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IOT–enabled smart farm irrigation system for rural development

[1]Mumthaz M, [2]Poornima B V, [3]Ankitha Bekal, [4]Mudassira Tahneet B Lahori

[1],[2],[3]Department of CSE BIT, Mangalore, India
[4]Rapidera Technologies Pvt Ltd, Pune, India
[1]mumthaz1213@gmail.com,[2]poornimabv.85@gmail.com, [3]ankita.bekal@gmail.com

Abstract*—India is an agrarian economy and the agriculture sector plays vital role in the overall development of the country. In the Indian context, villages are the heart of the nation; agriculture is the principal source of livelihood for many households in rural India. Thus, the issues and challenges concerning agriculture need to be focused to achieve the country development by empower villages through recent trends and technology. Irrigation is very much important in maintaining the soil moisture level for the grow of the plants. Hence, there is dire need for a smart and efficient irrigation system that results in the simple and burden free cultivation procedure for the farmer. The smart farm irrigation system enables precious water utilization in an efficient manner. This is done using the technology named IoT (Internet of Things). IOT has been referred to an incipient wave of advances in Information and Communication Technology (ICT). Main ideology behind this paper is to lower human intervention for the full automation of the system and effective utilization of water. This is made possible by using IoT devices with soil moisture sensors, which determines the amount of moisture contents of the soil and if it go below a predefined threshold value , then it release the water through the irrigation pipes. The entire system is controlled and operated by the microcontroller board called Arduino UNO Board.

***Index Terms*—Agrarian Economy, Moisture Sensor, Threshold,, Internet of Things,, Relay, Irrigation System,, WSN (Wireless Sensor Network), Microcontroller, Arduino UNO Board, ADC (Analog to Digital Converter)**

INTRODUCTION

In India, The main source of food production is Agriculture and it contributes 18% of the nation's Gross Domestic Product (GDP) which employs quite half the population[4]. As agriculture makes provision for food for the ever-increasing population, progressing farm yield is extremely exceptionally basic to satisfy the quickly growing demand for food across the state. One of the foremost challenges faced by Indian agriculture is irrigation. Although after China, India is that the second largest country of the planet which is irrigated, only one-third of the cultivated area is under irrigated. In a tropical monsoon country where rainfall is un reliable, uncertain and erratic like India, irrigation is the most vital agricultural input. And it cannot succeed in achieving sustainable agricultural development until and unless quit half the planted area is effectively irrigated.

Making use of correct manner of irrigation within the cultivation land plays a paramount role. Conventional irrigation strategies like localized irrigation, sprinkler irrigation, drip irrigation, surface irrigation, is presently used to irrigate the lands. However in present scenario water scarceness proves to be a serious hurdle in using these strategies. Moreover, there may be no regular power supply i.e. power cuts are very often and may exist for hours in various parts of India. Overcoming these drawbacks new trends and techniques are been accepted inside the irrigation mechanism, through which only small quantity of water flows to the cultivated land based on the moisture quantity in the soil. The plant soil moisture stress is prevented by providing needed quantity of water resources regularly or usually daily by that the wetness condition of the soil can remain well.

The Internet of Things (IoT) profits individuals work and live more perspicacious, and also gain perfect control over their lives. It has currently attained great popularity because it has demonstrated to be exceedingly effective in solving day-to-day problems. IoT plays an influential role in many areas, one of that is agricultural sector by which in future it will aliment millions of individuals on the earth.

The proposed system is an IoT enabled irrigation system, wherever all the information received from the sensors and the different parameters are given as an analogy input to the Arduino Uno microcontroller. The Analog to Digital Converter (ADC) pin within the microcontroller will convert the analogy signals into digital format. This Farm Irrigation system that intends to discover an automated farm irrigation mechanism the switches the water pumping motor ON and OFF be sensing soil moisture level.

Smart farm irrigation system making use of android mobile phone for monitoring and controlling of water flow remotely via wireless sensors.Smart Farm Irrigation System is developed in this paper, which is one of the most popular applications of IoT, is grabbing the spotlight on a global level. This system will result in water conservation, it is one of the great solution for water depletion and water scarcity and it also results in high quality crop production.

