An Internet of Things Based Smart Irrigation using Solenoid Valve

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Abstract: ***Water is an essential resource in agriculture and its optimal management plays a major role. The important objective of this paper is to provide an automated irrigation system to minimize the utilization of in agriculture by combining the advanced technologies like Internet of Things (IoT), optimization tools and cloud computing. This automatic irrigation system installs low cost sensors to sense variables of interest such as soil moisture, soil type, and weather conditions. The data obtained is then directly stored in the web page and can be monitored using mobile or through Pc. The data from the field is transmitted to the cloud using global system for mobile communication (GSM) cellular networks. Then an optimization model is used to compute the optimal irrigation rate which is automated using a solenoid valve controlled by Pic microcontroller. The previous variables of interest are stored in the cloud and accessible as a service to the agronomists. This proposed approach is demonstrated on a pilot scale cultivated capability and our results demonstrate the reduced water utilization, data-availability improvement and picturing.***

Keywords: Automated irrigation, IOT, cellular Networks and GSM.

I. INTRODUCTION

India is the country of village and agriculture plays an important role for the development of country. For agriculture Irrigation plays a crucial role. The smart irrigation system has wide scope to automate the complete irrigation system. Here we are building a IOT based irrigation system. The internet of things is the interconnection of uniquely identifiable embedded computing devices. There are fields like neither be under irrigated and nor be over irrigated. The main aim of this system is to design a modest, easy to install methodology to monitor and indicate the soil moisture level that is regularly organized and automated using GSM and GPRS technology. Agriculture in India has a significant history. India is ranked in second place in the farm output. In agriculture, monitoring and controlling is an important task for the farmers since they have to regularly feed water nights and days. Different types of sensors are used to collect the data from environment like soil moisture, temperature, humidity, water level and colour etc. Different communication technology has been developed for communication between network and element. Real time monitoring of temperature, moisture, humidity, nutrient facts of soil and atmosphere can properly guide the cultivation and improve crop production. Precision agriculture is an agricultural system that can contribute to the sustainable cultivation concepts. If programmed and installed properly, automatic cultivated systems can even save us money and benefit in water preservation. Automatic agricultural systems can be programmed to liberation more specific amounts of water in the field, which encourages water conservation. Now a days employment saving and water saving technology is a key issue in agriculture. There have not been any significant technological improvements being made in agricultural field as compared to other sectors. Agricultural system needs to be supervised on systematic methods. The main application of this concept is to reduce the depletion and guarantee soil quality by automating the entire agricultural system.

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II. LITERATURE SURVEY

There is a variety kind of irrigation systems available for multiple applications. Based on our research the commonly existed system with its usage and its specific application towards agriculture has been discussed below.

A. Single parameter working system

In this, water supervision system cannot take conclusion at that occasion by considering different characteristics of agriculture soil. Present automated irrigation system works based on one parameter at one time only. Soil has diverse features like soil moisture and temperature, humidity etc. If soil moisture is below threshold value then watering is done using a water pump and after appropriate water supply if it goes above threshold value, water pump off automatically. So it works only on one condition at one time. System does not have decision power that is the data of various parameters has been monitored. Although this system is automated, but not suitable for all kinds of vegetation. Commonly used for flowering plants. The following Fig..1 shows an example of this system being used.

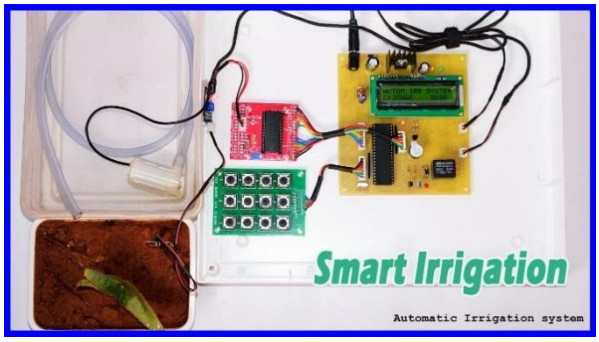

Fig.1.Smart Irrigation

B. System that works on multiple parameters but not automated

In this system, parameters like temperature, water level, humidity are sensed sequentially at a time and then data is forwarded to the farmer/user by using GSM and GPRS Technology. But in this case the farmer/user has to give the input to the system in return to take particular action like ON and OFF the motor that is being operated manually. This type of system is not suitable for the one who are dealing with multiple acres with huge land.

