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Smart Irrigation System Based on IoT Using Google Cloud

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ABSTRACT

Water requirement for agriculture is large. Due to inadequate rainfall, water requirement is not been able to meet. Under conventional irrigation system, irrigated land is either under irrigated or over irrigated resulting in adverse effects on crop growth and wastage of water. There is a need of an automated system. The proposed Irrigation System in this paper aims at fulfilling water requirements of the crops, by monitoring the soil moisture and other environmental parameters. The system which is based on Internet of Things, logs the sensor data to the cloud and the farmer can monitor and control all the water pumps remotely over internet using Android application. It consists of wireless sensor node with Arduino publishing sensor data to cloud using Wi-Fi module and controlling the pump using relay. The paper presents an automated irrigation system providing precision agriculture and thus preventing waterwastage.

Keywords: Android Application using MIT, Internet of Things, Wi-Fi module, Relay.

I. INTRODUCTION

In the present era, the greatest problem faced by world isscarcity of water. Agriculture is an occupation demanding plenty of water. Irrigation refers to the supplying water to cultivation land as supplementation of rain fall. There are various types of irrigation system that have been adopted.The efficiency of the irrigation system in conserving water is not appreciable. Moreover, the water requirement by the crop depends on type of soil, crop and environmental parameters like temperature and humidit.Conventional Irrigation system either result in over irrigated or under irrigated land. As growth and development of plants is prevented due to scarcity of water, similarly excessive water has adverse effect on growth of plants. Under Conventional Irrigation system, many parts of irrigated field are over or under irrigated due variability in the water holding capacity of land, water infiltration and water runoff. Over irrigated area, suffers from poor plant health due to increase in salinity. Excessive water replaces air in pores of the soil. Hence roots of the plants do not get

sufficient air. It may lead to leaching. While under irrigated area suffers water stress. Hence efficient water management plays key role in agriculture. In conventional Irrigation system, requires human effort and is time consuming. Today Internet of Things is able to provide smart solution to irrigation system. The Internet of Things (IoT) refers to the ever-growing network of physical objects ,and the communication that occurs between these objects and other Internet enabled devices and systems.Wireless SensorNetworks(WSN)have been the subject of research in various domains over the past few years and deployed in numerous application areas.WSN is seen a sone of them ostpromising contemporary technologies for bridging the real and virtual world thus, enabling them to interact. A WSN is composed of a number of sensor nodes, which are usually deployed in a region to observe particular phenomena in a geospatial domain. Sensor nodes are small stand-alone embedded devices that are designed to perform specified simple computation and to send and receive data. They have attached to them a number of sensors, gathering data from the local environment that is being monitored. WSNs have beenemployed in both military and civilian applications such as target tracking, habitant monitoring, environmental contaminant detection and precision agriculture[1].

The proposed irrigation system is efficient in managing water based upon soil moisture, environmental temperature and humidity. This automated system minimizes farmer's intervention in farming, increase scrop production, saves time, helps remote monitoring and controlling and easy to install.

II. PROPOSEDSYSTEM

The proposed system consists of two modules: transmitter and coordinator.Transmitter module consists of soil moisture senor and temperature-humidity sensor interfaced with the microcontroller. Microcontroller is connected to the internet via Esp8266 acting as Wi-Fi module