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II. LITERATURE SURVEY

Numerous experimentations have been implemented on how plant irrigation are often made more efficient. The researchers have used different conceptions counting on the soil moisture level and amount of water different technologies required.
Planning for the proposed system is done based on different factors, like studying the existing techniques, identifying the present requirements and developing an abstract for the proposed system. In this system, all three sensors like soil moisture, temperature and humidity sensors are placed in the root part of plant to detect the condition of the soil. All these soil moisture, temperature and humidity values sensed by sensors are also displayed on the android application. The threshold values for soil moisture , temperature and humidity sensors, will be set and stored in the Arduino UNO Board is used to monitor and control water supply to the field.

Tanmay Baranwal et al., [1] This system mainly focuses on protection and safety of farm yields from attacks of insects and rodents with in the cultivated farm fields or grain stores.

Laxmi Shabadi et al., [2] GSM technology based Soil Irrigation System implemented in this paper is may cost greater. To reduce that cost-effective Arduino UNO Board which contains built in wifi module is used in proposed system.

Izzatdin Abdul Aziz et al., [3] In this paper they developed a system that are sending data via Short Message Service (SMS). But proposed system sends the sensed values to Android mobile Application.

Q. Wang. Et.al., [5] In this system architecture the sensors were implanted down to the earth and the communication protocols were used to receive a information from the sensors. Here the hourly basis sensor transmission is done. The primary limitation of this system is that the asynchronous receiver transmitter interface is used to accept the signals detected from sensors and the sensors were fixed down to the soil, which can weaken the signals.

Lav Gupta.et.al., [6] This system enables the agriculturists to remotely view their land details and it detects the diseases in the plant which decreases crop yields where the disease identification is the most challenging work to do physically by the human.

S. R. Kumbhar et al., [7] In this system earlier low storage capacity microcontroller is utilized to regulate the system. However proposed system created with the most user friendly Arduino UNO Board in which we can easily store a program .

III. OBJECTIVE

Water stress is a genuine issue in numerous parts of the world.. The appropriate utilization of water through innovative smart farm irrigation system is very much important to save a tremendous amount of water in agricultural sector. The main objectives of this system are:

- To enables farmers to utilize the technologies to meet the expanding demand with minimized human intervention and to proficiently make utilize of satisfactory resources available.
- To investigate a cost-effective smart farm irrigation system that boosts the cultivation by saving money, time , energy & electricity of the farmer and provide improvement to farmers by expanding the agrarian yields.
- To supply weather- predicated watering which takes into consideration regular plant, soil and weather conditions to lessen over-watering to field, and to provide ideal moisture to the landscape.
- To facilitate the farmer to receive real time status and updates of the field

IV. SYSTEM DESIGN

A. Proposed System Architecture

A cost effective, efficient and fully automated smart system for remotely monitoring and controlling plant irrigation environment is summarized in the proposed system architecture shown in Figure 1.

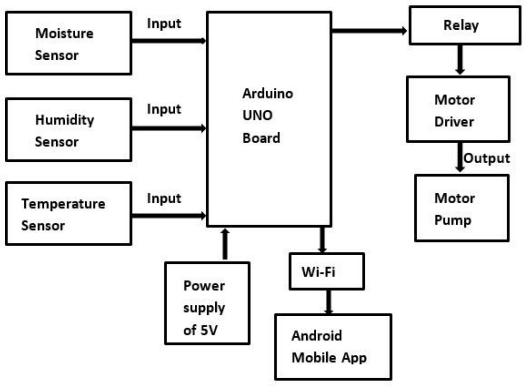

Fig. 1. Block diagram of Smart Farm Irrigation System

Automated Irrigation can be implemented using Sensors, Arduino UNO Boar Microcontroller, Wi-Fi technology, and Android Mobile Phone with android application. This system

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consist of three sensors which are soil moisture sensor, temperature and humidity sensors and they are connected to Arduino UNO Board Microcontroller which control and monitor the sensors. Wireless transmission channels are used to transfer the data sensed from these different sensors and these data come to the user application with the goal that user can control the entire irrigation system. Here relay is used to connect the Arduino board to the motor driver, and again the motor driver is connected to the water pump. The motor will be driven by a battery of 5 volt, supplies power from the Arduino board or from the external source. The Arduino boars is programmed utilizing the Arduino IDE software.

