IoT based Smart Irrigation and Control System

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Abstract-IoT plays an important role in agriculture industry. One of the important processes in agriculture is irrigation**.** Proper irrigation system could be achieved by using WSN technology. Monitoring and control system have been tremendously improved by using WSN technology. It enabled efficient communication with many sensors. Hence the energy of sensors must be efficiently utilized in wireless sensor networks to extend the lifetime of the network. Irrigation is automated by detecting soil moisture which operates according to the soil moisture threshold set accordingly, so as optimal amount of water is applied to the plants which helps to reduce wastage of water. This system will be more useful in areas where water is in scarce. The data from sensors are sent to Arduino uno using wireless network device. The analog data received from the sensors are transmitted to Arduino.It process all data and control and selects the direction of the flow of water in pipe and then controller node switch on the motor to irrigate associated field. Further notification SMS is send to registered mobile phone which is registered in Arduino. The Arduino is monitoring with a screen to see the current status of the irrigation and use for change the setting of user required.

Index terms- **Smart irrigation,Soil moisture sensor, Arduino, Raspberry-pi, electromagnetic valve, IoT.**

1. INTRODUCTION

In our nation agriculture is real wellspring of nourishment generation to the developing interest of human population. In farming, water system is a basic procedure that impacts crop production. Farmers visit their agriculture fields regularly to monitor soil moisture level and based on need water is pumped by motors to irrigate particular fields. Farmer need to sit tight for certain period before turning off motor with the goal that water is permitted to stream in adequate amount in particular fields. This water system strategy takes lot of time and exertion especially when a farmer need to irrigate numerous farming fields disseminated in various topographical regions.Generally farmers will exhibit in their fields to do water system process. But these days' farmers need to deal with their agrarian action alongside different occupations.Mechanization in water system framework influences agriculturist to work considerably simpler. Sensor based mechanized water system framework gives promising answer for farmers where nearness of agriculturist in field isn't mandatory. A small processor modified for control an electromagnetic valve and furthermore contrast with electromagnetic valve work engine to begin watering. Really INDIAN agriculturists require modest and basic UI for controlling sensor based computerized water system framework.Presently a day's internet is generally utilized. Utilizing internet farmer think about the farming field water system status.This encourages agriculturists to know the status of farm field watering heading through a message whether the farmer is far from field know the status of water engine is ON or OFF and bearing of watering.In this paper we present a prototype for fully automationaccessing of irrigation motor where Prototype includes numberof sensor node placed in different directions of farm field. Every sensor are incorporated with a remote systems administration gadget and the information got by the "ATMEGA-328" microcontroller which is on an "ARDUINO-UNO" advancement board.TheRASPBERRY-Pi is used to send messages via internetcorrespondence to the microcontroller process. For experimentation we have preoccupied number of soil moisture sensor utilized as a part of various course of the farm fields. The soil moisture toward every path of field is detected by sensor hub and the detected information is sent to microcontroller hub through remote systems administration gadget.On accepting sensor esteem the controller hub checks it with required soil moisture esteem. At the point when soil moisture in a specific field isn't up to required level then controller hub switch on the engine to water related field and the RASPBERRY-Pi process all information and notice SMS is send to enlisted cell phone which is enrolled in RASPBERRY-Pi. The RASPBERRY-Pi is observing with a screen to see the present status of the water system and use for change the setting of client required.

2. IMPORTANCE OF IRRIGATION

The rainfall of in our nation relies upon monsoons. Rainfall controls agriculture, however the agriculture is said to be "the betting of the rainstorm" as the monsoon rainfall are unverifiable, sporadic and uneven or unequal.So water system is fundamental for agriculture. In INDIA there are 80% of the aggregate yearly precipitation happens in four months, i.e. from mid-June to mid-October. So it is extremely important to water system for cultivate field amid whatever remains of the eight months [1].

2.1 TYPES OF IRRIGATION

There are different types of strategy for irrigating farm field for various kinds crop field. Essentially Indian farmer utilize these three techniques channel system, sprinkler system, drip system. Channel system is a customary strategy for water system. But a smart water system framework is another innovation to irrigating farm field automatically.

2.2 Channel Irrigation System

This framework is generally utilized as a part of cultivating water system framework. As this framework is a minimal effort framework for irrigating a vast region cultivating field. In this framework funnels are associated with a water pump and keeping in mind that pump began water move through pipe a from lake, waterway, bore well to cultivating field. Furthermore, the agriculturist completely connected with for irrigating the yield field with number of labourers. Gigantic measure of water waste and substantial number of labourers are engaged during watering.

Fig. 1 Channel irrigation system

2.3 Sprinkler Irrigation System

This framework is more helpful whether the water is accessible in littler amount. At the point when pump began then water course through fundamental pipe and furthermore course through the opposite funnels. A nozzle on the highest point of opposite pipe is joined and turning consequently at general interval. This framework is exceptionally valuable on the sandy soil. Less number of specialist required water waste is less [1].

