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IOT BASED COST EFFICTIVE SMART IRRIGATION CONTROL SYSTEM

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ABSTRACT
Now-a-days the whole world is suffering from water stress problem and agriculture is one of the most affecting factor for it. Due to improper management, billions of liters water is wasting in agriculture. So we implemented a proof of concept model, IoT based cost effective smart irrigation control system for agriculture. In which according to moisture conditions we are controlling the water pump timings through internet. It is one of the most novel applications of IoT platform. The GSM module provides internet access to control system as well as it will send the SMS to farmer regarding status of moisture level and water pump status. The control system will take input from moisture sensors and publish the data on cloud so accordingly pump will ON or OFF. This complete control system will definitely useful to avoid wastage of water in farm and cost effective as well.

KEYWORDS—Irrigation control system, IoT, Cloud, Moisture sensor, GSM

I. INTRODUCTION

Water stress is the most emerging problem of world. From year 2011 India also came into the list of Water Stress Countries. Water stress percentage of world map is as shown in figure below. In which India having High water stress country with 40% to 80% of water stress. For this water stress problem, there are many reasons behind it like industrial waste, urbanization, pollution, rainfall wastage and improper agricultural practices. According to Bhartiya Agro Industries Foundation survey 70% of water is wasted during agricultural activity due to lack of automation in agriculture field which results in soil erosion. But still there are very few farmers who use the automation in the farms due to the cost of automation and reliability of the same.

In India, farmers still uses traditional methods of irrigation. The traditional methods like manually switch on and switch off the motor pump. This method is totally depends upon the human being so due to the human error there is improper quantity of water is feeds to crops. While irrigation moisture of soil is not consider. Only after specific period of time water is feeds to crops in which sometimes water level become high in soil and extra water got evaporated. So billions of liters water get wasted and soil erosion get take place. In other condition soil moisture level get low and due to low water level crops become weak and sometimes crops dies.

In India there is another major problem of electricity load shading. Due to poor management of electricity availability every time farmer have to available in farms to switch on and switch off the water pump which is not feasible. To avoid these both the problem it is necessary to increase automation in agriculture area.

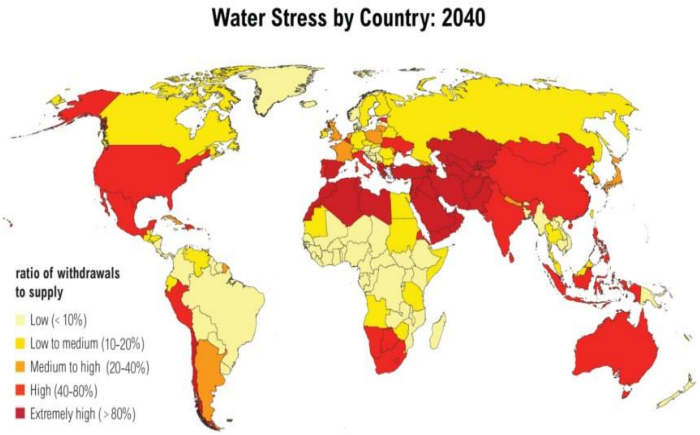

Fig. 1 Water Stress level of World by 2040

II. RELATED WORK

There are many existing irrigation system are available in market and many of researchers working on it. In [1] [4][22] and [15] proposed system was a sensor network connected with a fuzzy controller and fuzzy logic system so the system response becomes slow and system become costly. So very few of farmers can be use this system. In [2] system, the complete system depends upon the weather website, where system takes the data from website and gives to arduino. Then the arduino gives output to solenoid valve. But sometimes website data is not actually to true data so this system fails here. System [5] is PLC based system where water control flow is controlled by PID controller but system is not affordable for poor farmers in their farms. System [6] is very complex, in this system their software and database is made locally so it requires skilled farmers to monitor it.

System [9] is developed only for gardens; large amount of data cannot be handled by raspberry pi. So this system cannot be used for farms. In [11] system uses old arm microcontroller and zigbee technology. For long lasting this system can't be used. A bulky system design [16], in which the design uses arduino UNO and raspberry pi and for wireless communication between these zigbee is used. This system is wireless but not IoT so system can't be handling from remote location. System [17][18] having raspberry Pi but for internet connection first we have to install internet connection for it. We can't connect GSM to raspberry Pi.

Now this paper aims to achieve all the basic need of farmers with affordable price for poor farmers as well. So we design the IoT based smart Irrigation system using ESP8266 microcontroller board and basic sensor with a controllable water pump timing.

III. PRAPOSED SYSTEM

The system architecture of IoT based smart irrigation system is shown in figure (2). It will illustrate the block diagram of complete system.

