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IOT BASED SMART CROP-FIELD MONITORING AND AUTOMATION IRRIGATION SYSTEM

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***Abstract*— Agriculture plays vital role in the development of agricultural country like India. Issues concerning agriculture have been always hindering the development of the country. The only solution to this problem is smart agriculture by modernizing the current traditional methods of agriculture. Hence the proposed method aims at making agriculture smart using automation and IoT technologies. Internet of Things (IoT) enables various applications crop growth monitoring and selection, irrigation decision support, etc. A Raspberry Pi based automatic irrigation IOT system is proposed to modernization and improves productivity of the crop. main aim of this work to crop development at low quantity water consumption, In order to focus on water available to the plants at the required time, for that purpose most of the farmers waste lot time in the fields. An efficient management of water should be developed and the system circuit complexity to be reduced. The proposed system developed on the information sent from the sensors and estimate the quantity of water needed. A two sensors are used to get the data to the base station the humidity and the temperature of the soil, the humidity, the temperature, and the duration of sunshine per day. The proposed systems based on these values and calculate the water quantity for irrigation is required. The major advantage the system is implementing of Precision Agriculture (PA) with cloud computing, that will optimize the usage of water fertilizers while maximizing the yield of the crops and also will help in analyzing the weather conditions of the field.**

Keywords—Precision Agriculture Irrigation system, IOT, Raspberry-pi, cloud computing

I. INTRODUCTION (*HEADING 1*)

India's major source of income is from agriculture sector and 70% of farmers and general people depend on the agriculture[16]. Indian irrigation system the famers are chosen most of the methods manually such as drip, terraced, ditch irrigation system of them[1-5]. In order to improve to the crop productivity there is an urgent need to change manual method to automation[6]. Also consider the water availability throughout India it is one of the valuable resources to protect and save for future needs. Embedded based automatic irrigation system is suitable for farmers available at low cost easily install[7]. This system should help to the farmer that provides the water to crop at stringent time and quantity. Automation irrigation system observes the moisture sensors and temperature variations of around the crop area that's gives a precise time of operation the motor turn ON and OFF. So Automatic human avoid the human errors and check soil moisture level[8,9].

Internet of things (IOT) is allowing controls the systems from remote area over an internet. It can controls the sensors which are used at various areas at blinding roads railways grids and water control systems. So it can avoid the human errors and errors appear during system operated[11]. IOT is the emerging area that penetrates other area and made them so efficient. It develop now a days by inclusion of new sensors, sensor network, RF based communications[17,18]. It can exhibits smart intelligence, precise sensing along with good identification. Once added cloud computing with IOT a changes has occurred in computer network base technologies and mobile based technology. Now days other networks are 3G, LTE, GSM, WLAN, WPAN, WiMax, RFID, Zigbee, NFC, Bluetooth that develops IOT so smart system and operate system at remote places[12,13].

The principle of cloud computing for IOT is shown in below fig:1.

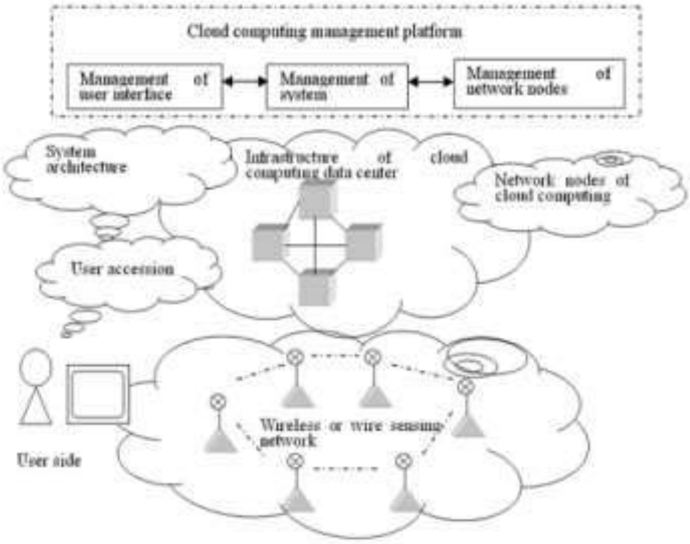

Figure:1 The principle of cloud computing for IOT

II. BACKGROUND

S.Muthunpandian et.al [1] has given an automated system has been designed and implemented on for crop field monitoring continuously. The system maintains the water levels in the crop field at power consumption in the crop field. Developed system is useful in the irrigation system.

