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Water Flow Monitoring and Automation in Agriculture Field

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Abstract- Smart Agriculture helps to reduce wastage, effective usage of fertilizer and thereby increase the crop yield. In this work, a system is developed to monitor crop-field using sensors (soil moisture, temperature, humidity) and automate the irrigation system. Our main objective of this work is to for Farming where various new technologies to yield higher growth of the crops and their water supply. Automated control features with latest electronic technology using microcontroller which turns the pumping motor ON and OFF on detecting the dampness content of the earth and GSM phone line is proposed after measuring the temperature, humidity, and soil moisture. The irrigation is automated if the moisture and temperature of the field falls below the brink. The notifications are sent to farmers' mobile periodically. The farmers' can able to monitor the field conditions from anywhere. This system will be more useful in areas where water is in scarce. This system is 92% more efficient than the conventional approach.

Keywords—Sensors, Irrigation

I. INRODUCTION

Wireless Sensor Networks are the auto-configured and infrastructure-less networks monitor environmental conditions such as atmospheric temperature, pressure, motion, sound, etc. These data are observed from WSN and sent to appropriate network. WSN contains Nodes and Sink. Nodes are fixed or mobile sensors. These sensors sense data and send to the sink. Sink retrieving required information form sensor by injecting queries and send to network admin. Sensors are capable to perform particular instructions or specific format of data. These sensors work continuously or specific time. Sensors positions are captured by using GPS devices.

WSN technology is widely used in Agricultural field. This field improves the production and quality of product and this reduce human operations. Modern technology implements automation in agricultural field called precision agriculture. This method controls the input parameters such water, fertilizer, pesticide, etc. and inject these parameters in specific time.

Wireless sensor networks easily captures crops from fields that prevent from other sources such as insects, etc. this increases crop production. Here a typical example of tomato field is considered. Tomato is a water-stress-sensitive crop. Tomatoes have a relatively shallow root system that provides very little margin for irrigation errors. Tomato plants are more productive and produce higher quality tubers when watered precisely using soil water tension (SWT) than if they are under or over irrigated. Soil humidity provides useful guidelines to avoid water stress by projecting when to irrigate.

WSN implements sensing devices in agricultures that identify irrelevant activities and environmental changes in crops such as fungus, plagues infection, irrigation controlling. Irrigation system is manually controlled in certain countries. This increase more human work in agricultural field and sometimes lot of crop dried. This reduces productivity in agricultural field and affects directly to the farmer.

Monitoring and tracking water supply in agricultural environment is a critical one. The increases worldwide water loss in this environment. Water is the very important source in food crops. Traditional water sources lead huge costs for providing fresh potable water from non-traditional sources such as desalination plant. Pipeline leakage is the main water loss in this environment. Inadequate corrosion protection, damaged valves and mechanical damages are the main factor in pipeline water leakage.

Wireless Sensor Networks employ monitoring and sensing pipeline leakage in better ways. This paper analyses and implements various methodologies using pipeline water supply automation in agricultural field by using wireless sensor network. The proposed method controls pumping motor for water supply that implements electronic technology using microcontroller. This resolves irrigation if the moisture and temperature changes. The proposed work is more efficient from the conventional work.

II. RELATED WORKS

Manish Giri et al. in 2013 [1] developed a drip irrigation system built around microcontroller and solenoids, which are used to automate the valves and turn ON the system in case of intense requirement of water. The purpose is served by using WSN along with linear programming. Whereas this technique is not suitable for real life situation in presence of constraints. The benefit harnessed is the decline in soil erosion as well as nutrient leaching.

DeeptiBansal et al. in 2013 [2] presented another work on WSN with microcontroller and GSM. In this [2] system, the farmer is informed about the environmental factors of the field and the actuators are permitted to control by him. The valves and the sprinklers are used for judicious usage of water for the irrigation. This involves Zigbee based low power devices and working range limited to only about 150 meters. The prototype implemented has the accessibility of the GSM network as an inevitable requirement. While in Indian scenario network availability is poor in the village and near agriculture fields.

M.Ramu et al. in 2013 [3] developed a system to automate the irrigation system based on 8051 microcontroller and GSM. It senses the soil condition and availability of the water and controls the motor through the microcontroller. Besides, the humidity and temperature sensors are used to sense the condition of the weather. Additionally, through serial communication between microcontroller and GSM, the information is sent as SMS to the user through GSM. The LCD displays & GSM conveys the information about conditions of the irrigation field.

