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User Friendly Smart Irrigation System

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Abstract:

Agriculture plays a vital role in Indian economy and most people living in the country depends on agriculture for their living. Indian agriculture is plagued by several problems, one of them being the lack of proper irrigation plans and systems. The automation of irrigation systems facilitates the operation of the system with no or minimum manual interventions. To help farmers, an IoT based smart irrigation system is proposed. The objective of this proposed methodology is to reduce manual intervention of farmers by automating the irrigation process. The motor is controlled automatically and the direction of the water flow in pipeline is selected with the help of soil moisture sensor finally, the information (operation of the motor and direction of water) about the farm field in terms of mobile message and gmail to the farmer. The proposed methodology is simple and inexpensive, which is affordable by the Indian farmers.

Keywords —Irrigation, IoT, Automation, Agriculture, Moisture Sensor

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I. INTRODUCTION

Drip irrigation is one of the breakthroughs in agriculture. However, farmers face several problems with irrigating the field. Majority of the set ups must be operated manually by farmers. They need to go either early in the morning or late at night to water their fields. Sometimes they may forget to switch off the system, which in turn leads to loss of water and crops damaged by over irrigation. In other cases, they may forget to switch on the system causing the plants to dry out and soil infertility. At night, farmers are prone to an electric shock from the system in the field due to dim light and contact of electrical appliances with water. Hence, it is decided to solve these problems, by developing an IoT based automated drip irrigation system with open source hardware. The proposed solution includes an interactive voice response that allows farmers to determine the status of the water in the borewell and the overhead tanks and to control the gate valves across the farm.

Our primary goal is to inculcate all the advantages of a drip irrigation system along with the convenience of automation aided by IoT into an affordable, yet efficient and user-friendly irrigation system.

Indian agriculture is plagued by several problems, one of them being the lack of proper irrigation plans and systems. The automation of irrigation systems facilitates the operation of the system with minimal or no manual interventions. This is justified where a large irrigated area is divided into small segments called irrigation blocks.

By automating the process, the farmers benefit greatly because they can save time and energy by focusing on other farming tasks Nevertheless, the hazards of electric shock and causalities due to loose circuits in the fields can be avoided during monsoon season. The time delay caused by the moving from one plot to another is greatly reduced as all water flows can be simultaneously controlled using from one place. This also prevents over irrigation and water waste age due to the delay in switching off the system manually, one by one at

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each plot that extends to several hectares. The system can be operated safely at night, thus avoiding evaporation of water in the daylight.

In contrast to other existing systems, which are expensive and require a high level of maintenance, the proposed plan is very easy to use and affordable. This system is suitable for every type of phone, not necessarily for smartphones. This is to ensure that the main user (the farmer) can easily afford the equipment. The GSM system can be adapted to different national languages so that farmers can understand it and work accordingly.

II. RELATED WORK

A plenty of research work has been done to improve the performance of agriculture field. In [1], the system uses arduino technology to control watering and roofing of the green house. It uses statistical data acquired from sensors (such as temperature, humidity, moisture and light intensity sensors) compared to the weather forecast for decision making. The kalman filter is used to eliminate noise from the sensors. The agriculture System (AgriSys) [2] uses temperature, pH, humidity sensors and the fuzzy inference to input the data from sensors. The system monitors the sensors information on LCD and PC. In [3] Wireless Sensing Network with ZigBee technology helps to control air humidity, soil moisture and temperature. The system is implemented with components such as soil moisture sensor, humidity sensor, temperature sensor, ZigBee, 18F458 PIC Microcontroller, water pump, fan, relay and buzzer.

In[4], a wireless sensor network is integrated with ZigBee to transmit soil moisture level and temperature values. The data is transmitted to a web server via GPRS through a cellular network. The data monitoring can be achieved via internet using graphical application. In [5], the authors proposed an automated system to switch on/off the water sprinkler based on the soil moisture levels. The main work is to automate the time-consuming irrigation activities in farming.

The authors in [6] summarizes the stare of art methods with respect to smart irrigation system and discussed about the important soil and whether related parameters to be monitored for the irrigation system. Summet et. al [7] proposed IoT based smart system for irrigation. An IoT based irrigation improves farm production without any human interference. In [8], comparative analysis of different smart farming techniques was discussed. In [10], the authors discussed about the important parameters to be monitored and various sensors used for monitoring the land condition.

III. THE PROPOSED SYSTEM

This IoT based automated drip irrigation system is remotely operated and can be customised to operate in local languages to make it easier for farmers in different states of the country. For the system to work, an active network connection is required, which is easily available throughout the nation. The solution comes with this scalability for large scale farms, with the increase in the electronic valve system which is configured with the existing hardware. The plan is to integrate the soil moisture, humidity and the crop growth parameters to completely automate the farm.

The proposed system helps user to improve quality and quantity of their farm yield by sensing ambient temperature and humidity values, soil moisture value and water level of the tank from the field without any human intervention. By using the concept of IoT, the system can be more efficient. The system contains wireless sensor units node1 and node2 as shown in placed in the field to acquire the real time values, a master node to receive and transmit acquired information to the control section, and a control section which controls the drips for watering subsystem. Each node includes temperature, humidity, soil moisture and water level sensors as well as microcontroller and relay switching unit. The sensed data from each node is transmitted to the master node via zigbee. The received data from the master node is stored at the cloud server.