Joaquin Gutierrez et.al [2] showed automated irrigation system that reduces the water resources more effective by considering the timing of water scarcity. They shown water utilization is minimized and incorporated a solar power system to reduce power consumption. This was developed by smart phone operating by considering the sensors data via internet. Mohan raj et.al [3] focuses on monitoring the data in farming cycle. The system contains ATMEL microcontroller based GSM operated sensors are used to monitors wind mill temperature variation PH level of water. After that an Arduino based IOT system are used however when we consider the to monitor the huge number of Raspberry pi system is more suitable. Michael G.Williams [4] showed an irrigation system with raspberry pi system. Raspberry pi based systems for home automation, entertainment systems, security. Developing Raspberry systems are more interesting for thrusting environments [10].

The paper aims a high precision monitoring the data and control agriculture automation system with IoT technologies. A Raspberry pi and cloud based IOT system to monitoring the real time data come from the crop field. The system mainly focuses moisture variations correlate with temperature changes data by smart sensors and controls irrigation system. In order to providing the cloud based computing to system the precision level has increases as suitable to use the system by farmer. The papers organize as introduction, Hardware description, and system design, proposed algorithm, results & discussions followed by conclusions

III. HARDWARE DESCRIPTION

RASPBERRY PI 3 - MODEL

The Raspberry Pi 3 Model B is an upgraded ARMv7 multi core processor and Gigabytes of RAM, this seems to be a pocket computer and able to moved from being a 'toy computer' to a real desktop PC requirements. The figure:2 shows the circuit board diagram of raspberry Pi. The big upgrade is a move from the BCM2836 (single core ARMv6) to BCM2837 (quad core ARMv7). The Processor speed increases 2 times that is equal to multi core processors. By efficiently using architecture the speed may increases from 4 to 7.5 times. This processor improves the quantity performance web browsing and game playing. The Pi 3 will run the all other daughter boards at 99 % efficiency[4].

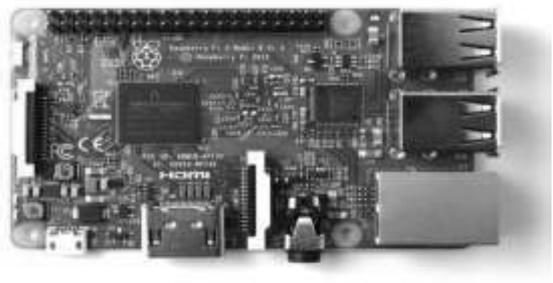

FIG:2 RASPBERRY PI 3 MODEL B

Pi 3 works on ‘sudo apt-upgrade’. Pi 3 is a quad core 64-bit CPU and on-board WiFi and Bluetooth. The RAM remains 1GB and there is no change to the USB or Ethernet ports. However, the upgraded power management should mean the Pi 3 can make use of more power hungry USB devices [11,12].

Software used

Python is widely used programming languages for Raspberry pi computer. The main advantage is programmer can write low number of codes that might be considered other types programming languages. Examples C++ or JAVA at large scale programming modules. Python is not a web programming language but works also like a PHP code cold FUSION and comfortable for server programming languages. Python uses a customer frustrating issues[4].

Power Supply:

All digital circuits require regulated power supply. In this article we are going to learn how to get a regulated positive supply from the mains supply.

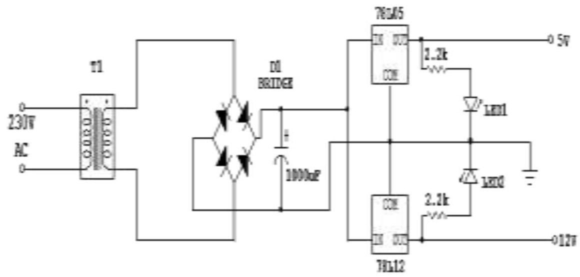

Fig:3 Power supply

Figure:3 shows the basic circuit diagram of a fixed regulated power supply. Let us go through each block.

Data acquisition system:

An advance data acquisition is chosen on single chip which includes sample and hold circuitry. MCP 3208 as shown in the fig :4 is one of the advanced IC which converts analog to 12 bit digital signals. It programmable either single or differential pair inputs. Accuracy in differential nonlinearity is specified at ±1 LSB and integral nonlinearity is±1 LSB. It has SAR architecture. A sample and hold capacitor obtain for 1.5 clock/cycles starting on the fourth rising edge of the serial clock. This sample hold capacitor gives output 12 bit and conversion speed of 100ksps. A 4 wire SPI communication interface is compatible for this device and operating at minimum clock rates.