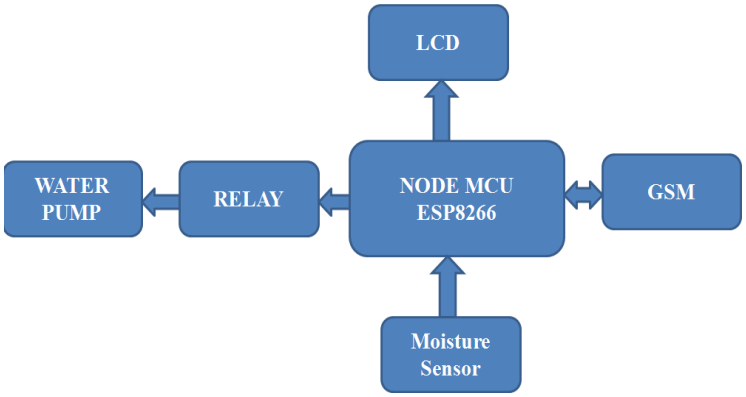

Fig. (2) Block Diagram of System

Both moisture sensors are connected to the Node MCU and these sensors are capable to sense the moisture of soil and temperature of surroundings, then these data sends towards the microcontroller. Moisture sensor (DHT11) is connected to the Node MCU i.e. ESP8266 which is IoT enabled microcontroller board. GSM module is connected to Node MCU for two purposes, first it will send SMS to farmer regarding to moisture level and water pump motor ON/OFF status and second one is to enable internet access to ESP8266 board through GPRS. GSM share internet to Node MCU and then Node MCU sends data on cloud.

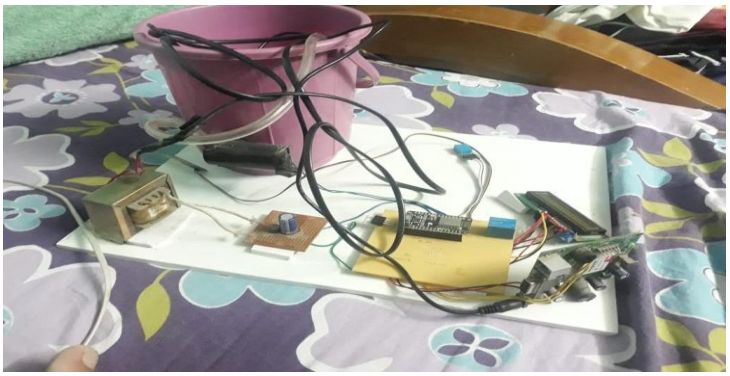

Figure (3) Proof of Concept System Model

When moisture level of soil get decreased than reference level, water pump motor will ON and after increasing sufficient level of moisture of water pump get OFF automatically. This status of water pump motor ON/OFF also get updated on Adafruit IO and sends SMS to farmer.

IV. RESULTS

The actual readings of this system are taken at a particular field for a single day with specific time interval. Readings are taken in morning time, afternoon time and Night timings which are shown in Table I, II and III respectively.

created at	Temperature	Humidity	Moisture	motor
7:45	32.7	38	578	0
7:50	32.6	38	577	0
7:55	32.5	38	577	0
8:00	32.6	38	0	100
8:15	32.5	38	0	100
8:20	32.6	38	0	100
8:25	32.6	38	501	0
8:35	32.6	38	509	0
8:40	32.7	38	513	0
8:45	32.6	38	522	0

TABLE I - MORNING TIME READING

created_at	Temperature	Humidity	Moisture	motor
2:00	37.6	39	412	0
2:15	37.5	39	411	0
2:30	37.8	39	410	0
2:45	37.9	39	390	0
3:00	37.6	39	200	100
4:00	38	39	210	100
4:30	38.1	39	215	100
4:35	37.5	39	375	0
4:38	37.8	39	376	0
4:40	37.6	39	365	0

TABLE II- AFTERNOON TIME READINGS

Time	Temperature	Humidity	Moisture	Motor status ON/OFF
7:45	30.1	36	390	0
7:50	30.5	36	385	0
7:55	30.3	36	370	0
8:00	30.2	36	380	0
8:15	30.1	36	385	0
8:20	30.5	36	370	0
8:25	30.4	36	360	0
8:35	30.8	36	365	0
8:40	30.7	36	360	0
8:45	30.8	36	365	0

TABLE III- NIGHT TIMING READINGS

V. CONCLUSION

After taking various readings for several days, the system works accurately and water wastage reduction is achieved by 78%. This system cost and maintenance cost is very less than that of existing automatic irrigation systems. So for poor farmers this system is affordable and very helpful in their farming. This system will save water wastage as well as it will reduce efforts of farmers.

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