Smart Irrigation System

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Abstract- *This project is based on providing easier and more practical solutions to the problems faced by farmers on the agricultural lands. A smart irrigation system promises improved crop production, less water consumption and more healthy crops. This project is an application of IoT and machine learning technology. The main theme of this project is to develop a device that can monitor the moisture level of the crops and if the moisture level of the crops is below a threshold level then the water pump is turned on so that crops don't get dried up and die. Apart from this the device can also detect nutrient deficiencies and crop diseases. It is then programmed to send the data collected via email to the user from a remote location. Sensors are used to detect the problems and transmit the data to a Raspbery Pi and an Arduino board. These are microcontroller boards which are used to obtain the data from the sensors and it also programmed to perform operations like pumping water from the water pump when the moisture level of the soil is low.*

Keywords- IoT, machine learning, Raspberry Pi, Arduino

I. INTRODUCTION

India is essentially the biggest rice bowl of the world. The worst fact is that India can't feed its own 1.21 billion people. There are a number of crop diseases that affect the growth and cultivation of crops in India almost during every harvest. For example most of these diseases occur only in summer due to the scorching heat of the sun which makes the crops very dry and it also reduces the nutrition levels of the crops by doing so. An estimate of 15-25 percent of crop is lost every year due to pesticides and mainly crop diseases. This happens either due to unavoidable circumstances or lack of attention to the crops on the field. We as a community can prevent crop failure to the best of our abilities from happening by analyzing the health of the crops and by paying more attention to its growth in return to receive a healthy harvest. Our project mainly focusses on the above factors to provide a good harvest regardless of the season by closely monitoring the condition of the soil and the health of the growing crops. The smart irrigation system that we have developed has been programmed to minimize the risks of crop failure and maximize the production of healthy crops for a good harvest. By using sensors to detect moisture content of the soil to sensors that nutrition content of the crops we will have an accurate idea as to how the harvest will be. A DH11 sensor is used in this case to sense the moisture content in the soil. There are 2 important nutritions when it comes to crops which are sodium and magnesium. Sometimes due to pests or parasites the nutrients get over and nothing remains for the plant. This leads to crop failure. Hence we have nutrition sensors to minimize the risk of dying crops on the field.

II. RELATED WORK

In the past there have been many attempts to automate the irrigation system and make further advancements using IoT and machine learning. A company called Hydrapoint Data solutions has made a project on the similar concept of smart irrigation that provides low water wastage, elimination of water of waste and reduction of leaks and breaks. The company's core solution suggests smart water management which is definitely needed for our country due to the current water problems we are facing. This project includes the functioning of over 40000 sensors which are deployed in the fields to monitor the weather and according water the crops also making sure that only the required amount of water is used for the crops and not over watering. The weather is monitored using a software called WeatherTRAK which provides

precision in recording and transmitting data. Other work that has been done in this particular area is mostly related to just moisture detection of the soil. But that again is not enough for the crops to stay healthy.

III. EXISTING SYSTEM

The existing system pretty simple but not that efficient. It has not yet been implemented on a large scale. The existing system mainly focusses on the moisture content of the soil that is to be replenished. So the existing system consists of a water pump which pumps water on command of the control board which in this case is the arduino when the moisture content detected by the moisture sensor is below a certain threshold. ZigBee is used as a communicating tool to transmit the data from the board to the mobile phone.