Fig. 2 Sprinkler irrigation systems

2.4 Drip Irrigation System

In this framework waterfall drop by drop at the situation of the roots. It is the best innovation for watering organic product plants, gardens and trees. Water move through a primary pipe and isolated into sub channels. Uncommon arranged nozzles are joined to these sub funnels. Water consumption is very less and also no man power is needed for irrigation. At the point when the agriculturist knows the status of the farm field at that point begin the motor and picked the directions from nozzles. At that point consequently watering the plants and after some time the farmer check the status of the field and keeping in mind that the entire product are watering at that point OFF the engine [1].

Fig. 3 Drip irrigation system

2.5 **Smart Irrigation System**

Over three frameworks are for the most part work by a user however a smart water system tells that the aggregate framework is controlled by self-governing mean consequently control the aggregate water system framework whether the agriculturist is absent his ranch field and send messages to the agriculturist about the data of homestead field and change in activity of the farm field. Which require no laborer for working, and furthermore less waste of water with contrasted with past three strategies.

Fig. 4 Smart irrigation system

3. SYSTEM COMPONENTS

3.1 Soil moisture sensor

The Soil Moisture Sensor utilizes capacitance to quantify the water substance of soil (by estimating the dielectric permittivity of the dirt, which is an element of the water content). Just embed this tough sensor into the dirt to be tried, and the volumetric water substance of the soil is accounted for in percent.

3.2 Arduino

The Arduino-Uno is a microcontroller board in light of the ATmega328.It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset buttonIt contains everything expected to help the microcontroller; just interface it to a PC with a USB link or power it with an AC-to-DC connector or battery to begin [8].

3.3 Raspberry-pi

The Raspberry Pi is a little, effective and lightweight ARM based PC which can do a large number of the things a work area PC can do. The capable illustrations capacities and HDMi video yield make it perfect for sight and multimedia applications, for example, media focuses and narrowcasting arrangements. The Raspberry Pi is based on Broadcom BCM2835 chip. It doesn't highlight a worked in hard disk or solid-state drive, rather depending on a SD card for booting and long-term storage [9].

3.4 Electromagnetic valve

The solenoid is an electromagnetic piece of a valve, contained of a coil, core tube, and centerwalled in area. The choice of 2- way, 3-way and 4-waysolenoid valves, intended to deal with the most requesting fluid control applications. 3-Way Electromagnetic Valves have three pipe associations furthermore, two holes. When one hole is open, the other is shut furthermore, vice versa. Naturally controlled by the water requirement of sensor hub.

4. PROPOSED SYSTEM

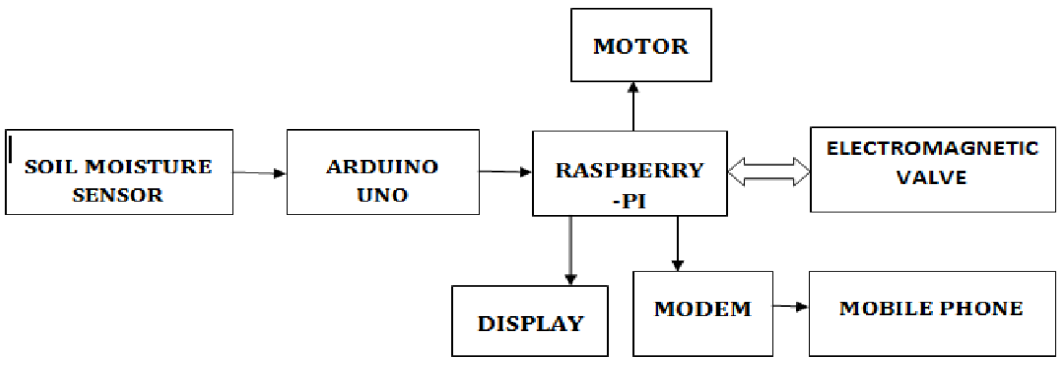

Fig. 5 Block diagram of smart irrigation system

Fig.5 represents the functions of smart irrigation system. The soil moisture sensor sense the moisture level in the soil and send the data to the Arduino where ATMEGA-328 microcontroller process the data and calculates the dryness level. For each five minutes arduino gives the dryness level. The dryness value is given to the raspberry-pi to control electromagnetic valve and operate motor. Raspberry-pi connected with the internet sends message to the registered mobile number. It the dryness in the field and according to that open the electromagnetic valve. Water can be irrigated efficiently to the farm without wasting the water.

In a substantial zone of farm field there is utilize large pipes for watering plants in various ways from the attachment of motor. Which is changed by the farmer to water a specific course of the field. However, utilization of electromagnetic valve the pipe framework are constantly associated and electromagnetic valve consequently alter the course of the water required territory of the field and the valve is controlled by the Raspberry-Pi. While the valve is open then the water engine ON consequently. What's more, send a message to the enrolled number and enrolled g-mail account. By which agriculturist know the status of the farm field while farmer far away from field. Use of large number of sensors and devices increases the cost of the system. The sensor and devices as to be reduced.Sensors are deployed in each corner of the irregular area and then design the inside of an irregular surface like square and then sensors are deployed in each corner of the square. Which required less number of sensors. Each sensor node connect with a wireless network devices.

