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Intelligent Irrigation System for Sugarcane Production using Interactive Voice Response and Atmospheric Condition Monitoring

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Abstract: ***The agriculture sector is the backbone of Indian economy. With the advent of the electric motor, the burden of manual irrigation by the farmer has migrated a lot. Still, there is a problem to turn ON and OFF the motor during night times. In this work, an attempt is being made to build a solution to control the irrigation system remotely from anywhere. The idea is to design a system using the Internet of Things (IoT) technology to control the irrigation system. Here, GSM module is used to communicate with the server. The system takes the input from the farmer through a voice call. The voice is basically used in IVRS system to extract the input from the farmer. Based on the input received from the farmer, the motor is turned ON or OFF. Along with this, the system is integrated with the flow sensor, moisture sensor, temperature sensor, and humidity sensor. The flow sensor is used to sense the amount of water given to the farm. Other three sensors are used to read atmosphere conditions and moisture content present near the crops.***

The system works as a closed loop system, where sensor reading is used as feedback to determine whether sufficient water has been delivered or not. When the moisture level exceeds the threshold level, the device has an intelligent system that will make a call to inform the farmer to switch OFF the motor.

The system reads the environmental condition near the crops and tells the farmer to start irrigation, if needed. Furthermore, the system can be used to provide some suggestions based on the type of the crop to improve farming in order to obtain the maximum yield from the field. This will be future implementation which uses machine learning algorithms to predict the weather conditions and provide suggestions from the data received from the field.

Keywords**: Arduino, GSM module, Cellular phone, Motor, Moisture sensor, Humidity sensor.**

I. INTRODUCTION

The Sugarcane is indigenous to tropical parts of south and south-east Asia. It is perennial grass that forms lateral shoots. Lateral shoots are typically 3 m to 4 m high and about 5 cm in diameter. It is long duration crop and requires 10 to 15 and even 16 months to mature, depending upon geographical condition. It requires hot and humid climate with average temperature of 21°C to 27°C and 75-150 cm rainfall. Temperature above 20°C combined with open sky helps in acquiring juice and its thickening. Agriculture plays a dynamic role in most country's economies. Farming is the basis of source of revenue for the population through the creation of food and important stuff. Furthermore, agriculture continues to play a significant role in providing employment at a large scale to people. Agricultural enlargement is considered essential for progress and a country's alteration from a traditional to a modern economy and mainly about India being well known for agricultural work. Agriculture in India is a vital part and India is deliberated as the land of farming. More than half of the labour force is related to the cultivation and its associated fields. Currently everything in a world can be operated and controlled automatically, but there are still a few main sectors in India where automation hasn't been adopted or not been put to a complete use, one of the reasons may be the required expenditure in the agricultural field.

Approximately all the farmers are still dependent on the conventional orthodox method of farming. It is being examined that due to succumb of crops, fruits have not being growing. Yet in some parts, it is declining. Automation has been achieved, humans are replaced by machines. Directly speaking, science and technology has proved its value in those areas. Therefore there is requirement to grab the fertility of science and technology in the field for higher yield and enlargement in farming. The use of science and technology in the field of agriculture not only reduces the man efforts but also helps in increasing the yield of crops. There are many plants that are very sensitive to water levels and required specific level of water supply for proper growth, if this not they may die or results in improper growth. It's hardly possible that every farmer must possess the perfect knowledge about growing specifications of plants in case of water supply. By the use of sensors, awareness about changing conditions of moisture, temperature and humidity

