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IOT BASED SMART IRRIGATION SYSTEM USING GSM

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Abstract - Agriculture is the primary sector and a large portion of Indian population (about 58%) is engaged in this sector and allied industries. Irrigation is an essential part of agriculture. Out of the only 3% fresh water available to the world, less than 0.5% is available in form of underground water or atmospheric moisture, the water that we can use. In this situation it becomes essential that an irrigation technique which is effective, efficient yet feasible is used. Irrigation is basically providing water to the crops artificially to fulfill their water requirements. It can also be used to provide nutrients to the soil. In a country like India where most of the farmers are dependent on the uncertain monsoon, it is essential that we make use of the most efficient techniques that we have. IOT based smart irrigation system is one such technique where irrigation can be done without much hassle and efficiently, saving water as well. With everything on smartphones, irrigation can be done easily and accessibly from a person's mobile, that too by setting instructions once and the system then works on its own. This wireless monitoring of field irrigation also generates a large amount of data however, that can be tackled by cloud computing. The advantages of this smart irrigation system are much more than small problems. With time, there will be more developments and research in the same, the system will become even finer.

Key Words: Irrigation, IOT, Precision Agriculture, Sensor.

1. INTRODUCTION

IOT based smart irrigation system can be used in many ways depending on the crop, soil, field, type of farming and needs of the farmers. Irrigation is not only one type. There are different types which are practised by farmers for improving crop yield. For example, IOT irrigation system can be used in trip irrigation in which water is delivered at the roots of the plants which requires a lot more maintenance. IOT irrigation can make the work of the farmers easy since they can control it remotely and also the system keeps a check on the variables 24/7. This system can also be used by farmers practising Terrace farming which is the practice of cutting flat areas in hilly areas or steep slopes. Soil erosion is common in terrace farming and farmers need to give access care to it by installing barriers. But the water flow can be managed by IOT and the farmers do not need to rush to turn off or turn on their water pumps. Farmers can easily access their field's condition from their smart phones. Water sprinklers used by farmers can be placed unevenly and thus, some of the crop field receiving more water than the other and the crops get killed either by over moisture or under moisture. This smart irrigation system makes sure that soil all over the field receive enough and adequate moisture. The farmers cannot monitor their crops all the time but this system can. This system can also provide information to the owner about any animal or insect harming their crops and farmers can take action remotely through their smartphones.

2. LITERATURE REVIEW

This paper seeks to make the job of farmers easy and increase their yield by using Iot (internet of Things) based Smart irrigation system. Irrigation is an important part of agriculture and with shortage of water, it is essential to make the best use of available resources. Farmers dependent on monsoon often face this problem of shortage of water. Farmers have to use the limited water collected in dams and other reservoirs for a long period of time and thus, face shortage. India is also a tropical country with 25-degree Celsius average temperature which increases evaporation rate and transpiration rate of plants. Farmers have started using computers, smartphones and software systems to organize their data and keep a track of their transactions with third parties. IOT based smart irrigation system uses water judiciously by providing water at the root of the plant. Further, the crops are often destroyed by excess water, or excess heat and by stray cattle or other animals that enter the field. Farmers cannot be in the field to take care of all these things and thus, IOT based smart irrigation system takes the job of monitoring and taking care of crops at all times, while taking actions necessary for crops' good yield like turning on or turning off the water pumps, and alerting the owner in case of any sounds. The system uses sensors to determine such

information. The owner can also install other necessary devices to make the system more accurate.

3. METHODOLOGY

3.1 Project Overview

A Smart Irrigation System, contrary to a traditional irrigation method, regulates supplied water according to the needs of the fields and crops. The feedback mechanism of a smart irrigation system is a temperature sensor. This temperature sensor is placed at a specific location on the irrigation field.

