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COST EFFECTIVE AUTOMATIC IRRIGATION SYSTEM

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Abstract: ***In a country with large number of rivers present, farming plays a key role in building the economy of that country. In a country like India, production of crop always has to meet the challenge of feeding the large population. Due to rise in demand of water in the various industrial sector and urban areas, it has become necessary to reduce the wastage of water in the crop fields. It has therefore been found by the researchers that traditional method of farming is not suitable to predict the right amount of water consumption in the field under the current situation of scarcity of water. Researchers have therefore invented the method of smart irrigation process that is capable to monitor soil parameters and control the process of watering the plants in the field. This method is popularly known as smart irrigation. Several costly systems have been designed by industries to meet the requirement of automatic irrigation. The objective of this paper is to provide a cost-effective solution for automatic irrigation system for the farmers who are unable to procure high cost solution.***

Key words: ***Automatic Irrigation, In house Irrigation, Low cost Irrigation, Smart Irrigation***

1. INTRODUCTION

The world has been bestowed with renowned civilizations that were mostly flourished around the rivers. Hence, from the ancient ages, the most popular trade of people has become cultivation of the crops. Like most other river centric countries, Indian civilization has been flourished around many popular rivers and till now, the majority of Indian population revives around

agriculture in the river basin area. But with the increase in population and advent of other trades and industries, production of crop is no longer limited to the river basin area but has spread outskirts from the river basin. The soil characteristics and availability of water of those areas are different from that of river basin areas. Most important resources of water for the plants in those areas are monsoon rainfall and ground water, which are limited in quantity. It has therefore become necessary to utilize the water resources scientifically. The branch of engineering that deals with artificial watering system to the crops is known as irrigation [1]. Irrigation is precisely maintained by implementing different kind of sensors, actuators and controllers that are capable of managing the consumption of water according to soil properties and specific water requirement of the crops. Application of scientific methods in irrigation system results not only the exemption of human intervention on making decision on irrigation but to the efficient use of limited resources.

2. LITERATURE REVIEW

The burning issue of the efficient use of limited underground water resources for the cultivation of crop, lead the researchers around the world to propose various methods which could be able to efficiently increase the production of selected crop with limited resources. India is also not an exception. Nikhil Agarwal and Smita Singhal (2015) in this paper [2] have proposed a system that uses hardware devices connected through internet to transfer the datapicked up by the sensor in the field area. Processing of the data enables the controller to make decisions about suitable application of water to the crop without human intervention. This kind of internetwork of sensors and systems to control automation on the basis of data storage and analysis in the server by help of internet connectivity is popularly known as internet of things (IoT).The proposed system by the authors of this paper has enabled to put water only at the root area of the plants where absorption of required water for biological need is mostly performed. This novel method of watering the plants is with least wastage of resource water is popularly known as drip irrigation. The system proposed by the researchers in this paper aims at producing an energy efficient automatic irrigation system using Raspberry Pi, Arduino Uno development board, ZigBee Modules, relay boards and array of suitable soil moisture sensors. Raspberry pi has been used as the main controller of the system that controls auxiliary controllers like Arduino Uno board. Arduino uno portrays as an interface between user and the

main controller through various wireless communication modules. This system communicates with the user through an email account to provide the status of irrigation. On the other hand, ZigBee protocol is used for communication between hardware devices. But despite of its ability to perform automatic irrigation, this system seems to be suitable only in urban regions having crop fields equipped with high-tech infrastructure and high-speed internet connectivity. Another limitation of this prototype could be one of the main reasons of non-acceptability in rural areas where most of the people don't know about using smart phone and the use of internet. Also, poor people of rural areas cannot afford the cost of high-tech infrastructure and maintenance cost of the system.

Bobby Singla, Satish Mishra ,Avishek Singlaand Shashank Yadav (2019) have aimed to develop a system [3]that utilizes the readings received from IoT enabled moisture and humidity sensor placed in the field for making a decision on watering the plants. The principle aim of the system is to process the received field data through IoT platform and provide required instruction to the controller on the field and inform the farmers through smart phones. The system works by comparing the received field data with some preset values for that particular climatic situation and soil properties suitable for production of the crop. Here the user accessibility to the information is easier than the previous methods from the user point of view through a smart phone but, yet the question comes from the affordability of a smart phone by a poor farmer and availability of high-speed internet in remote village areas which may produce unexpected result for implementing this system.

In this paper [4] G.Sushanth and S.Sujatha (2018) have proposed a system that uses IoT platform to monitor the temperature of the environment and soil moisture using the suitable sensors. In addition to this, the researchers in this paper have also added mechanism of monitoring the intrusion of harmful animals in the fields. The proposed system uses Arduino Uno, an open system hardware platform as control unit. The temperature and moisture sensor produces analog voltage signal which is fed to the control unit through analog input pins. The digital data corresponding to the analog signal is compared with the stored preset values. If any mismatch of the corresponding data is found by the controller, it generates notifications to the farmers through Wi-Fi,3G or 4G mobile network. Though the proposed system in the paper is capable to reduce the human interference to a large extent by incorporating IoT platform, but the set up may be costly to afford by middle class farmers. In addition to that, slow data rate of the

internet and places without any mobile network, such as in hill areas, may not be suitable to apply this irrigation system.