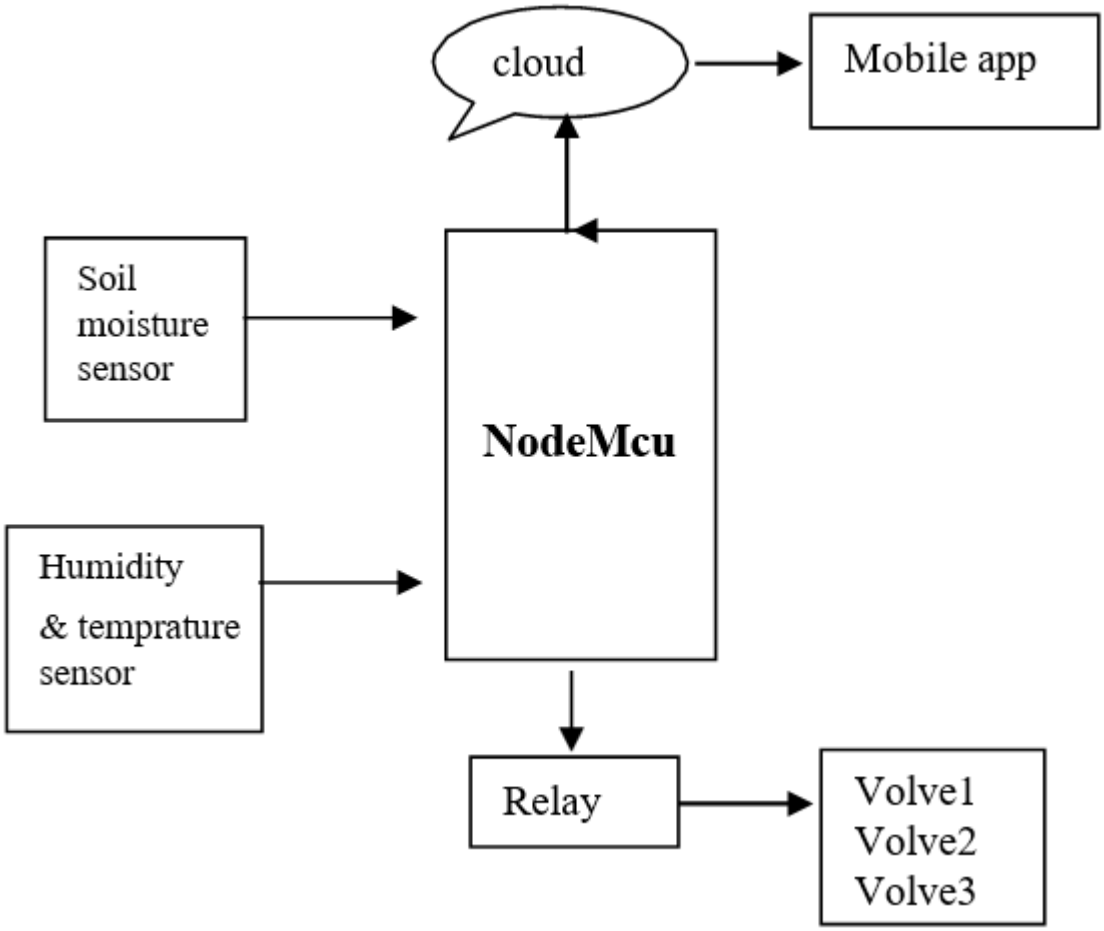
[1]. A channel is created in ThingSpeak, which is open source IoT (Internet of Things) application. ThingSpeak provides an API (Application Programming Interface) key which is used to send the sensor data to the cloud and store it in the created channel and specified fields created

[2]. The microcontroller collects the sensor values and sends them to the ThingSpeak cloud through internet using the HTTP protocol

[3].Coordinator module in receives the command from the Android App through internet. It consists of microcontroller interfaced with relay to control the motor and is connected to internet by Wi-Fi module.

[4].This system is used to maintain the optimal conditions of the irrigation system effectively. The data can be viewed on the Thing Speak app or web page.

[5].The farmer can go through each and every information regarding the levels, at what time it's been functioning, any fluctuation appearing or not, whether the operations are been performed in time.



III. HARDWAREREQUIRED

A. YL-69 Soil MoistureSensor

YL-69 Moisture Sensor or the hygrometer shown in Fig. 4 is usually used to detect the humidity of the soil. So, it is perfect to build an automatic watering system or to monitor the soil moisture of your plants. The sensor is set up by two pieces: the electronic board, and the probe with two pads, that detects the water content. The sensor has a built-in potentio meter for sensitivity adjustment of the digital output,a power LED and a digital output LED. The voltage of the sensor varies with the moisture, when the soil is dry voltage is high and when soil is wet voltage is low.