The cloud server performs decision making by comparing between sensed values and predefined threshold values as per crop selection. Once the data is processed and decision is determined at the control section with the help of irrigation algorithm, the controlling action is sent to wireless sensor node. The microcontroller from the node controls

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relay switching unit and watering subsystem accordingly. Report system that is an android application is developed to deliver recent field information to user. Also, it asks user to respond to an essential incident such as rise in temperature and water requirement for plants.

This architecture is designed using arduino technology to provide scalability for network. It uses AtMega 328 microcontroller at each node. The irrigation system is optimized in order to provide irrigation efficiency which will allow saving water as well as improving the crop quality. The proposed methodology is depicted pictorially in figure 1.

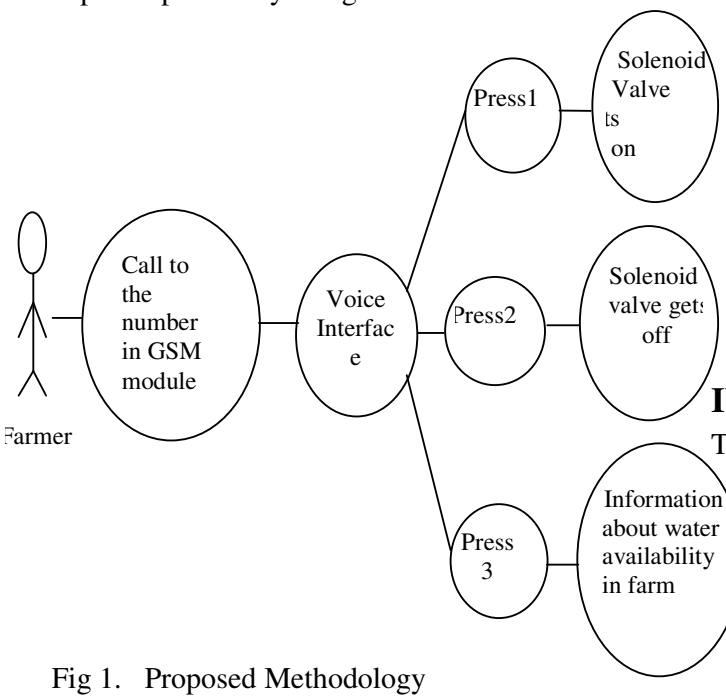

Fig 1. Proposed Methodology

The following are the components used in the proposed system.

- **GSM Shield:** It includes an interactive voice response for the farmers to operate with the sim card module and to know the status of the water and control the gate valves across the farm.
- **Relay:** It helps in actuating the gate valves across the form by the response given by the farmer using GSM Shield.
- **Arduino:** It helps in connecting the GSM Shield to the power supply and controls the relay.
- **Solenoid valves:** It acts as a gate valves to give the limited water supply to the farm. The valve is controlled by an electric current through asolenoid: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports.
- **Sensors:** An appropriate sensor is used to find out the temperature, PH and condition of the soil and to automatically trigger the motor to OFF condition according to the weather.

This IoT based automated drip irrigation system is remotely operated and can be customised to operate in local languages for the ease of farmers in different states of the country. An active network connection is required for the system to work, which is easily available throughout the nation. The solution comes with this scalability to the large-scale farms, with the increase in the electronic valve system that is configured with the existing hardware. Our plan is to integrate the soil moisturising, humidity and the crop growth parameters to completely automate the farm.

IV. IMPLEMENTATION

The prototype of the proposed system for automatically controlling the irrigation is pictorially represented in figure 2 and 3.The sensor node is deployed in irrigation field for sensing soil moisture value and the sensed data is sent to controller node. And relay is used control the motor.On receiving sensor value, the controller node checks it with required soil moisture value. When soil moisture in irrigation field is not up to the required level then the motor is switched on to irrigate associated agriculture field and alert message is sent to registered mobile phone. These sensors sense the various parameter of the soil, motor is used to provide water to the land.

we present a prototype for automatic controlling a irrigation system. Here prototypes include sensor node and control node. The sensor node is deployed in irrigation field for sensing soil moisture value and the sensed data is sent to

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controller node.On receiving sensor value the controller node checks it with required soil moisture value. When soil moisture in irrigation field is not up to the required level then the motor is switched on to irrigate associated agriculture field and alert message is sent to registered mobile phone. The prototype is capable for automatic controlling of irrigation motor based on the feedback of soil moisture sensor. This system is used in a remote area and there are various benefits for the farmers. By using the automatic irrigation system, it optimizes the usage of water by reducing wastage and reduce the human intervention for farmers. It saves energy also as its automatic controlling the system. So, there are the system is OFF when the field is wet and automatically start when the field id dry.