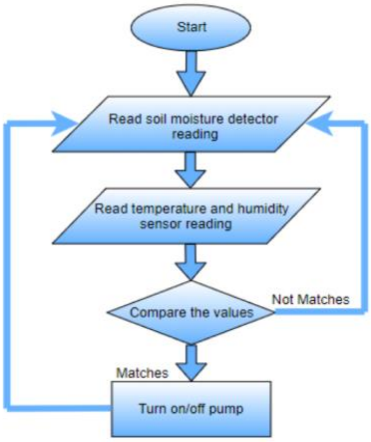

Fig-1: Project Overview

3.2 WORKING PRINCIPLE

All the major devices or components of the system have been introduced before. Arduino board can be called the brain of the IOT based irrigation system. The board receives data and information from all the devices and works upon the same. If the board has instructions from the owner to switch on the pump, the board will send instructions to connected devices in the pump will switch on. The pump will switch off either by instruction of the owner or by information sent to the Arduino board by the moisture sensor. The owner presets the moisture level and temperature and the same depends on weather conditions, type of crop, and location of the field. These details are to be taken of by farmer himself, and the rest can be controlled remotely.

If the owner has not given instructions then the board will work according to the information given by moisture sensor and temperature sensor. Moisture sensor sends the data to the board and after interpreting it if the moisture level is below the set level then it will turn the water pumps on. Accordingly, it will turn the water pumps off based on the information received.

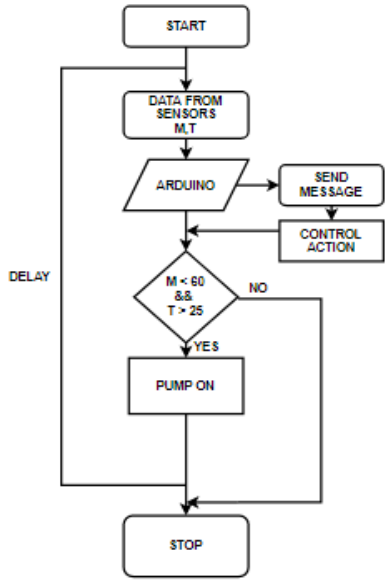

Fig-2: Working Overview

If the owner has not given instructions then the board will work according to the information given by moisture sensor and temperature sensor. Moisture sensor sends the data to the board and after interpreting it if the moisture level is below the set level then it will turn the water pumps on. Accordingly, it will turn the water pumps off based on the information received.

The above flowchart depicts the working of the IOT based smart Irrigation system. In the above example, the pre- set data for the Arduino is given. Moisture shall not be more than 60 and temperature shall not be more than 25. This data can be changed at any given time, according to owner's wishes, with the connected smartphone. If the moisture level or temperature is not according to the pre set data, the sensors will send data to the Arduino automatically, and the Arduino board will then take action accordingly. It will turn on and off the water pumps. Further, if there is delay in receiving the information from the sensors, Arduino board will turn the pumps off if they were on.

Also, if the weather condition is such that it started raining, then the microcontroller i.e. Arduino board will stop the water pump and if after raining, if the soil moisture has reached the required threshold i.e. 60 in above example, then, it will remain off but if the threshold is not reached, it will turn the pumps on again. Moreover, in case of power cut, Arduino board will automatically start the water

pumps when the power returns. The owner doesn't have to turn on the pump again manually.

3.3 COMPONENTS

I – Arduino board - which is typically an open source hardware and software, is used with moisture and temperature sensor. It develops digital devices by designing and manufacturing board microcontrollers and its kits. When Arduino board receives the data from connected devices like say moisture sensor, it compares the data to the pre-set data and takes action accordingly. The same data and action taken is sent to the owner's phone through GSM board. The owner can also send data to the GSM (Global System for Mobile Communications) board and Arduino board reads, interprets the data and takes action according to instructions of the owner. Thus, Arduino boards works on its own with the connected devices and it can also be controlled by the owner. GSM board is like a 2G cellular network which is a world standard for mobile phones. GSM supports, text messages, incoming and outgoing calls, and digital communication. GSM typically looks like a mobile or a modem.

II - IOT - Internet of Things is a system of interrelated computer devices, mechanical and digital machines, objects, animals and humans which are provided with unique identifiers (UIDs) and thus, having the ability to transfer data over a network without any human interaction. Most of the work is done without human interaction but humans can set the sequence, give instructions or access any information. Connectivity, network and communication depend upon the devices that are used in the same. GPRS (General Packet Radio System) is used to transfer data from or to Arduino board from or to different devices and components. It ideally transfers 56-114 kbit per second, and it is also possible to access the internet with GSM shield by leveraging information.