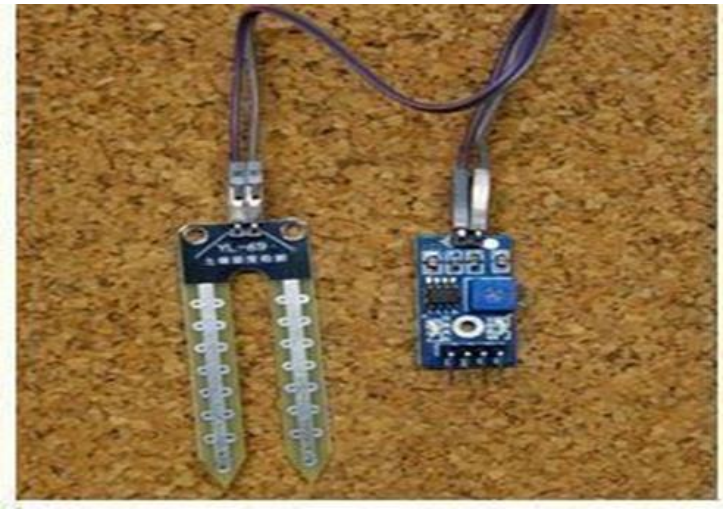


Fig. 4. YL-69 Soil Moisture Sensor D. Relay

B. DHT11 Temperature Humidity Sensor

DHT11 Temperature and Humidity Sensor in the Fig. 5 features a calibrated digital signal output with the temperature and humidity sensor complex. Its technology ensures the high reliability and excellent stability.

This sensor includes a resistive element and a sense of wet NTC temperature measuring devices. It has excellent quality, fast response, anti-interference ability and high cost performance advantages. For measuring humidity, the humidity sensing component is used which has two electrodes with moisture holding substrate between them. So as the humidity changes, the conductivity of the substrate changes or the resistance between these electrodes changes. This change in resistance is measured and processed bytheIntegrated Chip which makes it ready to be read by a microcontroller. For measuring temperature these sensors use a NTC temperature sensor or a thermistor. A thermistor is actually a variable resistor that changes its resistance with change of the temperature. These sensors are made by sintering of semi conductive

Fig. 5. DHT11 Temperature Humidity Sensor

C. Node MCU(ESP8266)Wifi module

NodeMCU is the more popular development board for the vastly popular Wi-Fi Internet of thing chip from Espressif, the ESP8266.It uses the Lua scripting language to make it simple to run user programs on the ESP8266 without any recompilation. The board consists of an ESP-12E module, CP2102, and USB connector for power. All the pins of the ESP- 12E are brought out on compactand narrow board design to make it breadboard friendly. we canuse the node mcu firm ware orther. Arduino development Environment applications.

Fig. 6. Esp8266 WiFi Module ESP-01

The relay is the switch (turn on and off) which operates electrically or electromagnetically. In this project, the relay will used to turn on and off the water pump. Themain usage of the Relay was seen in the history for transmitting and receiving the information, that was called as Morse code where the input signals used to be either 1 or 0, these change in signals were mechanically noted in terms of ON and OFF of a light bulb or a beep sound, it means those pulses of 1s and 0s are converted as mechanical ON and OFF using electromagnets.

Fig. 7. 12V Relay module

E. Solinoid valve

A solenoid valve consists of two basic units: an assembly of the solenoid (the electromagnet) and plunger (the core), and a valve containing an orifice (opening) in which a disc or plug is positioned to control the flow of fluid.

- The valve is opened or closed by the movement of the magnetic plunger.
- When the coil is energized, the plunger is drawn into the solenoid (electromagnet), and flow through the orifice is allowed.