Fig:4 data acquisition chip

Soil moisture sensor

Precision soil moisture has chosen shown in fig:5 which consists two probes that are inserted in to soil. When the current pass through the probes, the soil contains low moisture offer a less resistance and passes high current. That is variable resistance is the parameter to identify the level of soil moisture [20].

Fig. 5 soilmoisture sensor

Temperature sensor (LM35*)*

The LM35 sensor series are precision integrated-circuit temperature sensors as shown in fig:6, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.[15]

Fig:6 temperature sensor

LM 358

LM 358 IC contain a dual high gain and band width product operational amplifiers that are designed and operated over high range of voltages. These devices are used instrumentation applications at low power values. LM358 is applied at DC gain blocks and other types of conventional circuits. The main advantage is easily operate and implements at single power supply circuits[15].

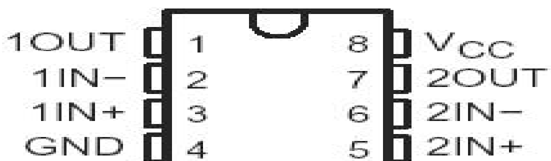

Fig: 7 pin diagram of lm358

RELAY

A relay is used to control the A.C motors from the controlled DC signal. It can isolate one operated electrical circuit to another. The principle behind the electromagnet operates the close and opens the circuit. Relays are applied wide area electronics circuits such as industrial control circuits a high power amplifiers, telephone exchanges etc. Advanced rating relay is used in this work as shown in fig:8

Fig:8 relay

Buzzer

A buzzer or beeper as shown in fig:9 is used this proposed work to give warning signal that motor is turn on/ off. This provide audio warning signal either by mechanical, electrical, or electronics operated. A **buzzer** or **beeper** is an audio signaling device, which may be mechanical, electromechanical, or electronic. Various types of buzzers presently available such as alarms, timers, mouse click or keystroke.

Fig:9 buzzer

IV. BLOCK DIAGRAM DESCRIPTION

The block diagram of the proposed system is shown in the fig.10 The hardware components have connected to shown in the fig. During the time of operation initialization of the System to be done, and check the hardware connections the raspberry-pi make sure all the connections are connected. In this project we are connecting two sensors 1) temperature sensor 2) soil moisture sensor. Moreover, to develop a more accurate system the historical data regarding the quantity of irrigation used in previous period are considered to adjust the quantity of water that is needed for irrigation.

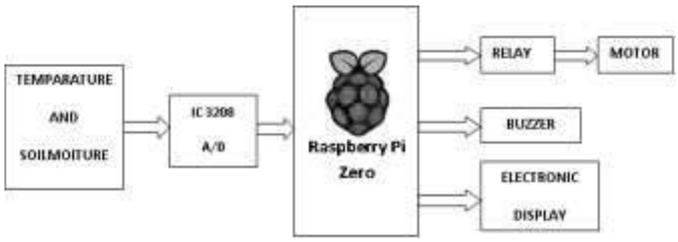

Fig:10 Block diagram of IOT Based automatic crop field monitoring

Circuit Diagram:

