Automatic Soil Conditioning and Moisture Sensing System

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Abstract

Agriculture is the main source of income for the majority of the Indian population and therefore has great impact on the economy of the country. But these days, as people are focusing on technology more and more, less people are willing to do something menial like farming. Farming is an activity that depends heavily on the conditions present in the environment surrounding the agricultural field. The work of the farmer is affected by the natural conditions such as climate, topography, etc. This project implements the emerging applications of IoT technology. Using IoT networks, a control system is being proposed that will act as an embedded system which can monitor and control an irrigation and moisture sensing system. The system also consists of fully automated irrigation, fertilizer preparation, fertilizer distribution and pesticide distribution system. The method employed is to continuously monitor the soil moisture level to decide whether irrigation is needed, and how much water is required in the soil. The objective of this project is to decrease human involvement in and increase the efficiency of farming process.
Keyword- IoT

I. INTRODUCTION

Agriculture plays an important role in the development of any country. In our country, agriculture depends on the monsoons which sometimes tend to be an erratic and insufficient source of water. So manual irrigation system is used in agriculture field. In irrigation system, depending upon the soil type, water is provided to the crops. [1]

The two factors which are important in agriculture are first to get information of about the fertility of soil and second to measure moisture content in soil. In the olden days, all this was done manually using the knowledge and experience of lifelong farmers, it was sufficient. This was due to the large workforce in the field of agriculture and the smaller global population at the time.

Coming to the 21st century, we can see that the population of the world has increased and will continue to increase exponentially. As this demand increases, it usually follows that the supply should also increase. However, the percentage of people who are engaged in agriculture has drastically diminished, especially in developed and developing countries. In these years of rapid technological advancement, people are more concerned with high-level technical jobs and the noble occupation of farming is considered to be best left to poor, uneducated farmers.

However, the irony is that, with all these new advancements even in the field of agriculture, it has become easier for just about anyone to take up farming, if not as their main occupation, then at least as a side business. New technologies such as motorized equipment, modified housing for animals and biotechnology, which allows for improvement in agriculture, are now readily available. The new technology has allowed farmers to feed more people and requires fewer people to work on farms to feed their families. Nowadays, even for irrigation, different techniques are available which are used to reduce the dependency on rain. These techniques are usually driven by electrical power and on/off scheduling. The farmers are making the most out of their resources but with continuously improving technology, they are able to partake in sustainable agriculture and farming practices like conservation, preservation and moderation. The new techniques for irrigation are extremely important, maybe even more so than any other advancements in agricultural science. In our country, most of the irrigation is done by the monsoons or with the help of water bodies like ponds, rivers, canals, etc. But due to changing climatic conditions and other factors like global warming, the whole country now faces a water crisis. The monsoons have become erratic and the water bodies have begun to dry up. So proper conservation of water resources is necessary for sustainable agriculture.[2]

Taking this into consideration, the project includes a conservative irrigation system, which is the moisture sensing system. In this technique, a water level indicator is placed in water reservoir and soil moisture sensors are placed near the root zone of plant and near the module. The gateway unit handles the sensor information and transmit data to the controller which in turns the control the flow of water through the valves.

Another important part of the project is the fertilizer system. This system is geared to produce biodegradable fertilizer from food waste and disperse it to the crops via the irrigation system. The food waste is loaded into a storage tank and allowed to compost, with the help of a catalyst that will draw out the maximum nutrients from the waste. It will then be fed into a crushing and grinding system, powered by a universal motor, which will break it down into granules, so as to increase its solubility in water,

and then the compost and water will be mixed together to get the final fertilizer. This fertilizer is fed directly into the soil via the irrigation system.

Another important part of the project is the pesticide system. Here we use an organic pesticide called tobacco soap solution, a biodegradable pesticide that has been used in Kerala for hundreds of years. The pesticide is stored in a small storage tank kept at a height level of a few meters. When required, it is brought out via PVC pipe system. It is heated at the beginning of the pipe with the help of reflector. The pesticide is then transported to a sprinkling system consisting of shower heads attached to horizontal bars placed on metal columns. This will spray the pesticide directly onto the leaves of the plants.