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level will be made available for the farmers so that according to changing conditions of moisture, temperature and humidity farmers will be able to schedule the proper timing for water supply and all the necessary things that required for proper growth of plants. This system can also be used in greenhouses to control important parameters like temperature, soil moisture, humidity etc as per the requirement of proper growth of plants [1].Too heavy rainfall results in low sugar content and deficiency in rainfall results produces fibrous crop. Irrigation is required in areas receiving lesser rainfall than the prescribed limit. Environmental parameters such as temperature, soil moisture, humidity, solar radiation, pH, etc. plays very vital role in overall development of the plant. Temperature affects numerous plant activities like germination, pollination, etc. Respiration rate rises that result in lessening of sugar contents of plant when there is high temperature. Photosynthesis activity is slowed down at lower temperatures. For dryness and temperature management of the plant humidity is responsible. More water will saturated in the leaf area and evapotranspiration will be less for high humid environment. Overindulgence of water may bring to a close gaseous exchange between the atmosphere and soil, which decreases root growth and root respiration. Optimum level of moisture guarantee healthy development of the root and overall growth of the plant [2]

A. Objectives

Monitoring of environmental factors is considerable. Observing agricultural environments for various parameters such as, moisture, humidity, temperature along with other factors can be important. Individuals manually take measurements and check them at different times this is a traditional method to measure these parameters in an agricultural environment. To stay away from this, it is essential to document the detail changes in environmental factors by the use of technologies helping for both i.e to improve the yield as well as to reduce the man efforts [1]. Crop quality is based on data collected from field such as soil moisture, ambient temperature and humidity etc. Advanced tools and technology can be used to increase farm yield [3]. There have been extreme socio-economic developments in the life of urban and rural people since the introduction of mobile phones in county. With newest advancements in mass production of mobile phones and technology in the market, they have been used in every walk of existence which includes automation job. The agriculture industry is also in these hi-tech advancements. Mobile phones have become a essential in the ordinary man's life. The mobile are capable of sending messages and making calls in recent advancement use of internet in mobile phone is increasing widely. With these capabilities, there has been an unprecedented utilization of mobiles in many areas of automation. Irrigation process can use mobile phone with approach of automation Irrigation method can work using vocal commands through the mobile phone. The Farmer just need to call a permanent number and provide the control commands through his phone. The control system at the field includes a voice recognition unit which decodes it and Arduino microcontroller interfaced with GSM modem to receive the command from the farmer. According to the decoded commands by the controller, the motor will turn on/off. A message to the farmer's mobile about the action that has taken place sent by control system. The moisture sensor attached to the system helps in collecting the moisture content of the soil and switch off the motor after it reaches the required value [4]. Evapotranspiration algorithm is used to calculate accurate requirement of water. This would increase the productivity of farm as proper amount of water only would be supplied to the plants [5].

II. LITERATURE SURVAY

Automation is illumination of human afford from the working field. From last two decade the industrial automation is growing very rapidly. But the automation concept in agriculture is not developed as much. In the 2042 automation in agriculture will crucial. The world population is projected to increase to 9 billion souls. There will be a huge challenge in providing abundant high quality, affordable, safe and nutritious foods for such population, especially in light of the trend to use arable land for bio-fuel production. The wastage of seed, improper spraying of pesticide on crop so soil standard get degrades also food become harmful to human body are some drawbacks with tradition method of agriculture. If major problem of water which is facing by each nation, especially India, Brazil, China and South Asian countries is only due to the improper use of water and water management deficiency [1].

In [2], authors state features of their system as -

1) The system supports water management decision, used for monitoring the whole system with GSM (RS-232) module
2) The system continuously monitors the water level (Water level Sensor) in the tank and provide accurate amount of water required to the plant or tree (crop).
3) The system checks the temperature, and humidity of soil to retain the nutrient composition of the soil managed for proper growth of plant.
4) Low cost and effective with less power consumption using sensors for remote monitoring and controlling devices which are controlled via SMS using a GSM using android mobile.

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A conceptual system layout of distributed in-field WSN is proposed in [3]. The system consists of five in field sensing stations distributed across the field, an irrigation control station, and a base station. The in-field sensing stations monitor the field conditions of soil moisture, soil temperature, and air temperature, whereas a nearby weather station monitors micrometeorological information on the field, i.e., air temperature, relative humidity, precipitation, wind speed, wind direction, and solar radiation. All in-field sensory data are wirelessly transmitted to the base station.