The android mobile application designed in this system is assigned the task of confirming the data receive and comparing it with the predefined threshold values of the soil. The decision can be either made manually by the user or automatically by the user android application without any user intervention. The program that has been composed into the Arduino Microcontroller Board is used to manage the moisture content of the soil regarded information which continuously it detecting from the different sensors.

The threshold values for all moisture, temperature and humidity of soil , will be set and stored both in the Arduino UNO Boars and user mobile application. The Arduino Board and the user communicate via Wi-Fi. The sensor value may fluctuate according to the climatic condition. The moisture, temperature and humidity value will be distinctive in summer and winter season. After studying all these climatic environmental situations, the threshold value will be fixed. Then if the soil moisture value declines below the fixed threshold value, motor pump will be switched on either by a farmer manually or automatically by the system and vice versa.

B. Proposed Methodology

A graphical representation of the sequence of operations in the proposed system are described through the flowchart shown in Figure 2.

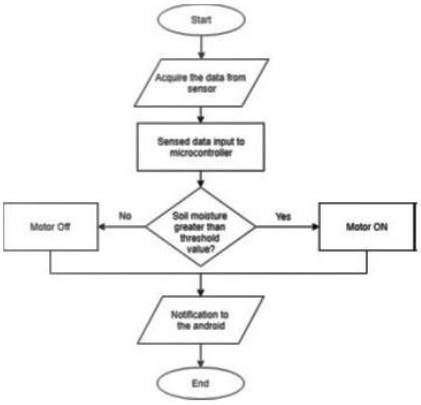

Fig. 2. Flow chart of Smart Farm Irrigation System

Here we developed a system that will help a agriculturist to know his field status from his domestic or may be from any part of the World where he resides. IoT (Internet of Things) plays a dominant part with in the proposed farm irrigation system. The reason of the IoT in this system is, it has got to share the information to the users. Thus the IoT server is associated with the W-Fi module. The data of the soil is transmitted to the Wi-Fi network through the signal conditioning circuit of the different sensors.

The physical information about the soil like soil moisture, temperature, humidity are forwarded to the Wi-Fi module, later with the help of IoT it is transferred to the user. If the soil moisture level reaches below the prefixed value , then the signal from the user device is sent through the IoT server to the field section. On receiving these signals the water irrigation system is activated and the sufficient water is supplied to the agricultural field. Whenever it reaches the span value , then the irrigation system is again deactivated and that data are additionally transmitted to the user.

Since the sensors detects only the analogy values, the Analog to Digital Converter (ADC) pin on the microcontroller will be used to convert these analogue signals into digital format. The microcontroller will access information from the various devices connected to it. Once the motor pumps are turned On/Off it will be displayed in the user's android application. This is often the cyclical process of this proposed smart farm irrigation system.

C. Implementation

The proposed agricultural system is designed to find an optimal solution to the water crisis. The design implements IoT mechanism using the Arduino UNO Board ,an android device, sensors to sense various features of soil, a water pump to supply water to the farm and relay, which is used to connect the motor.

As show in figure 3, the working of the irrigation system commences by sending a command from user android phone application to turn the motor on. Through a serial terminal this will send a request, a string to microcontroller board , which will match the string with the preserved one in Arduino board and if it is valid then it will start the motor. Afterward the entire process of irrigating the field will be done automatically by the microcontroller itself.

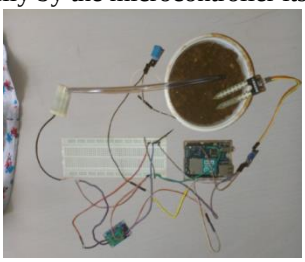

Fig. 3. Working Model of Smart Farm Irrigation System

The microcontroller fulfill four unique cases that may emerge during the plant irrigating process. They are as follows:

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Case 1: After turning on the motor, the micro controller will constantly scan the moisture , humidity and temperature sensor values and additionally checks for order commands so as to halt the motor pump if user commands it consistent with his requirements. By this way the user can regulate the system.

Case 2: While scanning the sensor to detect soil moisture level , the motor pump will automatically switch off if the moisture value of the soil exceeds than predefined threshold value.