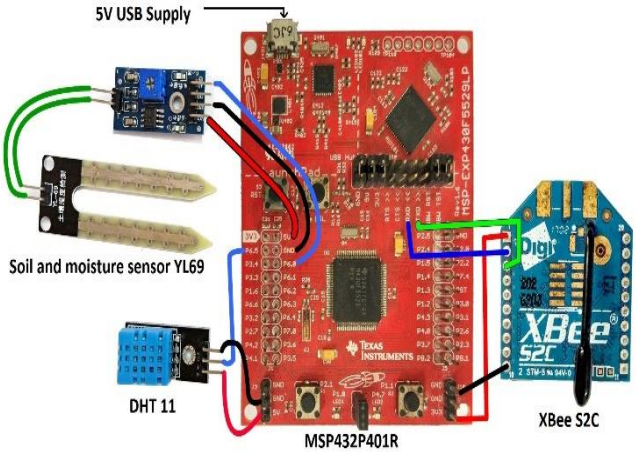


FIGURE 1: EXISTING SYSTEM

The above picture depicts the simple design of the current system. Here an Arduino board is used and the moisture sensor is connected to the board. The communication service from the board to the user is done using a communicator called XBee which is a radio module. It is designed for point to point connection over small distance only. It does not have the feature of remote connectivity like the proposed system. The Arduino board used in this device is very slow when it comes to clock speed.

IV. PROPOSED SYSTEM

The system that we propose focusses on the overall improvement of smart irrigation for the current scenario where the crops are closely monitored for diseases and nutrition checks are done on failing crops. Malnutrition in crops can be due to various reasons. The most common reason crops fail is because of negligence. The spraying of pesticides is not enough to get rid of the insects and rodents. The crops must also be monitored closely. The proposed system takes care of this by using a nutrition sensor which senses for the levels of sodium and magnesium content in the crops. These 2 minerals are very important nutrition for any plant. When the sodium and magnesium levels are low in a plant then an alert is sent to the controller board which then sprays the fertilizer for those plants so that they don't get infected and die. By doing this we make sure that the crops are healthy enough and are free of diseases and pests for the people to eat and for a good harvest. In order to implement this particular design the irrigation land or field has to divided into parts so that when the alerts from the sensor are sent to the board and immediately the fertilizer or the water pump is made to spray over the crops.

- Raspbery Pi: this is the microcontroller board or a mini computer where all the sensors are connected to and where all the data from the sensors is sent. This board also controls the pumping of the water and the spraying of the fertilizer when the moisture or nutrition content is low. The main reason why we are using a raspberry pi board over the Arduino board is because it's clock speed is 40 times faster than the Arduino. It can run an operating system in Linux and also connect wirelessly to the internet. This allows the data to be accessed over the cloud.

FIGURE 2: Raspberry Pi Model 3

- DH11 sensor:- It is the moisture sensor that is used in this device to detect the moisture of the soil and it is programmed in such a way that when the moisture iin the soil decreases below a certain threshold then the information is sent to the board and water is pumped to that particular section of the field.

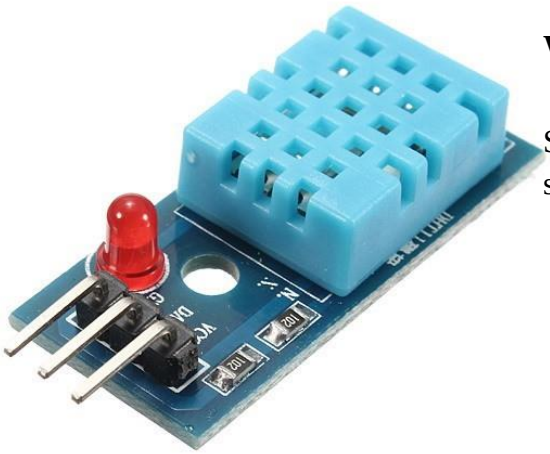


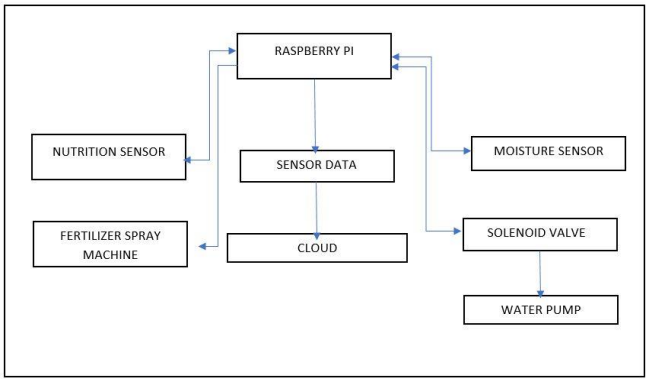
FIGURE 3: DH11 sensor

- Rrimin nutrition sensor:- This sensor is used to sense the levels of sodium and nitrogen in the soil. When these levels are below a certain threshold then the alert is sent to the board and the fertilizer is sprayed over that particular section of the field.