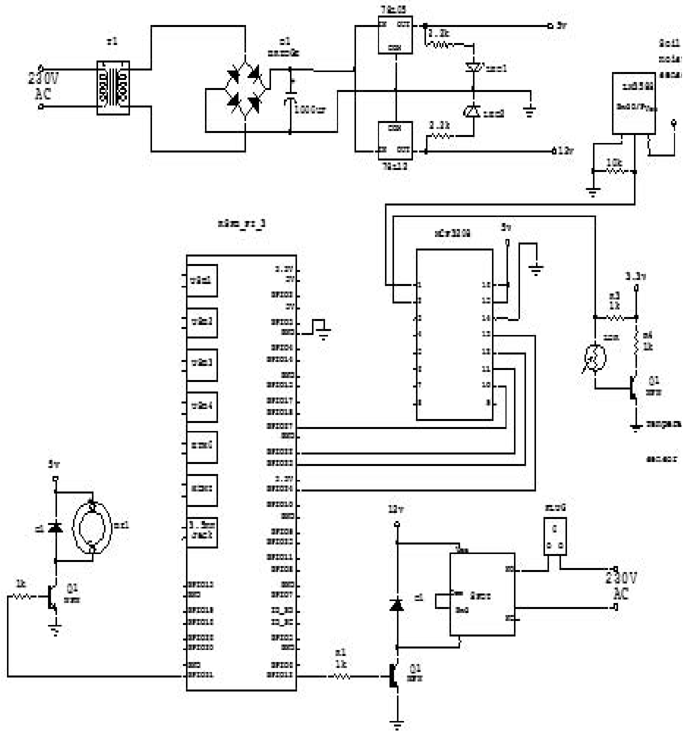

Fig:11 Circuit diagram

These two sensors are placed in the crop, the data will be collected from that sensors these data in the form of analog values, so that analog value is given to the IC3208 that converts analog values in to 12 bit digital values, the digital values are given input to the Raspberry-pi that data sends to the database by using wifi, the sensors calibrated so that the minimum wet condition in the field 2.4v is taken, The threshold voltage is varied according with different crop field in different seasons. In that 2.4v ,according that threshold voltage the Raspberry-pi operated the relay, relay is also placed on that, when the data comes from the controller is that value is compare with 2.4v , when the value is less than 2.4volts so the field is dry conditions then signal send to the motor on, when the value is greater than 2.4 volts when the field is wet conditions. The temperature variation is calculated through another temperature sensor, by considering the calibrating value and these sensors data are correlated at every instant time then accurate level of soil dry is measured. So that the signal send to the motor off automatically a buzzer is indicates change the condition when motor is “off state to on state” and “on state to off state” .Proposed system implemented on raspberry pi as shown in fig: 11 flowchart. A python programming is chosen to implement proposed algorithm on LINUX operating system

Data processing and decision making

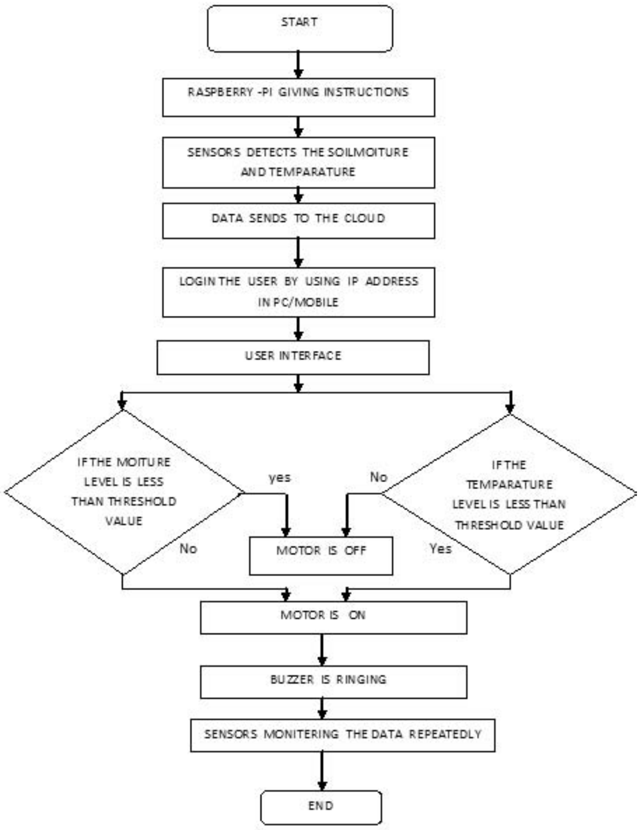

Fig:12 Flow chart of the proposed method

The data has store in cloud data base. The system is completely automated and state of condition of the system can be known by check his mobile phone, PC through IP address. so these information the farmers identify the change that condition and in the raspberry process using python code it generate the IP address all the sensors data is available in that address and also motor condition will also contains, at any place these IP address search in Google by using laptop, mobile and system the data will display on our device.

V RESULTS AND DISCUSSION

The designed hardware proto kit as shown in fig:13 The real time results as shown in the fig. and the status of the system has taken on **4G** mobile system shown in the fig:14. The data obtain from sensors are stored in the cloud and can be monitored by farmer through his mobile/ PC. The system accurate values which actually occur from the system are observed by farmer; with his intervention at his crop fields the irrigation ran automatically. Micro controller processed and correlated huge data obtained from the sensors checks at every time to the threshold values. Here calibration of the sensors system is so important. The system displays temperature value and condition of soil moisture, based on the two sensors the condition of motor. The status of the system can able to check at remote place and complexity of the system is less so we can do trouble shooting easily in firmware.