The system can be implemented in all type of irrigation system (channel, sprinkler, drip). And we present we used a smaller number of sensor nodes in a large area of field, so the cost of the system also decreases. And power consumption of the wireless network devices is also lesser, and the system perform a long time function. Thus, the microcontroller-based system proves to be a real time feedback control system which controls and monitors all the activities of drip irrigation system efficiently. The present proposal is a model to modernize the agriculture industries at a mass scale with optimum expenditure. Using this system, one can save manpower, water to improve production and ultimately profit.

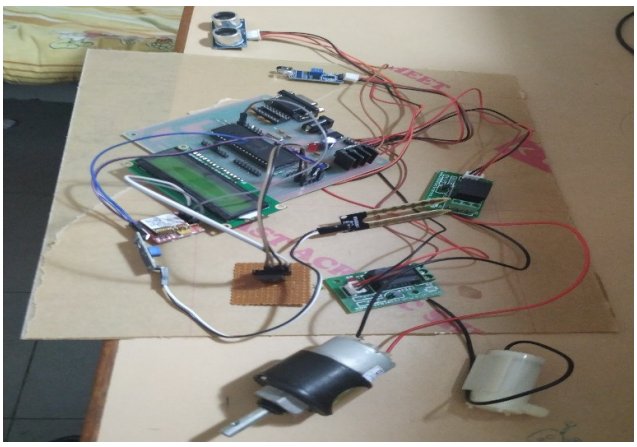

Fig2. Working prototype

Fig3. Working model

In addition, a web app is developed to help farmers to register their name, mail id and location details. From the app, it is easy to retrieve the water level, hours of irrigation and report about the moisture status of the farmland. The same is represented in figure 4. The soil moisture graph generated is represented in figure 5.

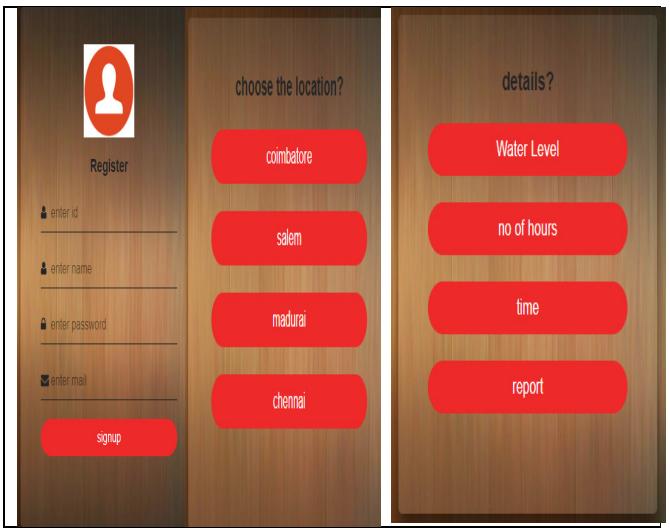

Fig 4. Pages created in Web App for data collection

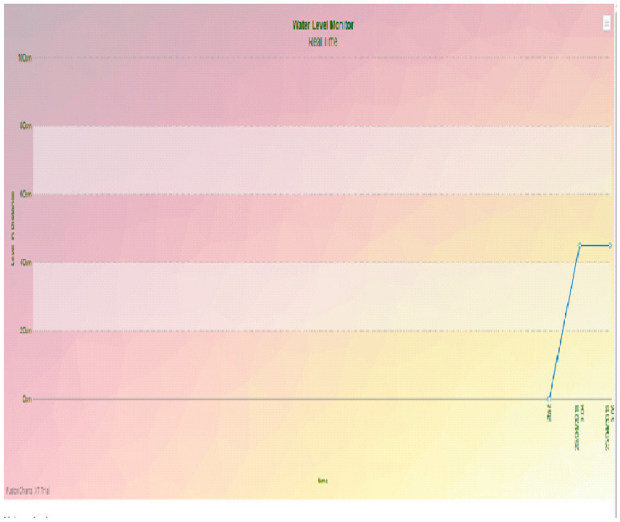

Fig.5. Soil Moisture graph

The proposed system offers the following benefits

- Automation eliminates the manual operation of opening or closing valves Possibility to change frequency and optimize the irrigation processes.
- System can be operated at night, water loss from evaporation is thus minimized
- Irrigation process starts and stops exactly when required, thus optimizing energy requirements
- Easy to use and is affordable as GSM enables the use of smart phones and eliminates the need for internet connection.
- Can be operated by anyone of any age at any place.
- Remote monitoring and controlling avoids human intervention.
- Customized to local languages

V.CONCLUSION

Thus, the microcontroller-based system proves to be a real time feedback control system which controls and monitors all the activities of drip irrigation system efficiently. The present proposal is a model to modernize the agriculture industries at a mass scale with optimum expenditure. Using this system ,one can save manpower ,water to improve production and ultimately profit. The study and analysis related to the interconnected field studies of Internet of Things, Machine-to-Machine and Wireless Sensor and Actuator Networks, it was possible to identify that there are various developments in the last couple of years, there is still problem to address regarding the generated and collected data. The automated irrigation system presented in this work was found more viable and can manage irrigation water supply more effectively. It helps to optimize the use of water for irrigation purpose. It shows that water consumption is reduced with the implementation of soil-moisture based automated irrigation system.

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