The base station processes the in-field sensory data through a user-friendly decision making program and sends control commands to the irrigation control station. The irrigation control station updates and sends geo-referenced locations of the machine from a differential GPS mounted at the cart to the base station for real-time monitoring and control of the irrigation system. Based on sprinkler head GPS locations, the base station feeds control signals back to the irrigation control station to site-specifically operate individual sprinkler to apply a specified depth of water.

In [4], authors describe the development of a wireless sensor network in humidity and soil moisture where the wireless connection is implemented to acquire data from the various sensors, in addition to allow set up difficulty to be as reduced.

In [5], the system proposed uses deployment of temperature and moisture sensors at suitable locations for monitoring of crops. The sensing system is based on a feedback control mechanism with a centralized control unit which regulates the flow of water on to the field in the real time based on the instantaneous temperature and moisture values. The sensor data would be collected in a central processing unit which would take further action.

Thus by providing right amount of water, the efficiency of the farm is increased. The farmer decide course of action himself based on the sensory data.

In [6], the authors introduced system that has automatic and manual mode along with Wireless Sensor Network (WSN). The real time sensed data is stored on the cloud server for decision making and controlling actions. The user can monitor the controlling actions taken at the farm as well as control the irrigation via android app on farmer's mobile phone.

In [7], it is stated that the farmer can save his time by turning on/off the motor with just a phone call from his cell phone. The power detection unit and battery backup unit at the field sends the information about the power availability and the moisture content of the soil to the farmer's mobile phone. The action taking place in the field is sent as a message to the farmer through the modem. Also the system switches off the motor automatically when the moisture level of the soil has reached a sufficient value.

III. PROPOSED TECHNOLOGY

The burden of manual irrigation by the farmer has migrated a lot. Still, there is a problem to turn ON and OFF the motor during night times. The idea is to design a system using the Internet of Things (IoT) technology to control the irrigation system. Here GSM module is used to communicate with the server. The system takes the input from the farmer through a voice call. The voice is basically used IVRS system to extract the input from the farmer. Based on the input received from the farmer, the motor is turned ON or OFF. Along with this, the system is integrated with the flow sensor, moisture sensor, temperature sensor, and humidity sensor. The flow sensor is used to control the amount of water given to the farm. Other three sensors are used to read atmosphere conditions and moisture content present near the crops.

The system works as a closed loop system where sensor reading is used as feedback to determine whether sufficient water has been delivered or not.

When the moisture level exceeds the threshold level, the device has an intelligent system that will make a call to inform the farmer to switch OFF the motor. The system reads the environmental condition near the crops and tells the farmer to start irrigation if needed. Furthermore, the system can be used to give some suggestions based on the crops types to improve farming in order to obtain the maximum output from the field.

The Microcontroller used is Arduino board to which all the modules are integrated. At first, the call is generated through IVRS from the user to a registered number to turn ON the motor. On receiving call by GSM, the system makes some voice commands to direct the used to choose the required language and control the motor using keypad.("1" for "ON" AND "0" for "OFF") .Calculating the amount of water required by a particular crop per day using the values of temperature, humidity and water flow. This information is sent to the used through SMS.

On receiving the call and getting the input, the system will check for the presence of water and electricity and it will switch ON the motor. When the moisture level exceeds the threshold level, the device has a intelligent system that will make a call to inform the farmer to switch OFF the motor.