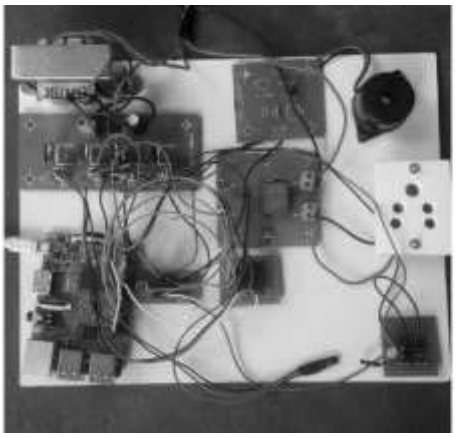

Fig:13 HARDWARE KIT

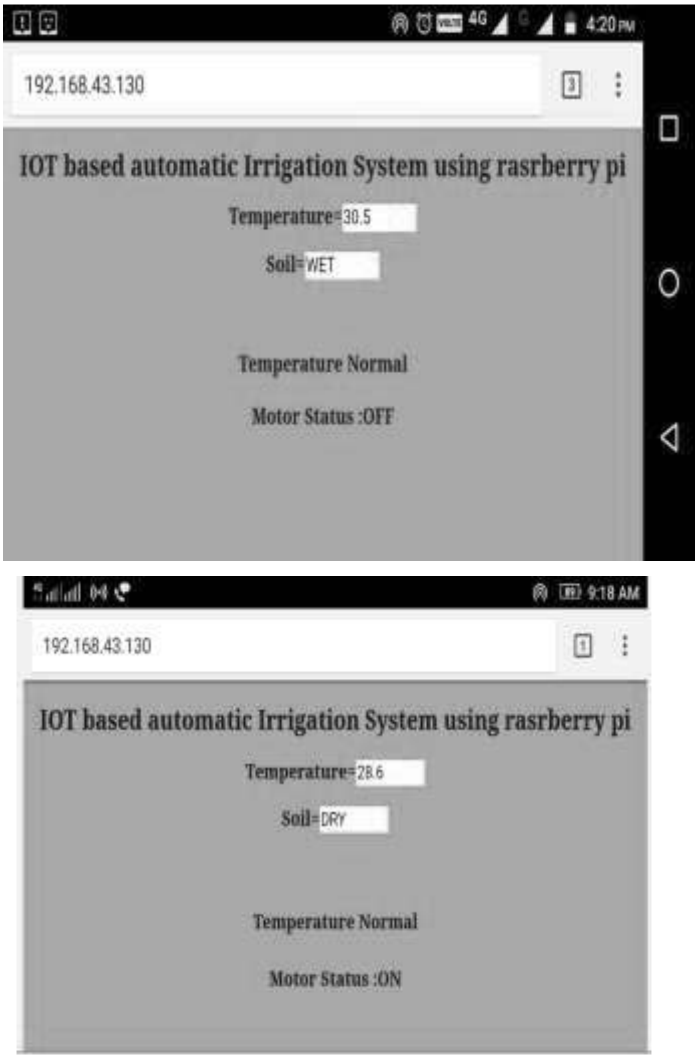

Fig:14 Mobile phone display the status of the system

VI CONCLUSIONS

A PA agriculture irrigation system is developed with low complex circuitry. A two sensors are used efficiently those are temperature and moisture of soil in the circuit to get the calibrated information to the system. Two sensors and Raspberry pi microcontrollers of all three Nodes are successfully interfaced various Nodes. All observations and experimental tests proves that proposed is a complete solution to field activities, irrigation problems, Implementation of such a system in the field can definitely help to improve the field of the crops and overall production. . With the help of this approach the irrigation system completely automated also provides real-time information about the lands and crops that will help farmers make right decisions. Cloud computing is "a new style of computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet". Here two sensors are used to control the irrigation system so the troubleshooting easily done whenever it necessary. Here proposed correlated data based algorithm reduce the hardware complexity compare to the other proposed systems [13]. The threshold voltages are chosen for calibration of the sensors by considering past months of temperature and soil moisture values. Threshold values may be varying depends on the crop and plantation. In future by introduce the machine learning algorithm to be used to process the data and reduce the complexity of the hardware. Hardware resources in agricultural information network are integrated into resource pool by using vitalization technology, achieving dynamic distribution of resource and balance of load, significantly improve efficiency.

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