This is like a remotely operated system, like controlling various parameters of soil through an Android mobile or through PC. The following Fig..2 gives the idea of its usage

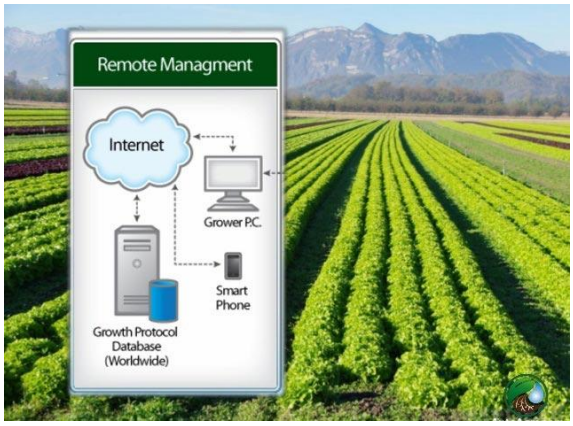

Fig. 2. Remotely operating system

III. PROPOSED SYSTEM

A. System designed to work on multiple parameters automatically

In order to overwhelmed the drawbacks of present system, the mechanized irrigation system based on low power microcontroller is established and organized. We introduce a new design of Microcontroller technology with Internet of Things (IoT). The mechanized irrigation system consists of disseminated sensor network built using soil moisture, temperature, humidity sensors and a solenoid valve. Irrigation system uses taps to turn irrigation scheduled and unscheduled. Earlier, farmer faced the problem of sending messages and making calls, incapacitating which we are designing a favorite presentation which does the work by button clicks and also control of water level in a particular area. Everything in this system is automated. The above mentioned system is IOT based and we know that the internet of things is the interconnection of exclusively recognizable embedded computing devices. This type of system helps farmers who are dealing with multiple acres that too with huge land surface.

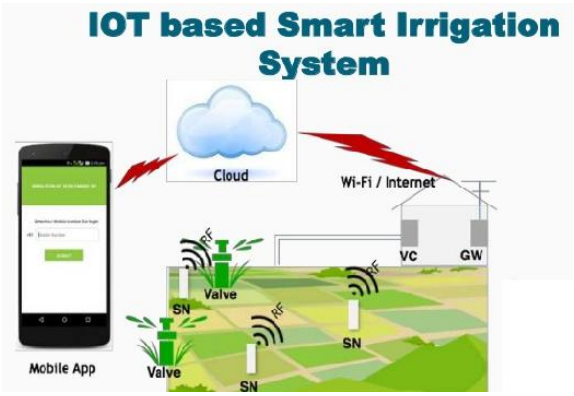

Fig. 3. Automatic Irrigation

We can sense the level of the Water, Temperature and also Humidity at a time, that is everything is automated based on the readings considered. Regulating the water level in a Particular area with the help of solenoid valve adds an extra advantage.

IV. SYSTEM ARCHITECTURE AND DESIGN

Unlike other systems, this System includes both Hardware and Software components. Initially the soil sensors injected in soil sends the data to the Pic-Microcontroller after analyzing the data, it sends signal to the solenoid valve and making water pump ON based on the threshold values that are considered, in the similar way the humidity and Temperature sensors sense their level to get displayed in the LCD. In the entire process the micro-controller is operated in the range of (24V),while the Solenoid valves operating in the range of(12V).Transformers are being used in this method to regulate the 230V direct power supply.