An algorithm called Local Shortest Path(LSP) use for control in remote different systems. In this algorithm each WSN gadget figures the briefest ways associating itself to the close-by WSN gadgets in view of some connection weight function[17]. The sensor nodes and remote system gadgets are controlled by battery with constrained power source. Hence, the vitality utilization of the sensor nodes is treated as the most genuine issue for the long task of the WSN. Grouping WSN gadgets is a proficient strategy which is known for energy saving of the sensor nodes[13].A two-tire WSN is formed by gathering sensor nodes into clusters in the lower tire. In each group there is a cluster head(CH) and remaining nodes are cluster members(CMs). CMs gather the information and send to the CH. The CH at that point send the accumulated information to the sink straightforwardly or through other CH. There are two sorts of correspondence amongst CH and sink i.e., single-hop correspondence and multi-hop correspondence. In single-hop the CH straightforwardly interface with sink and the multi-jump the CH interface by means of other CH to sink. Each CH appropriates and transmits the information packet to the sink with the goal that the heap of the sending nodes is adjusted and the vitality devoured by the CH is limited during the time spent information routing[13].

5. IMPLEMENTATION

An adhoc network of soil moisture sensors are connected using CBRP protocol. The fig. 6cluster heads collects data from the sensors under them and they transmit them to Arduino. Sensors are connected to the data pins of the Arduino. The cluster information are the data collected by the Arduino board is given to raspberry-pi. The raspberry-pi controls the on and off operations of the motors and electromagnetic valve.

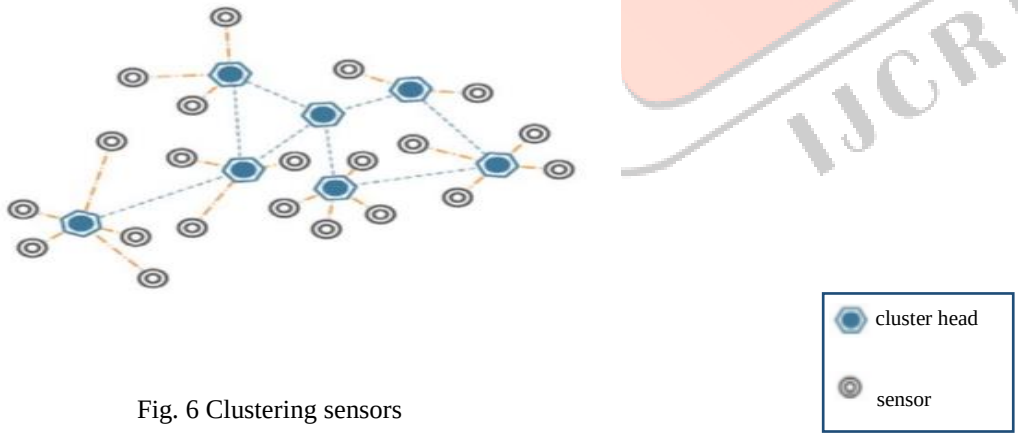

Fig. 6 Clustering sensors

In fig.7represents the soil moisture data level for mentioned period. The water irrigated to the farm is based on the moisture level result observed from the graph.

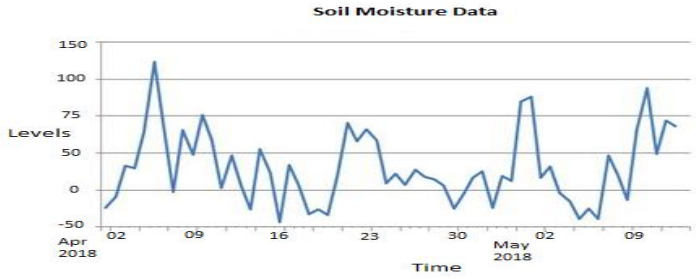

Fig. 7 Graphical representation of soil moisture data

Table 1 represents the moisture level of soil of each cluster.

Table. 1 Extracted measurements

cluster	Soil moisture level %
1	50
2	23
3	75

6. CONCLUSION

In this paper we exhibit a model for automatic controlling a water irrigation system. Here models incorporates sensor node and control node. The sensor node is placed in water system field for detecting soil moisture esteem and the detected information is sent to controller node.On getting sensor esteem the controller node checks it with required soil moisture esteem. Whenever soil moisture in water system field isn't up to the required level at that point the motor is changed on to water related farming field furthermore, ready message is send to registered mobile number. Using this smart irrigation system man power can be reduced and also water can be saved. Usage of minimum sensors also reduces the cost of the system.

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