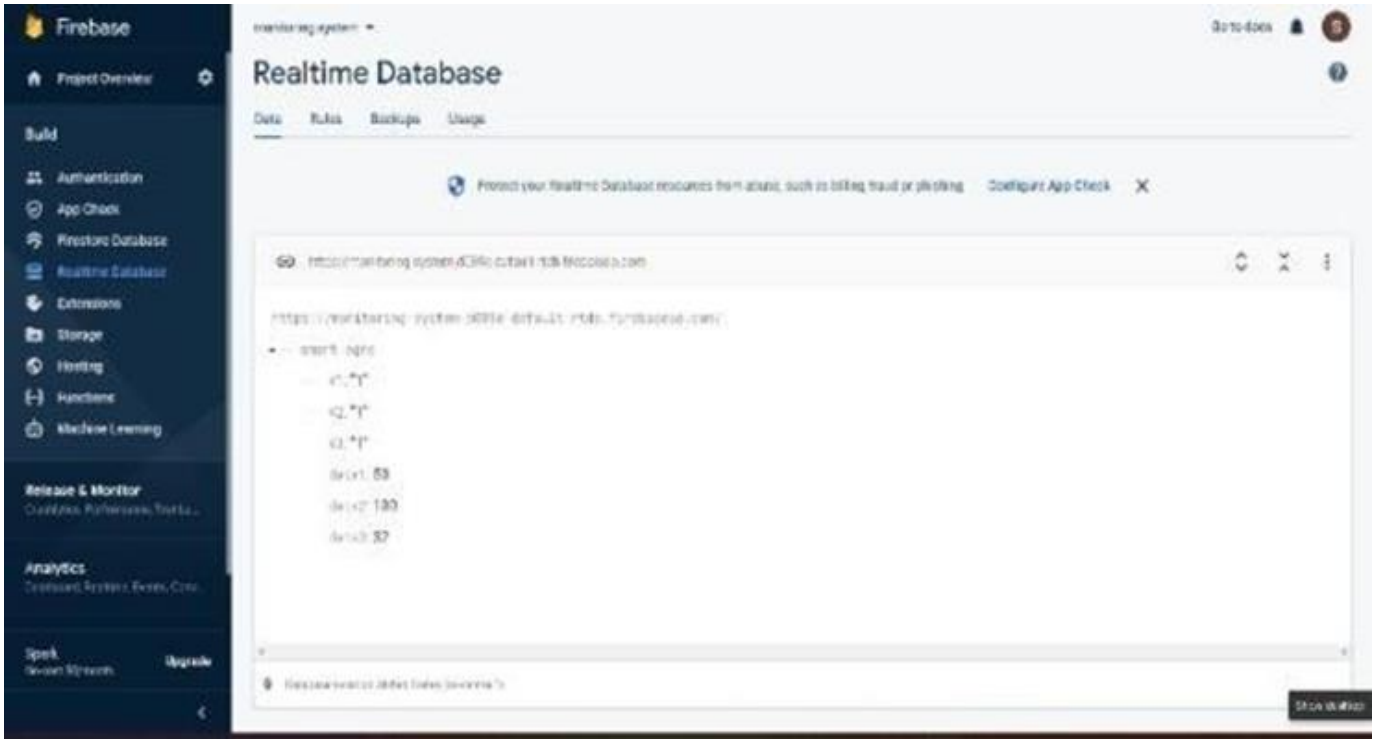
Direct acting (direct operated) solenoid valves have a simple working principle, which can be seen in along with the components. For a normally closed valve, with no power the plunger (E) blocks the orifice with the valve seal (F). A spring

(D) is forcing this closure. When power is applied to the coil (A), it creates an electromagnetic field, attracting the plunger up, overcoming the spring force. This opens the orifice and allows the media to flow through. A normally open valve has the same components, but works in the opposite way.

IV. SOFTWARE REQUIRED

A. Firebase

Firebase is a mobile and web application development platform developed by Firebase, Inc. in 2011, then acquired by Google in 2014. Firebase Analytics is a cost-free app measurement solution that provides insight into app usageand user engagement. Firebase provides a realtime database and backend as a service. The service provides application developers an API that allows application data to be synchronized across clients and stored onFirebase's cloud.