- Solenoid valve:- This is an instrument which is used to control the flow of water from the pump when the moisture content of the soil is low.

System Architecture

The following diagram depicts the basic architecture of the smart irrigation device.



WORKING

So this is a brief explanation of the working of the smart irrigation system.

- The moisture sensor and the nutrition sensors are placed in the proper position in the field. The water pump and the fertilizer spray are set at different part of the field according to the position of the sensors.

- The device will function properly only when all the essential parts are in the right place.

- The moisture sensor senses the threshold condition of the moisture in the soil. It immediately sends an alert to the microcontroller board.

- The data is then sent to the user's viewing device for analysis and the command to pump water is generated which waters the crop through the solenoid valve attached to the pump.

- Similarly when the nutrition content of the soil goes below the specified threshold an alert is sent to the raspberry pi board. This data is again recorded and sent to the user and a programmed command is sent to the fertilizer spraying device that then sprays the fertilizer over the crops to make sure the nutrition in the soil is replenished.

- This way the device minimizes crop failure by a large extent and makes sure the soil is always replenished with nutrition which is supplied by the fertilizer.

- Hence this device saves on water usage and produces a healthier harvest.

V. FUTURE WORK

The ideas that our team had in mind was to improve on the current irrigation system and there still remains a lot of issues that can be improved using technology by the community and the government. The engineers of the future must focus on attacking these problems with logical solutions and must make them a possibility by using the advancements in technology to the fullest. Some of the advancements that can be done are :-

- Technology is a complex field of work. It must be made easier for the people to understand it and for them to use it on an everyday basis. Farmers need to know the process of smart irrigation in order for them to use it.

- The system can be made easier by asking inputs from the farmers as to how the device should function according to their leisure and convenience so that they can use it more efficiently.

- The automated functions of the any smart irrigation device even in the future must also be operated manually in case of any malfunction with the board.

- The water pumps can be powered by wind mills which run on wind energy which is a renewable source of energy and also generates electricity.

CONCLUSION

The project presented is based on a smart irrigation system that focusses on water conservation and good harvest of crops. In today's world of technology anything is possible.

We as future engineers must take responsibility and make technology user friendly for all the people. Internet of things is a vast domain of ideas and opportunities for the future. So the smart irrigation system is capable of making sure that the soil never becomes dry by using a moisture sensor. When the moisture in the soil decreases below a certain level the device is programmed to pump water over the field. This helps in water conservation and also makes sure that the soil is always wet and moist. Sometimes the soil's nutrition content begins to reduce over time and usage by the crops. So to prevent this from happening a nutrition sensor is placed in the soil so that when it reaches below a certain threshold the fertilizer is sprayed across the field to prevent the plants from dying. This prevents crop failure and helps in providing a good harvest. Some of the advantages that are provided by this system are :-

- Water conservation:- there is a lot of water that is wasted in irrigation when the water pump is left open on the fields and often the crops get more water than they need. This results in washing off the top soil which has all the minerals required by the crops. So by controlled water flow only when necessary helps in conserving a lot of water.

- Good harvest: when the soil is always filled with the required nutrition the crops are healthy and free of diseases which gives a good harvest for the farmers and for the people.

ACKNOWLEDGMENT

The authors would like to acknowledge SRMIST for funding this work as a part of the Multi Disciplinary Design project during 2018 and also, the authors thank _____ our guide for her valuable input and support.

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