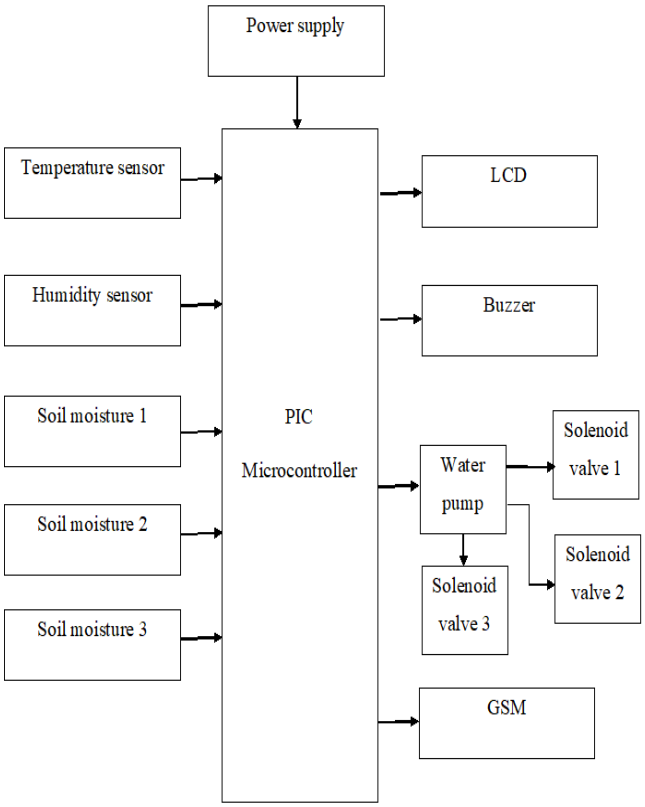

Fig. 4. Block Diagram

IV. HARDWARE DESCRIPTION

A. PIC MICROCONTROLLER

The PIC microcontroller used here is 16F877A. This performs the key role of processing the received data from the sensors and transmitting them to the GSM module. The advantage of microcontroller such as low power consumption and flexibility to connect other devices.

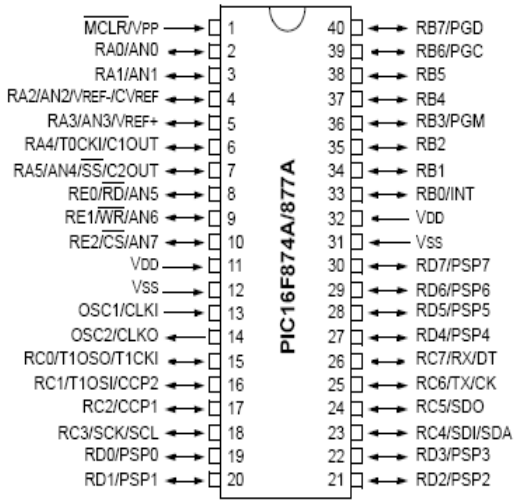

Fig. 5. Pin Diagram

B. TRANSFORMER

Transformer is an electric device that steps up or down the voltage given to the supply, here we are using a step-down transformer to reduce the supply from 230-24V.

Fig. 6. Step-Down Transformer

C. GSM

Global system for mobile communication**.** GSM modulator and demodulator accept any GSM system act as SIM card and just like a mobile phone with its own exclusive phone number. Benefit of using this modem is that, RS232 port is used to communicate and develop embedded applications. The SIM800 delivers GSM/GPRS 900/1800MHz concert for voice, SMS, Data, and Fax in a small form factor and with low power consumption

Fig. 7. GSM Module

D. TEMPERATURE SENSOR

Here we are using LM-35 as a temperature sensor**.** The LM35 series are accuracy integrated circuit temperature devices with an output voltage is linearly proportional to the temperature in centigrade. By using LM35, temperature can be measured more accurately than with a thermistor. It also retains low self heating and does not cause more than 0.1^0C temperature rise in still air**.**

Fig. 8. LM-35

E. SOIL MOISTURE SENSOR

Soil moisture sensor can be used to check the moisture of soil, when the soil is consuming water shortage, the module output is at high level, and else the output is at low level. Using this sensor one can spontaneously water the flower plant, or any other plants requiring automatic watering technique. Soil moisture sensors calculate the water content in soil by volumetrically. Since the direct gravimetric measurement of free soil moisture entails eradicating, aeration, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, like dielectric constant, electrical resistance or collaboration with neutrons as a proxy for the moisture content.