Case 3: This case is significant for water preservation. If there should be an occurrence of atmospheric condition such that it begins raining, the Arduino microcontroller will halt the motor pump temporarily till rain stops and afterward once again it checks the moisture value of the soil detected by moisture sensor, if it is not exceeds predefined threshold value, then system automatically switch ON the motor but if moisture sensor value exceeds the preset threshold value limit then motor will stops permanently.

Case 4: Finally, in case of power breakdown the motor will stop, But, when power supply will be re-available the again user has not required to start out the motor manually, due to program composed into Microcontroller it will automatically get started with less or no user interference.

D. Proposed System Components

Here the system components are categorized into two types, like hardware and software components and they are explained as follows:

i) **Hardware Used**: The followings are the hardware components used to implement his system:

a) Arduino Uno Board (Microcontroller Board): The microcontroller acts as the brain of the entire system. Arduino UNO Board is a micro controller board we are used in our system.

It is an open source design , simple and accessible , user friendly , it has been used by a large simple and accessible user experience, it has been used by large community of people in thousands of various systems and applications. It makes easy to help in debugging projects. Arduino UNO boards are almost less expensive when compared to other microcontroller.

b) Android Phone: We are used android phone in this system,, which is capable of running android application that is designed to monitor and control the automatic farm irrigation system.

c) Sensors: Sensors can be used to tests test the moisture level of soil. When soil having water contents shortage, , the sensor is displaying low level output , and else it displaying the high level output. In this system three sensors like soil moisture sensor and temperature and humidity sensors are used in order to obtain the soil and environmental condition related information.

Soil moisture sensor is a one type of sensor that is used to gauge the soil's volumetric water contents. Temperature sensor is an electronic device which is used to measures the temperature or amount of coldness or even heat energy that is produced by the system. A humidity sensor is the most important devices that has been largely used in industrial, biomedical, consumer, and environmental etc. fields for calculating and monitoring Humidity or amount of water present in the surrounding air.

d) Motor Driver: Motor driver acts as a bridge between the Arduino Microcontroller Board and motor and it is mainly used to control motors. Usually Motor works on a high amount of current though the controller circuit requires low current signals. So here the main function of the motor driver is to receive a low-current signal and after that convert it into a higher-current signal that can run a motor.

e) Motor Pump : Motor pumps are used to take water from standing source and move it to another location.

f) Pipe : Pipe is used as a water channel for the flow of water for agricultural land.

g) Relay : In this system we are using Relays for connecting motor driver and motor pump. A relay is nothing but a switch that electronically or electromechanically opens or closes circuit.

ii) Software used: The software used in this system are as follows:

a) The Arduino Integrated Development (IDE) or Arduino Software: The Arduino software is a cross platform application and it runs on operating systems like Windows, Linux, and Macintosh OS etc. This is an open source environment and it is allowing a user to write a programming code and then transfer it in to Arduino board easily.

b) Android Mobile Application: The user application for the smart farm irrigation system is designed and developed using Android platform. Android is a mobile phone compatible operating system. It is designed based on Linux kernel promoted by Google and built mainly for touch screen based mobile devices such as smart phone and tablets. An Android App is an application software running on the Android platform.

V. RESULTS AND OBSERVATIONS

Experimental results analysis is observed through following screen shots:

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Fig. 4. Home page of user android mobile application

The detected value of soil and current status of the motor will be displayed on user's android mobile application as shown in the figure 5.

With the recent farming trends dependent on agriculture, IoT has led tremendous profits like effective utilization of water, optimization of inputs and many more. Here we have developed a system which will enable a farmer to understand his agricultural field's real time status and updates in his home or he could also be residing in any part of the world.

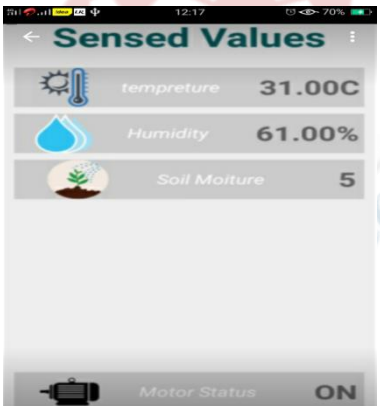

Fig. 5. Sensor values displayed on user android application

The proposed farm irrigation system has following advantages:

The main advantage of this is that it has the overall power to control the cultivating land with the simple tap on user android application by receiving real times updates and status of the condition of the field which can result in improvement of farm land productivity.