In the system [5], proposed by Srishti Rawal (2017), the accurate data is received from the precision sensors and are processed by Arduino Uno platform that is used as main controller of the entire system. This system incorporates sprinklers to provide water to the plants. The data received from the sensors is recorded in the server and a continuous upgradation of the webpage containing the data is performed. According to the analysis of these recorded data from the sensors, the controller selects the specific regions suffering from the deficiency of required amount of water and controls the flow of water in those regions. Though, the system proposed here is economical, but the yearly recurring cost to the maintenance of the webpage of server is a tough job and quite impossible without proper training. Also, a sprinkler system for may not be suitable to reduce the water consumption because most of the water falls on the outer surface of soil and leaves of plants that is wasted due to evaporation.

The automatic irrigation system proposed by Rajkumar Mistri and Madhupriya Singh (2018) [6], deals with the economic affordability of Indian farmer in the context of farming. Application of comparatively low-cost hardware and sensors is one of the main reasons of acceptability of this proposed system in rural areas. In this system arduino uno platform has been used as main controller and the soil moisture sensor has been used to produce equivalent voltage signal as per the soil moisture. A miniature water pump has been integrated with a relay circuit to control the flow of the water. This system is somehow simpler in architecture and can be acceptable for greenhouse farming. But control of the temperature inside the greenhouse has been neglected in this proposed design which is one of the prime causes of drying up the soil moisture.

3. PROPOSED SYSTEM ARCHITECTURE

Literature review on different mechanisms of the irrigation systems proposed by the researchers till now are considered to be efficient with high speed internet connectivity because they include the cloud server for storing and analyzing the data. Data analysis is an essential part of research in the context of statistical report generation about the different parameters of a particular crop. Hence, the proposed systems can be proved to be much useful for the farmers who are capable to do large investments and are trained with modern technologies associated with IoT for large production of crops. But with availability of small areas for crop production,

farmers are more accustomed with green house technology for better production of some selected crops. In this paper a greenhouse system has been proposed which is economically affordable for most of the farmers who are not well trained to operate smart phone but have limited area under his premises to produce the crop. The proposed system shown by Figure 1 consists of a control unit, soil moisture sensor and temperature sensor modules and actuators. The soil moisture sensor is a resistive type soil moisture which converts the soil moisture into equivalent voltage signal. The temperature sensor chosen is LM35 that produces equivalent voltage of the temperature inside the green house. Two single channel relay modules run an exhaust fan to control the temperature inside the green house and a submersible water pump to supply required water to the soil respectively. A display unit has been attached to display the amount of moisture present in soil and the temperature of the house. The entire system runs with DC voltage source. The controller runs with 9 Volt DC supply, whereas, the pump and the exhaust fan each requires 12Volt, 1 ampere supply. The sensors usually run with 5 Volt DC which is supplied from the Arduino uno controller board itself. All the major system components depicted above are listed in Table 1

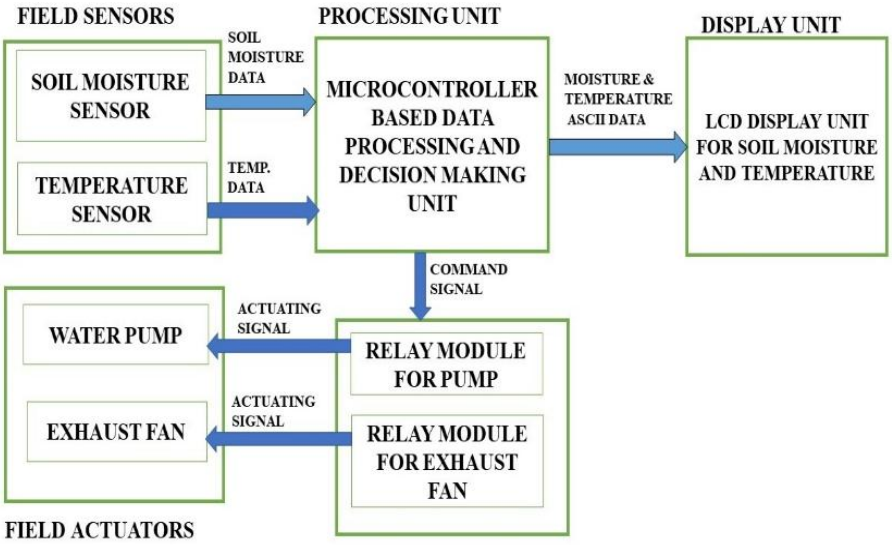

Table 1 List of major components

Serial No	Component	Quantity
1	Arduino Uno board	1
2	LM 35 temperature sensor	1
3	Resistive soil moisture sensor	1
4	12V Miniature water pump	1
5	12 V exhaust fan	1
6	Single channel relay module	2
7	Green house box	1
8	12 V adapter	1
9	9 Volt Battery	2
10	ON/OFF switch	2
11	16x2 LCD display	1