PrakashgoudPatil et al. in 2013 [4] developed an intelligent irrigation control system based on fuzzy logic using WSN. It [4] has incorporated temperature sensors, soil moisture sensors, computercontrolled devices, precise irrigation equipments, and an intelligent controller using fuzzy logic practice. The designed prototype, examines the leaf wetness, moisture level in the soil, humidity, temperature, and other necessary factors and as well the irrigation control is done intelligently. The paper has presented the simulation results of the agriculture field satisfactorily along with tabulation of the estimated numerical method which highly benefits for comparative studies.

N. Dinesh Kumar et al. in 2013 [5] developed a prototype design of microcontroller based intelligent irrigation system that allows irrigation to take place only at the zones where there is a requirement of water. It also includes pesticide sprinkling system which prepares the mixture in required proportion deserved by the plants automatically. The system uses valves, it is found that response from the valves in case of failure or fault in data is not been discovered and informed to the user.

R. Suresh et al. in 2014 [6] developed a technology where temperature and humidity of plants are specifically controlled. The proposed system uses GSM to report the details about the irrigation through an android mobile. The paper has implemented raingun irrigation system which is proficient in saving more than 50% of water, than used by flood irrigation and is capable of nitrogen fixation.

Ms. JyotsnaRaut et al. in 2014 [7] developed Automatic drip irrigation system using WSN and data mining algorithm for remote control of precision irrigation system. It acquires data from the different sensors and gives it to the base station using ZigBee. To enhance the intelligence of the system the Data mining algorithms are used for data processing and computation requirements to make the decision. The electricity and water conservation is done ably is the merits of this technology.

HarithaTummala et al. in 2014 [8] developed a system using WSN in precision agriculture. In this system, the moisture is normalized to the desired level of the soil by controlling the flow of water in the irrigation pump as per the sensor readings. It proficiently checks the soil moisture level, humidity, leaf wetness, temperature, and other essential factors intelligently.

Prashant S. Patil et al. in 2014 [9] proposed an automatic drip irrigation system based on a microcontroller. Soil moisture sensor and water flow meter are used to controls the soil moisture content of the cultivating field, monitor the water flow and analyze based on available data.

Veera Samson Janga et al. in 2015 [10] built an auto irrigation system using ARM7 and GSM module. In this, a WSN technique is used to acquire the signal moisture and temperature from various location of the farm and as per requirement of the crop, controlled decision is taken to make irrigation system On or Off. The controlling of the irrigation on the field is done by SMS through GSM which forms a link between ARM processor and centralized unit.

Prashant B et al. in 2015 [11] developed an intelligent, entirely automated water management system which is internet driven. The hardware and software are merged together to provide better command over the manual system. A microcontroller board is interfaced using PC based software to control the valve on/off timings. The on/off timings of the drips can be downloaded from websites hosted by agricultural universities using the software.

Farmers can be assisted from universities to modify the drip on/off timings based on the soil condition, current climate, fertilizers used, etc.

K Nilson et al. in 2015 [12] developed a system using ARM 9 processor and different kinds of sensors; used to control and monitor the irrigation system. In this [12], the Ph content and the nitrogen content of the soil are repeatedly observed. Using GSM module the user gets informed regarding unfavorable conditions like low moisture content, the rise in temperature and CO2 concentration via SMS. This system also lessen the soil erosion and nutrient leaching and devour a lesser amount of water than needed for the sprinkler system.

III. PROPOSED MODEL

Nowadays agricultural field is facing lot of problems due to lack of water resources. In order to help the farmers to overcome the difficulties, smart irrigation system has been used. In this system, various sensors such as soil moisture, DHT sensors are connected to the input pins of PIC microcontroller. The sensed values from the sensors are displayed in LCD. If the sensed output value reaches the limit value then the pump will be automatically switched ON/OFF by the relay circuit and it is connected to the driver circuit which helps to switch the voltage. The current field status will be intimated to the farmer through SMS. By using this system, the farmer can access the details about the condition of the field anywhere at any time.