This system significant impact on achieving water conservation by ensuring the optimal utilization of precious water resources and helps to control the pollution too.

This system is affordable for farmer, irrigation installer, landscaper, maintenance worker or a home owner, which helps them to minimize the humanitarian efforts and save their valuable time and also keep landscapes in peak condition.

The most beneficial impact of the system is that it also contributes to the economy by reducing the extravagant use of Water and Electricity which helps to decrease monthly water bills significantly.

A Future enhancement

In the future years with more improvement in the field of IoT This system can be expected with more efficient, less costly and much faster. The system not only used in agricultural field but can also be used to overcome the issues related to other fields like supplying water to the stadium or to garden, where regular observing of watering the plant is necessary, or a small personal field, only when water required etc.

With more improvement in the field of IoT expected in the future years, these systems can be more efficient, less costly and much faster. The system can not only used in field by the farmers but can be used to solve other issues where regular observing of water supply is required like in a garden ,or in the watering the stadium, or a personal small field when necessary etc.

This system can also be made more imaginative by adopting advanced technologies like real time monitoring and controlling the watering sprinklers, identifying the faults in the irrigation channels and in case of any problems in an irrigation system enabling the user to take immediate action by using their favorite technological device like Android phone or Tablet.

In the future, this system can be made as an inventive system, where in the system anticipates user activities, rainfall design, harvesting time, animal intruder in the agricultural field and transmitting data via advanced trends and technology like IoMT can be developed by which farming system can be made more autonomous of human action and in turn high quality and huge quantity of agricultural yields can be achieved.

VI. CONCLUSION

In this paper, we have succeeded to implement IoT enabled Smart Farming which upgrades the entire Agriculture system by real-time monitoring and controlling the agricultural field. With the help of sensors s and interconnectivity, the Internet of Things in Agriculture has not only saved the precious time of the farmers but has also shorten the excess utilization of resources like Electricity and Water. It keeps various parameters like temperature, , humidity, and moisture level of soil etc. under observation and provides a very clear real-time controlling [8].

The proposed system designed is cost effective to implement, user friendly to handle and highly efficient in power consumption. The system is especially focuses on people engaged in the agricultural farm, as the developed system monitoring and controlling water supply to the agricultural plants with less or no human intervention. The main applicable area of this system is for watering plants of gardeners and farmers who don't have sufficient time to do it.

REFERENCES

[1] Tanmay Baranwal, Nitika Pushpendra Kumar Pateriya, "Development of IoT based Smart Security and Monitoring Devices for Agriculture" in 6th International Conference - Cloud System and Big Data Engineering, IEEE, pp. 978–1-4673-8203-8/16, 2016.

[2] LaxmiShabadi, NandiniPatil, Nikita. M, Shruti. J, Smitha. P&Swati. C, and Software Engineering, Volume4, Issue 7, July 2014. "Irrigation Control System Using Android and GSM for Efficient Use of Water and Power",International Journal of Advanced Research in Computer Science .

[3] Izzatdin Abdul Aziz, MohdHilmiHasan, Mohd Jimmy Ismail, MazlinaMehat, NazleeniSamihaHaron, "Remote Monitoring in Agricultural Greenhouse Using Wireless Sensor and Short Message Service (SMS)", 2008.

[4] " Indian Economic Survey", http://mofapp.nic.in:8080/economicsurvey, Govt. of India, 2018

[5] Q. Wang, A. Terzis and A. Szalay, ―A Novel Soil Measuring Wireless Sensor Network‖, IEEE Transactions on Instrumentation and Measurement, Pages: 412–415, 2018.

[6] Lav Gupta, Krunal Intwala and Karishma Khetwani, ―Smart irrigation system and plant disease detection‖, International Research Journal of Engineering and Technology, Volume 4, Issue 3, Pages: 80-83, 2017.

[7] S. R. Kumbhar, Arjun P. Ghatule, "Microcontroller based Controlled Irrigation System for Plantation", Proceedings of the International MultiConference of Engineers and Computer Scientists 2013VolumeII, March 2013.

[8] Deeksha Jain, P. Venkata Krishna and V. Saritha, "A Study on Internet of Things based Applications", 2012 .\.