Fig. 9. Soil Moisture Sensor

F. WATER PUMP

Water pump motor is a direct current motor device that moves fluids. A DC motor converts direct current power from electrical to mechanical power. DC or direct current motor operates on the principal, when a current carrying conductor is placed in a magnetic medium, it experiences a torque and has a propensity to move. This is known as motoring action.

Fig. 10. Water Pump Motor

G. HUMIDITY SENSOR

Humidity sensor senses, measures both moisture and air temperature. The sensor is collection of two metal plates and contains a nonconductive polymer film between them. This film gathers moisture from the air, which causes the voltage between the two plates to change. These voltage variations are converted into digital readings displaying the level of moisture in the air. Humidity measurement can be done using electronic hygrometers.

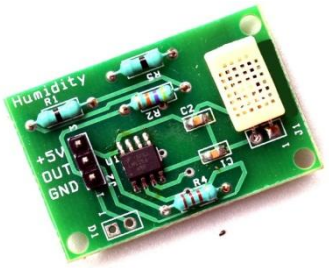

Fig. 11. Humidity Sensor

Features:

- Input Voltage: 5v
- Output: Analog (0-5v)
- More Performance
- More Stability
- Adjacent tolerances

H. SOLENOID VALVE

Solenoid valve is an electro mechanically functioned valve, which is measured by an electric current through a solenoid. It can be used to regulate the water flow and to measure the level of water. Solenoid valve offers fast and harmless switching, more reliability, lengthy service life, best medium compatibility of the materials used, short control power and compressed design.

Fig. 12. Solenoid Valve

V. SOFTWARE APPLIED

A. MP LAB

MPLAB is a registered freeware integrated development environment for the development of embedded applications on PIC and dsPIC microcontrollers and is developed by Microchip Technology.MPLAB and MPLAB X funding project management, code editing, debugging and programming of Microchip 8 - bit PIC and AVR microcontrollers, 16 - bit PIC 24 and dsPIC microcontrollers, as

well as 32-bit SAM - ARM and PIC32 (MIPS) microcontrollers.

B. EMBEDDED C

Embedded C is a set of verbal extensions for the C programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires modified extensions to the C language in order to support exotic structures such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operation.

VII. RESULTS AND DISCUSSIONS

As our country is facing water scarcity in some areas, this type of irrigation system is highly encouraged. As the use of IOT with Solenoid valves, reduce the water consumption compare to other irrigation methods. Also the sensor implementation with respect to Pic Microcontroller needs proper wiring as the supply goes down from 240-12V.And also this system a bit complex to implement and requires the personnel with basic knowledge of working of components. Table – I shows the variations of various parameters with various date and timing.

TABLE – I Temperature and Humidity value for different date and times

Date and Time	Temperature	S1 Value	S2 Value	S3 Value	Humidity
2020/03/12 12:51 AM	70	910	900	870	50
2020/03/14 11:00 PM	80	900	850	780	40
2020/03/18 12:00 AM	90	890	910	700	50

VIII. CONCLUSION

This type of Smart irrigation system is simple and cost effective for optimizing water resources for agricultural production.This irrigation system allows cultivation in places with water scarcity thereby improving Sustainability.The use of Solenoid Valve in this system is significantly Important for Organic crops.Automated system helps in saving time and labour cost etc.

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Dr.K.Kannan, received his Bachelor of Engineering (B.E) from the Department of Electronics and Communication Engineering, Jayaram College of Engineering and Technology, Bharathidhasan University, Trichy India in 1999. He obtained his M.E (Master of Engineering) in the stream of Optical Communication from Department of Electronics and Communication Engineering, Alagappa Chettiar College of Engineering and Technology (ACCET), Karaikudi, Anna University, Chennai, India in 2005.He obtained Ph.D in the area of wireless Vehicular Ad - Hoc networks in Anna University, Chennai during 2019.He is currently working as Associate professor in R.M.K. College of Engineering and Technology, puduvoyal, Chennai. He has 14 years of teaching experience from various engineering colleges and 4 years of industrial experience. He is life member of ISTE, IAENG and IET. He has international Journal publications, international Conference papers and national conference papers to his credit. His area of interest is communication networks, optical communication and signal processing. His research focuses are on the areas of communication networks and mobile ad-hoc networks.

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