3.1. ***Principle of operation*:**The proposed system by the authoruses Arduino Uno platform as the controller which receives the analog input signal from soil moisture sensor and temperature sensor through two different analog input channels. Signals received from the sensors are converted from analog to digital signal by the help of analog to digital converter. The soil moisture and temperature of the greenhouse is simultaneously measured to keep the inner temperature of the greenhouse at 25°C and soil moisture at 50% of the maximum soil moisture. Upon decrement of soil moisture below 50%, the controller generates a logic high output signal through the digital output port to single channel relay that drives the water pump. The water pump is turned on and runs until the soil moisture goes above 50% of the maximum soil moisture. In a similar way, when the temperature of the green house goes above 25°C, main controller generates logic high output signal through digital port to another single channel relay module which turns on the exhaust fan and runs until the temperature goes below 25°C. The flow diagram is shown by Figure 2 below.

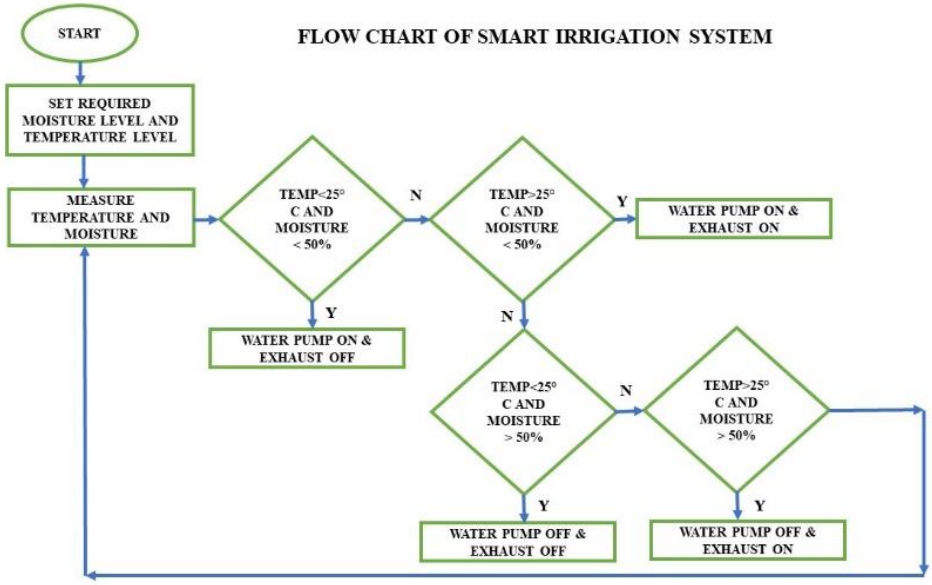

Figure 2 : Flowchart of smart Irrigation System

4. RESULT ANALYSIS OF THE PROPOSED SYSTEM

Still now, several authors have proposed various types of irrigation systems, which are nevertheless sophisticated and capable to analyze the data over internet. The farmers well trained in using modern smart phones and having field infrastructure with high speed internet can utilize better facilities for large production of crops. But a large group of farmers in India are poor who produces crops at the rural areas non-scientifically. The proposed system in this paper uses automatic control of irrigation to moisturize the soil. This system has been preset to run the miniature pump below 50% of the maximum moisture level of the soil and uses a single moisture sensor for a given plant inside the prototype. The preset level of moisture can be varied according to the crop to be cultivated in a greenhouse environment. Since a greenhouse is unaffected by the external environmental conditions like rain and storm, except the in-house temperature, the proposed method can be most suitable for greenhouse farming within a limited area with a constant soil moisture and temperature. The proposed system is a static system and cannot adapt automatic variation in soil moisture and temperature for different crop without human intervention. Hence, the proposed system lacks in adaptation of soil moisture setting and temperature setting automatically. Also, this system aims scientific irrigation in places without internet facility and it has been successfully tested in the prototype system. But without greenhouse, in an open field, this irrigation method may require dividing the entire field into

small area known as clusters, which could be suitable to be used with more than one soil moisture sensor, detect the average soil moisture of the cluster and provide required amount of water for a given crop.

6. CONCLUSION

In this paper, the issue of minimizing the wastage of water in areas with limited water source through scientific method has been discussed. Automatic irrigations system proposed in this paper aims at poor farmers who are not trained to use sophisticated technologies such as smart phone and internet. This prototype is tested in greenhouse condition within a limited area. The result is satisfactory with the operation of the sensors and actuators that is controlled by the Arduino Uno associated open hardware platform. This prototype represents a static system which cannot adapt variation of soil moisture and temperature from preset values according to environmental conditions without manual support for a given crop production. Hence it is less suitable to be used in an open field where environmental conditions prevails. But with the availability of internet facility and incorporating Internet of Things in this irrigation system, it could be possible to obtain better results but with a higher cost. That is why in the next prototype a new technique will be adopted to use clustering of field with multiple sensors to obtain the data from the cluster and after analyzing the data, decide the required amount of irrigation. In this way the irrigation could be free from human intervention according to the adaption in preset values of parameters based on the environmental conditions.

5. ACKNOWLEDGEMENT

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