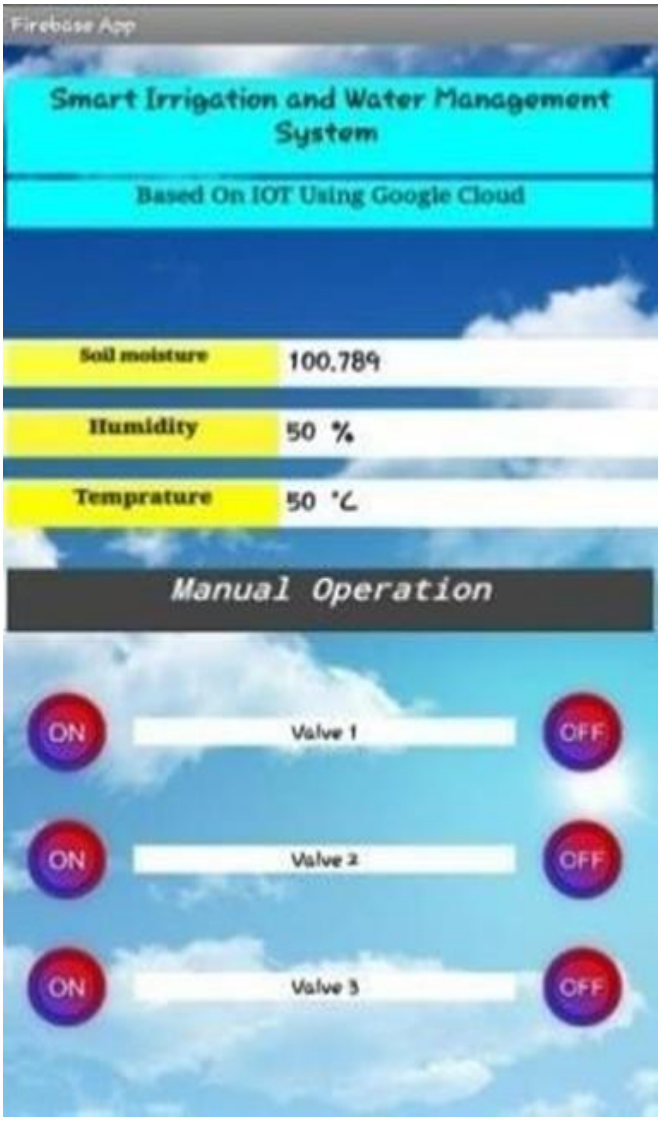


B. MIT app inventor

It is an open-source web application which allows newcomers to computer programming to create software applications for the Android operating system. We can get the data from firebase to app we created. So that instead of web we can have app in android to know about the conditions where plants are present. We can change the configuration of motor using the app. If you on the motor using app it gets off by itself if soil moisture is exceeding the limit. Through this we may not get the past data but we can know the present conditions.

V. WORKING

The soil moisture content and environmental factors like temperature and humidity are read by the microcontroller of the transmitter module. These values are sent to the cloud through internet for every 30 seconds [5]. The logged data is represented in the Thingspeak cloud in the form of graphs. When the sensors values go beyond the threshold, an alert message is sent to the farmer. Android Application enables farmer to turn on the water motor by controlling the relay connected to coordinator module through internet.When the desired environmental parameters are met an alert is sent again to the farmer to turn off the motor



VI. RESULTS

The prototype of the Smart Irrigation System is shown in the Fig.. The system is experimented for plant to check the reliability of the system. The plant's water requirements is 500-700mm a day. So the analytics on the cloud are set to soil moisture of 300-600 range [6]. It is found that system works properly and water is pumped into the field a sand when required.If the soil is dry,alertmessage is sent to the farmer. The farmer turns on the motor using the Android Appas shown in the Fig.When the desired soilmoisture is met, the system asks the farmer to turn off the motor through App. The Fig shows graphical representation of soil moisture, humidity and temperature respectively

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