We are also using an IoT (Internet of Things) based system for controlling the whole project. The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. The "Internet of Things" connects devices and vehicles using electronic sensors and the Internet. This means that the project can be controlled even when the user is far away from the site, with the help of just a smart phone.

The primary focus of this project is to help the farmers and reduce their work. The labour cost will be less as only a few people will be required to run the system. It will also result in less exposure of humans to a variety of harsh weather and environmental conditions. This module can be also implemented in both perennial plant irrigation land and gardening land. The project will go some way to reducing the supply-demand imbalance of the food production industry.

II. Overview Of The System

The block diagram of the proposed system is depicted in Fig 1.As the name suggests the project mainly focuses on soil conditioning and moisture sensing. This is makes use of three systems: 1) Fertilizing 2) Pesticide 3) Moisture sensing.

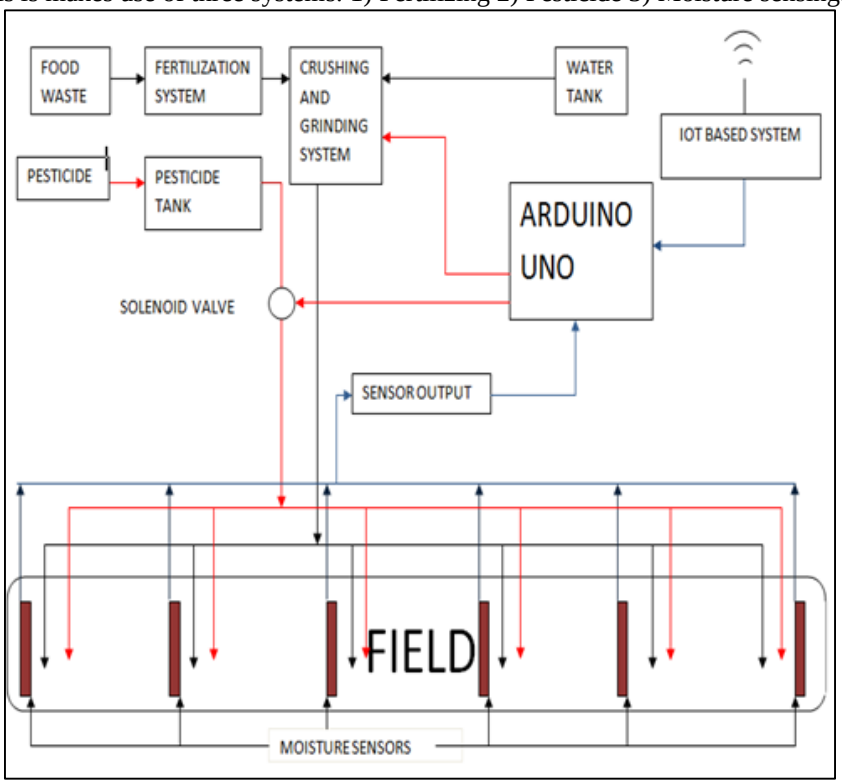

Fig. 1: Block Diagram

The compost made is given to the fertilizer system .In the fertilizer system the crushing and grinding is done and is fed to the mixing unit where the granules thus obtained is mixed with water .The mixture is the fed to the plants through the PVC pipes ,when required.

We also use an automated pesticide system where a solenoid valve is employed. According to the input signal the pesticide is heated and sprayed on to the plants using the shower heads provided. A moisture sensing unit is made to have an information about the moisture content of the soil. Whereby we can irrigate the field automatically. All the three systems are connected to the Arduinouno and by using an internet connection these data can be send to desired website and a distant controlling can be done.