The centralized unit connected to admin network using GSM based SMS services. The GSM sends this data to PIC Controller, after processing it displays it on the LCD. The activation command is given to start the motor and indirectly activate the transistorized relay circuit to constantly monitor the environmental factors and once the required level is reached the motor is turned off and the message is sent to the farmer. The following diagram illustrates the block diagram of the system.

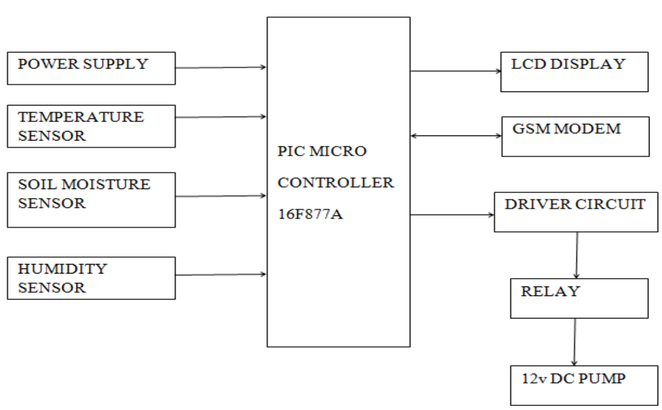

Fig.1. System Architecture

A. PIC 16F877A Microcontroller

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the complementary of metal oxide semiconductor and RISC based microcontroller. It has unique bus architecture for each instruction and parallel access of data memory. It reduces the power consumption that results high productivity. It's size also very small size with pin count.

Microcontroller's memories are different sizes and manufacturing category such as EEPROM, EPROM, FLASH MEMORY etc. recent technologies implement FLASH memories because of small size and low power consumption. In this system PIC 16F877A type memory is used because of data availability when power is turned OFF situation.

B. Soil Moisture Sensor

PIC Microcontroller sensor is programmed and it has two probes which is inserted into the soil. Probes send current to the soil to identify moisture soil and dry soil. This will transfer to the microcontroller.

C. Temperature Sensor

Output sensor contains temperature sensor identifies atmospheric temperature high/low and checks the normal temperature. This temperature is notified and converted by analog-to-digital converter. Converted digital output is transferred to central unit.

D. Humidity Sensor

The DHT11 temperature and Humidity sensor is used. The total amount of water vapor in air is defined as a measure of humidity. Relative humidity is calculated because when there is a change in temperature, relative humidity also changed. The temperature and humidity changes occur before and after irrigation.

E. DC Pump

Small DC motor is used to pumps water and it powers through a simple gear drive. Coils are insulated between two magnets in this motor. If the electricity passes in this system motor rotates and pushes the spin.

F. GSM Modem

GSM modem is used to connect indication of network, whether it is available or not. It has two LEDs and if the red LED glows then network is available otherwise green LED glows. This modem transfers SMS also.

G. LCD Screens

LCD displays characters, symbols or patters in polymeric layers and electrodes with liquid crystal. LCD screen consists of two glass plates with liquids and crystals.

H. Relay

This type of switches control circuit by the operation of low-power signal. It has electromagnet and connects it with circuit. Different types of circuit board applications implement this type of relay switch.

I. Buzzer

Buzzer is an indicator that usually illuminates a light on a panel and indicating a continuous beep sound. This type of buzzer is used in various applications such as household applications like microwave oven or game shows.

II. METHODOLOGY

As soon as the soil moisture sensor receives power it starts sensing the moisture of the soil. The moisture level which it senses has an analog value which needs to be converted in digital. Since, the soil moisture sensor does not have an inbuilt ADC(Analog to digital convertor), this function is done by an external ADC. The digital value is sent to the 16F877A chip. Based on the digital value following steps are taken:

- If the soil moisture level is more than 80%, the solid state relay turns off water pump.
- If the soil moisture level is between 20% and 80%, the value is sent to the LCD from the 16F877A chip and gsm modem send message to the farmer's mobile no. the farmer will be reply the message ON to 16F877A and then relay turns on water pump.

This system is designed for wireless embedded sensor networks and works on different individual components which reduce the system power consumption and low memory usages. It has different portals and tools used. The working diagram of this system is following.