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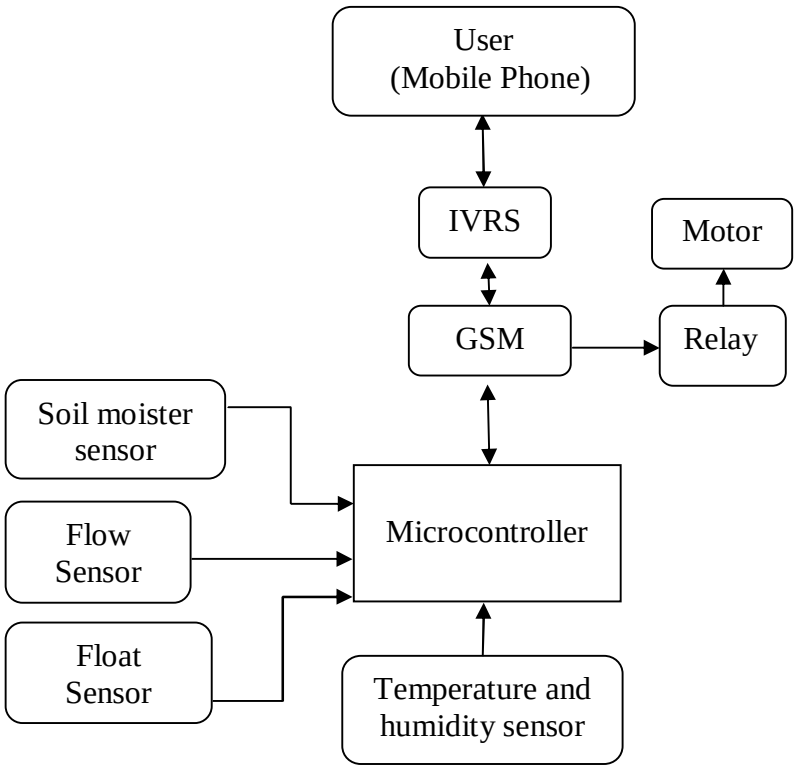


Fig. 1 Working Model of Automated Irrigation System

The Microcontroller used is Arduino board to which all the modules are integrated. At first, the call is generated through IVRS from the user to a registered number to turn ON the motor. On receiving call by GSM, the system makes some voice commands to direct the used to choose the required language and control the motor using keypad.("1" for "ON" AND "0" for "OFF") .Calculating the amount of water required by a particular crop per day using the values of temperature, humidity and water flow. This information is sent to the used through SMS. On receiving the call and getting the input, the system will check for the presence of water and electricity and it will switch ON the motor. When the moisture level exceeds the threshold level, the device has a intelligent system that will make a call to inform the farmer to switch OFF the motor. When farmer wants to turn ON the motor, he makes a call to the registered number in the GSM Module. Call is routed and connected through IVRS. The system makes vocal commands stating to choose the required language by pressing the numbers from keypad. Again a vocal command makes a voice command stating to Press 1 to "ON" the motor or Press 2 to "OFF" the motor. Then the motor will be "ON". The farmer can again make a call and OFF the motor. If the farmer forgets to make a call to "OFF" the motor and if the moisture in the soil reached the threshold level, the System will make a call and intimate the farmer that the motor is switched "OFF" automatically. When the balance in the SIM of GSM module goes low, it will be intimated to the farmer

B. Component Description

The various system components those are required for the circuit implementation is mention below,

1) Arduino Uno R3:The microcontroller use is ATmega328P is the same architecture as Arduino Pro/Pro Mini. It has 32 KB Flash, 2 KB SRAM, 1 KB EEPROM memories.

2) GSM module: It can communicate with controllers via AT commands. It has Quad-Band 850/ 900/ 1800/ 1900 MHz and Dual-Band 900/ 1900 MHz

3) Temperature and Humidity sensor: It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin.

4) Analog soil moisture sensor: Measuring soil moisture is very important in agriculture to help farmer for managing the irrigation system. Soil moisture sensor measures the content of water in soil. Soil moisture sensor uses the capacitance to measure the water content of soil.

