT technology.

Based on the current IOT technology analysis, by analysing and using advance Agriculture technologies and systems of IOT, it is going to start the research on the architecture and designing of Agricultural system. Started from the intelligent transportation, monitoring and Sensing and Centre Node Designing, IoT extends its application domain to public oriented agricultural Field.

3. RELEVANT THEORY

A. Component Used

WiFi Module: WiFi Module as shown in Figure is a low cost WiFi microchip with full TCP/IP stack and microcontroller capability that can give any microcontroller access to your WiFi network. The ESP8266 is a capable of either hosting an application or offloading all WiFi networking functions from another application processor.

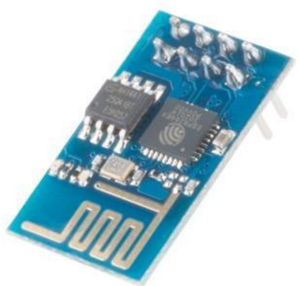

Fig.2 W i F i M o d u l e

Arduino Uno: Arduino Uno as shown in Figure is an open- source microcontroller board that uses the ATmega328P chip.

Fig.3 Arduino Uno

DHT-11 Sensor: DHT Sensor shown in Fig.4 is used to detect temperature & Arduino Uno: Arduino Uno as shown in Figure is an open-source microcontroller board that uses the ATmega328P chip.

humidity for monitoring the weather conditions. Temperature Range: 0-50°C

Accuracy: ±2°CHumidity Range: 20%RH to 90%RH Humidity Accuracy: ±5%RH

Fig.4 DHT-11 Sensor

Soil Moisture Sensor: Soil Moisture Sensor as shown in Fig.5 is used to capture the moisture content of the soil by measuring the voltage in soil using soil moisture as the dielectric. It then can convert the voltage.

Fig.5 Soil moisture Sensor

Solenoid Valve: It is an electric valve working on DC. It opens when the current is supplied to it and gets closed when no current is present. It controls the flow of water. Generally used with microcontroller boards with relays attached to them.

NRF Module: This is a transmitter and receiver module used to wirelessly connect the central and the Arduino stations using radio frequency waves working at 2.4Ghz. This works for large distances with minimal noise in the channel

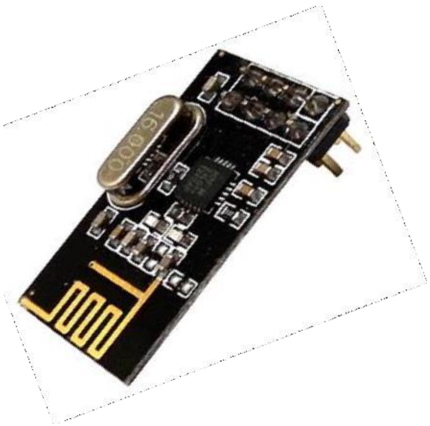

Fig.6 NRF module

- Drip Irrigation Kit: Drip irrigation kit comes with all the parts to assemble the drip irrigation system at any plant unit. Comprises Hardware Required.
- Water pump: The main purpose of a water pump is moving water from one area to another. It is used to supply water from the tank to the field.
- Arduino Ide: Arduino IDE is an open source programming which is basically used to write & compile code using a module that is Arduino.
- React Native: React Native is used for making mobile applications which will show the data of various parameters and give control of the pump to the farmers.
- Raspbian: Raspbian is a free operating system based on Debian. This operating system is the set of basic utilities and programs that make Raspberry Pi run.
- Firebase: Google firebase is used as a cloud platform in this project to store the data recorded by different sensing stations.
- Visual studio code: This is used for writing, editing and compiling the code for the mobile application development.

B. Working

We have shown a system in fig.8 to monitor the weather and soil conditions of the field and run actuators accordingly without human intervention. Multiple sensor and actuator stations are deployed in the field. Each sensor station consists of an Arduino microcontroller, moisture sensor, RF transmitter, relay and a solenoid valve. Capacitive Type Sensor is connected to it which measures the moisture content of the soil. The RF transmitter is used to send data to the central node. RF module has been preferred over the Wi-Fi module because it is not only cheap in price but also battery efficient. The central node consists of a Raspberry Pi, Arduino, RF Transmitter and a DHT Sensor. Resistive type humidity measurement component and a Negative Temperature Coefficient measurement component is used to fetch the temperature.