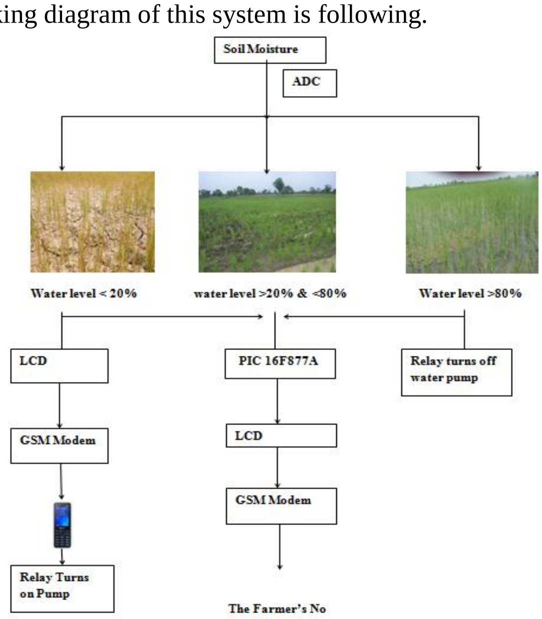

Fig.2. Proposed Model

III. RESULTS AND DISCUSSION

When the soil is dry, the soil resistance between the positive supply and the non inverting input is high resulting in positive supply to the non-inverting input less than the inverting input making FIZ output as logic low. This command is given to microcontroller. In this condition the microcontroller send message to farmer. Whenever the farmer reply the message then controller activates the DC pump using relay driver. When soil is back to normal condition, the controller deactivates the pump. Experimental results are shown in the following table.

Table 1. FIZ Activity Analysis

FIZ (Set Soil < Current Soil)	**MESSAGE (To Farmer)**	**MESSAGE (To Device)**	**DC PUMP (Irrigation)**
Abnormal	Send	Not Received	Off
Abnormal	Send	Received	On
Normal	N/W	Received	Off
Abnormal	Not Send (Insufficient Balance)	Received	On

Experimental results are better one when abnormal condition is reached in different water levels. These abnormal conditions are sent to farmer via GSM modem.

Fig.3. Motor is ON condition

When the Motor is in ON condition, soil moisture level is checked and if the condition is abnormal then water flow is changed.

Fig.4. Motor is OFF condition

The following table illustrates FIZ output conditions in various time duration and analyses DC pump irrigation activities.

Table.2. Performance Analysis

Time	**DC PUMP (Irrigation)**	**FIZ**	**Success Rate**
10.10 am	Off	Abnormal	85.48%
11.10 am	On	Abnormal	87.25%
12.10 am	Off	Normal	89.18%
01.10 pm	On	Abnormal	90.28%
02.10 pm	On	Abnormal	91.62%

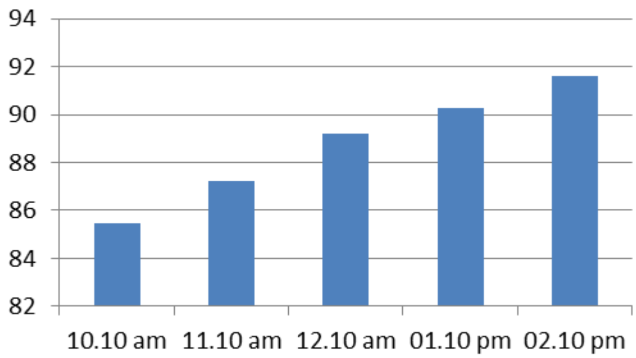

Fig.5. Graphical Analysis

IV. CONCLUSION

In the present the farmers use irrigation approach through the manual control, in which the farmers irrigate the land at regular intervals. This process seems to consume more water and results in water wastage. Moreover, in dry areas where there is inadequate rainfall, irrigation becomes difficult. Hence, we require an automatic system that will precisely monitor and control the water essential in the field. Installing Smart irrigation system saves time and ensures judicious usage of water. Moreover, this architecture uses micro-controller which promises an increase in system life by reducing power consumption. It provides with several benefits and can achieve with less manpower. The system provides water only when the humidity in the soil goes below the reference. Due to the direct transfer of water to the roots water management takes place and also helps to maintain the moisture to soil ratio at the root zone consistent to some extent. Thus, the system is efficient and compatible to changing environment. Our Future work involves, a water meter installed to estimate the amount of water used for irrigation and thus giving a cost estimation. A valve can be used for varying the volume of water flow.

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