The process essentially includes two aspects, one is switching on or off the water pump and the other one is controlling pesticide spray in the field. Water pump turns on and off based on the information collected by temperature sensor and moisture sensor. The owner can also switch on or off the pumps remotely from their smart phones. The system can also be used to spray pesticide in the field and owner can pre- set conditions for the same or it can be remotely controlled as and when seen fit by the owner.

III – Moisture Sensor - is used to check the level of moisture in the soil to know what amount of water is required for the soil. It is essential because plants derive their nutrients from soil through the process of transpiration. Roots of the plants grow and work better in moist soil, however, at the same time, too much moisture will also destroy the plants. Excess water can lead to anaerobic conditions within the soil. Thus, Moisture Sensor is important to regulate the moisture of the soil. Moisture sensor can be placed in the field at different locations. It is placed just under the surface of the soil. The moisture sensor works by using capacitance to measure the dielectric permittivity of the soil surrounding the soil. A Sound module or a sound monito**r** can also be installed which will work as a microphone to sense sound signals. However, the monitor can only sense the sound based on their frequency (no. of vibrations), it cannot tell the owner the tone of the sound or its scale, or the source of that sound.

IV – Temperature Moisture - checks the temperature of the environment since the evaporation rate depends on the heat in the atmosphere. Temperature sensors convert the information collected (temperature) into voltage form and sends it to the Arduino board and the board takes further actions. The simplest example of a temperature sensor is a thermometer but the device used in fields is not essentially a thermometer which is less accurate and is thus used in non- scientific purposes. Moisture sensor and temperature sensor are also important in controlling the water and heat energy exchange between the atmosphere and soil surface. It was an important role in the growth of weather cycles and prediction of rainfall. In addition to temperature sensor and moisture sensor, the farmers can also install. **Humidity sensor** which can help in predicting rainfall and it can also help moisture sensor in evaluating the soil moisture since it also depends on the weather condition. All the data will be passed on to Arduino board which will take action as required based on the information and data.

4. RESULT

4.1 Outcome of Experiment

MEASURED MOISTURE	MEASURED TEMPERATURE	PRESET MOISTURE	PRESET TEMPERATURE	CONTROL ACTION
80	32	60	25	PUMP OFF
75	29	60	25	PUMP OFF
55	28	60	25	PUMP ON
50	26	60	25	PUMP ON

The above calculations and data was taken and as seen, the system, worked according to the pre-set data and turned on or off the water pumps as required by the soil and information received. When the moisture level was 80, it turned off the pumps since the moisture level was more than the threshold level(60). The same happened when moisture level was 75 however, when the moisture level was below the set threshold (55 and 50), the pumps switched on and started working. Also, the owner receives this data simultaneously and he/ she can also take action through their smartphones.

5. CONCLUSIONS

Agriculture is essential and smart IOT system can improve the yield per hectare by efficient methods without employing much manpower and manhours. Further work can be done in the system by installing fire sensors and developing cattle management devices and CCTVs can also be installed to find the trespassers if the farm owners feel so. Further, the system can be upgraded by checking the soil type and the crop acceptable for such soil. It would be better if the system could even support organic fertilizers and if the harvest time can be estimated beforehand. There can be a lot of changes and upgradations in the system.

Smart Irrigation system improves efficiency of stock management because of improved output efficiency. The system also makes it possible to achieve greater production and better quality of harvest since the system monitors the field all the time. However, as far as the smart IOT system is concerned, it is easy but requires to be set up. It is a change which the small farmers in India are not willing to make. Moreover, the farmers do not lack manpower but money and resources. The system can be useful of rich and modern farmers however, poor farmers who live on the bare minimum cannot take the risk of adopting a new technique. But in the coming years with more upgradations and advancements, the system can also be moulded according to needs of the farmers and their fields. Some of the factors restricting its growth is the extensive power usage since it uses many devices. The system can be bettered by using low power consumption devices. Further, solar powered IOT based smart system irrigation can also be used which will solve the problem of power consumption. However, the same would take time to develop and with enough investment in Research and Development, a standard model can be achieved.

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