From here, the data received from all the nodes is sent to the cloud. At the user end, a mobile app fetches the data in real-time from the cloud. This app is very useful to monitor if there is an undesired situation and to send necessary instructions to the central node to perform actions using actuators. The farmer can monitor the farm conditions remotely anytime. The app has two modes: Manual and Automatic. In the manual mode, the app sends a notification alert whenever the soil moisture goes below the desired threshold. The farmer can manually turn on or off the irrigators of each sector independently directly from the mobile app. In the automatic mode, when the moisture comes below the set threshold, the controller irrigates the field with water by turning on the solenoid valve of that particular sector of the field until the desired moisture level is reached in that particular area. Solenoid Valves are laid in the field with each sensor station which supplies water to the field using a micro-irrigation system. These valves are directly connected to the central water pump.

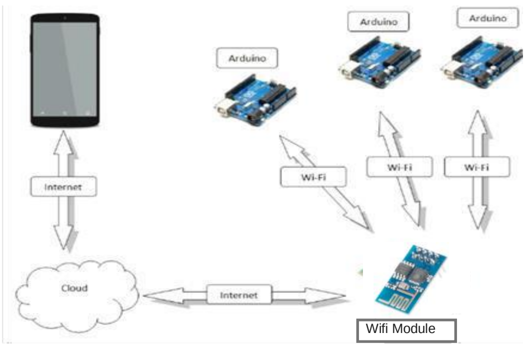

Fig.7 Communication between Controllers and web Application

It is necessary to monitor the field humidity and temperature because in standard meteorological systems, information fetched from weather stations is entered into a calculation model. The data fed into it is received from a large number of stations, generally 1 system per 32km resolution. Thus, this information is of a very large area and hence less precise. Placing more stations is difficult and costly. Also, at many remote places, stations aren't placed. Hence, we are providing a localized weather information of the farm to get precise and accurate readings which help in precision agriculture.

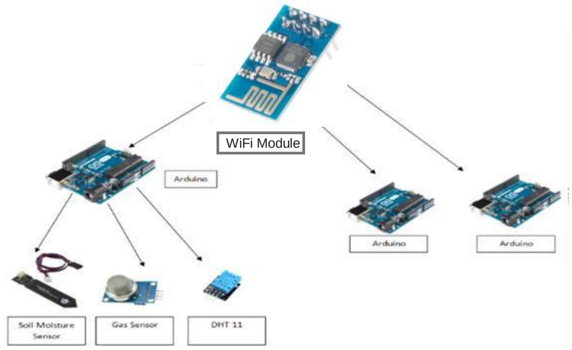

Fig.8 Communication between sensing nodes

This not only helps in optimal usage of water, but also increases the yield of the crop by preventing the flowing of nutrients from the soil. The field humidity level and temperature are the most basic tool in doing precision farming i.e. minimizing the use of resources. The data points produced can further be used for analytics which can contribute to research and increasing the crop yield. When the app is in automatic mode, it requires no human intervention and maintains the aforesaid conditions of the farm itself independently according to the parameters set.

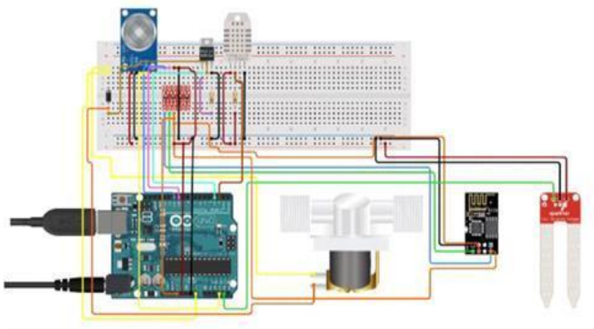
Fig.9 interfacing diagram of sensors

4. CONCLUSIONS AND FUTURE SCOPE

Irrigation is a necessary and inevitable task in farming. On the other hand, water resources are getting depleted day by day. This paper proposed a successful system of sector based smart irrigation systems which helps in improving the yields by automatically maintaining the soil moisture and also collecting the soil and weather data. This will not only automate the cumbersome task of watering the fields, thus improving the lifestyles of farmers but will also contribute to water conservation. This project can be improved further by giving more precise and accurate predictions. Increasing the frequency of data capturing can help in making better analysis and improving productivity but at the same time will deplete the battery life of the stations deployed in the field and will also need more storage.

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