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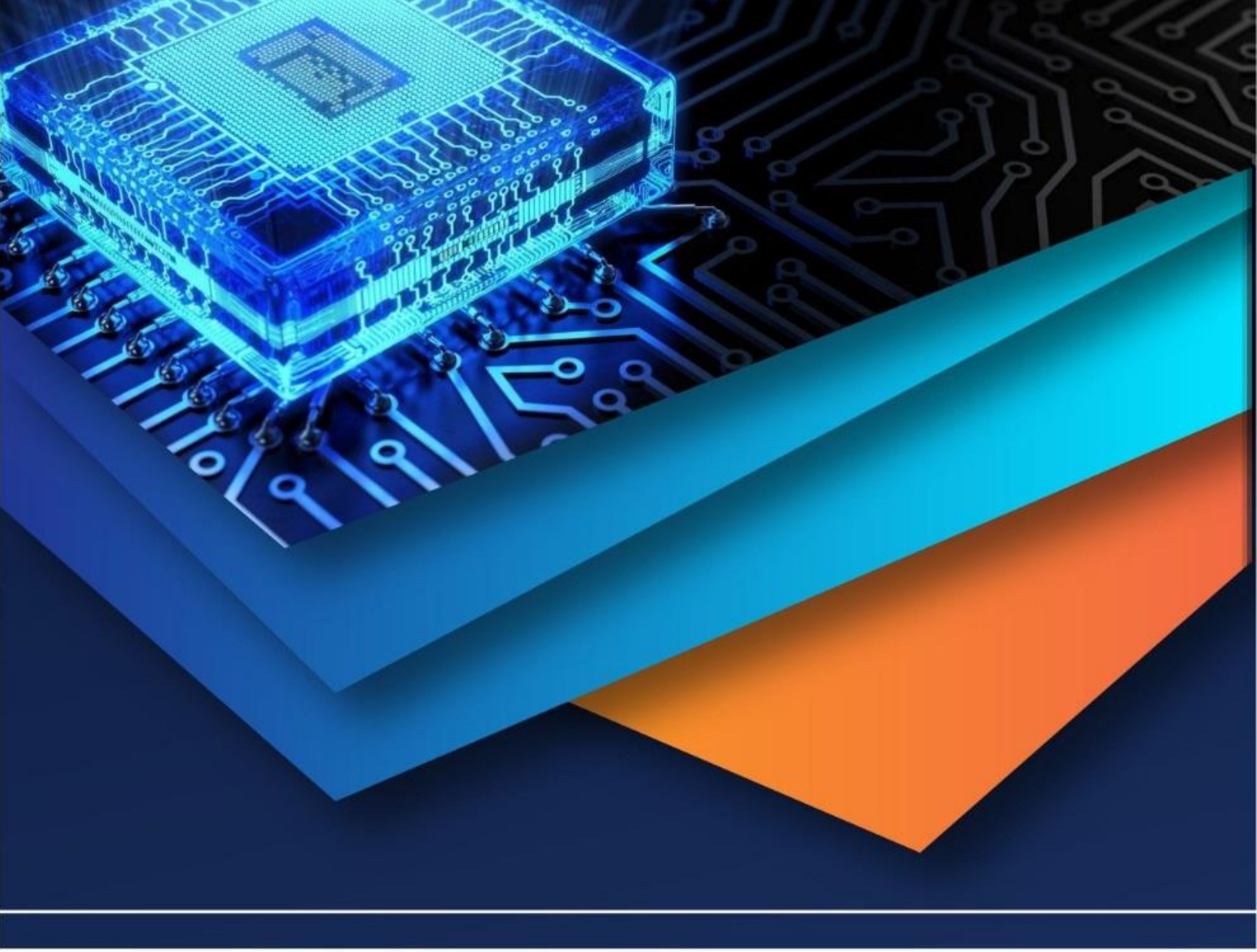
IV. CONCLUSION

The proposed system provides Indian farmer an option to ease their work in agriculture field with the help of cellular phone. The farmer speaks commands through the cell phone to activate the system at the farm. Farmer doesn't need to travel to farm in order to turn ON / OFF the motor. It saves farmer's time. The water management in farm is possible by use of moisture sensor and IVRS system. Moisture sensor senses the level of water in soil and automatically switches off the motor. IVRS provides the information to farmer and intimates the farmer that the motor is switched "OFF" automatically. The implementation work is under progress and this paper is submitted as a review paper.

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