III. DESIGN AND DEVELOPMENT

A. Preliminary Steps

In the preliminary steps the physical connections are made. For this, a water source has been identified and connections are made to the water tank using motors and PVC pipes of the required dimensions. After the completion of the connections the water is allowed to store in the tank. The water tank level is checked and maintained automatically with the help of a floating ball valve that is commonly found in flush tanks.

B. Fertilizer System

The fertilizer used is biodegradable food waste. It can be prepared with the help of a catalyst that speeds up the process of degrading the food waste into biodegradable compost. The catalyst brings out the maximum nutrients from the food waste. This process is done in the fertilizer preparation tank. The resulting compost obtained is fed into a crushing and grinding machine to make it into small water-soluble granules. At the same time, water is brought from the source via PVC pipe system so that mixing of the compost and the water can be done simultaneously. From here, the mixture is directly fed via the PVC pipe system to the crop soil when required.

C. Pesticide System

The pesticide used is an organic pesticide derived from tobacco plant that is commonly used in our state. It is a harmless, biodegradable pesticide that does not have any ill effects on the soil or on living beings. The pesticide is stored in a specific tank built for the purpose. The pesticide is transported using a pipe system. When in the pipe, it is heated with the help of reflectors that focus the sunlight onto the pipe. This is essential for proper formation of the pesticide. It is then given to sprinkler system consisting of shower heads mounted on inter-linked columns. The sprinkler system sprays the pesticide directly onto the crops.

D. Automation

In the automation, we are using an Arduino UNO to run a 0.5 Hp motor and open two 12V solenoid valves. According to the soil condition and moisture content, the Arduino will make its digital output pins high or low. When the pins become high, they give 5V output.

The three pins are connected to 0.5 Hp motor and the two 12V solenoid valves. The 0.5 Hp motor requires single phase ac voltage and solenoid valves require 12V ac voltage. From the single phase supply, we give an input of 230V directly to relay (12V, 5A). Again we give single phase supply to 230/12V, 2A step-down transformer.

The output of transformer is given to a bridge rectifier having 5A diode to convert it from ac to dc. The output of rectifier is given to 12V, 5A regulator (LM7812).

The output of the regulator is given to the collector of transistor (BC547). Emitter is directly connected to the input pin of relay. Base is connected to 5V digital pin of Arduino. When the digital pin of Arduino becomes high, transistor will conduct and switch on the relay, which turns on the motor.

Similar connections are done for the two 12V solenoid valves. The fusion 360 model of the system is shown in Fig2.

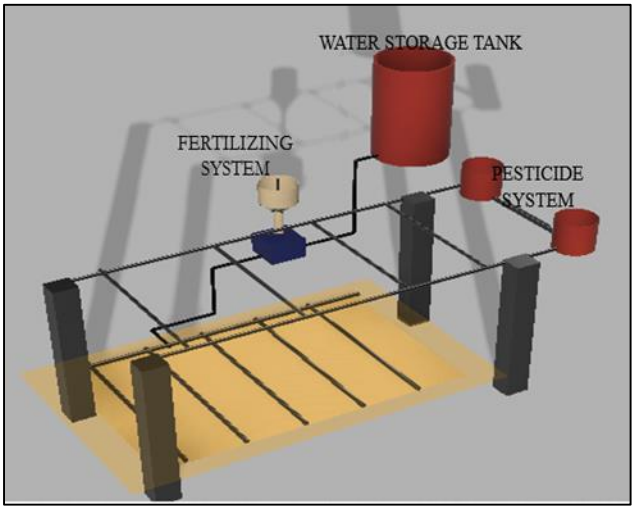

Fig. 2: Fusion 360 model

IV. CONCLUSION

When completed, this project will be a great asset to the agriculture industry. It will make farming easier and less work-intensive so that more people are enticed to start up their own agricultural activities. The automation provided in this project will reduce labour cost and provide an easier way of doing agriculture. The moisture sensing system will help to control the irrigation of the

field, which is essential in this time of water crisis. The IoT-control system will ensure control from places away from the site. Overall, this project will essentially help to promote farming among the current, tech-savvy generation.

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