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Automated system for monitoring micro-climatic conditions for farms

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ABSTRACT

This study proposes an advanced solution for monitoring the weather conditions and adapting new farming techniques for the overall growth of the economy. It has been found that 30% of our country's GDP comes from farming which proves that agriculture is the backbone of our country. Most of the farmers in our country rely on traditional farming however, traditional farming lacks technological advancements and affects our country's economy in several ways. Most of the problems faced by our country's farmers are lack of mechanization, improper irrigation system, and uncertain climate conditions. Also, there is a growing trend of using hazardous chemicals and improper use of fertilizers which has an adverse effect on the ecosystem.

This project aims at providing a solution to the above-mentioned problems by introducing new technologies for monitoring microclimatic conditions which will result in an increased production of crops and maximizing the yield, thereby improving the quality of life of the farmers.

Keywords: *Precision farming, Agriculture technology, automated irrigation.*

1. INTRODUCTION

Precision Farming or precision agriculture is generally defined as an Information and Technology based management system to identify, analyze and manage spatial as well as temporal variability between fields for optimum productivity and profitability, sustainability, and protection of the land resource by minimizing the production costs.
The fundamental concept of precision farming is to collect data and make decisions based on that data. For small farms, this concept existed for many years, but as the size of the farms grew, it became no longer possible to practice precision farming without the use of advanced technologies.

Indian farmers who practice traditional farming face certain problems such as lack of mechanization, improper irrigation system, and uncertain climate conditions. These factors affect the quality of the crop which indirectly affects the production of the yield; as the yield of the farmers is gradually decreasing; this limits their potential.
The issues faced by the Indian farmers who practice traditional farming are:

Lack of mechanization:

This is the most common problem faced by the Indian farmer. Little or no use of machines is made in ploughing, sowing, pruning, and harvesting.

Improper Irrigation:

Although India largely depends on agriculture, still only one-third of the cropped area is under irrigation. This poses an important problem since India is a tropical monsoon country, where rainfall is uncertain and unreliable.

Uncertain climate conditions:

Crops and agriculture produce are worst hit by extreme weather conditions. This element also plays a vital role in improving the quality and production of the yield.

Unethical methods:

There is the use of pesticides and chemical fertilizers which are proven to be hazardous as well as leads to degradation of soil and also poses a health risk to the consumers. Solving these problems would ideally improve the production of yield, increase the quality and enhance the financial condition of our farmers.

2. LITERATURE REVIEW

Precision agriculture is a form of agriculture that has the potential of drastically transforming agriculture in the 21st century.
The idea of Precision agriculture was first presented in 1980's by the United States of America. Most standard ranchers in American Midwest (US) make utilization of this system to amplify benefits by burning through cash just in territories that require composts. This practice helps the farmer to identify specific areas of the field where fertilizer is needed the most. This leads to a reduction in wastage of the fertilizers.

Around the world, Precision agriculture developed at a varying pace. United States, Canada, and Australia were the first to adapt this farming technique. In Europe, the United Kingdom was the first to make utilization of this innovation, took after nearly by France, where it's st showed up in 1997-1998. Argentina was the primary nation in Latin America to have presented this system in the mid-1990's with the help of National Agricultural Technological Institute. Later on, Brazil likewise stablished a state-claimed undertaking, ***Embrapa***, to investigate and create agribusiness.

For any planning activity, a good knowledge of research papers and ideas is needed. The following research papers came as a huge help to understand the concept of precision farming and the different technologies that have been used to date.

TechMahindra: "Research paper on Precision farming and its potential market in India"[#4]

This paper helped us understand the concept of precision farming and its potential market in India.

When it comes to farming, yield productivity and cost of cultivation are as good as the decision, a farmer takes with the given data on the field. Now, what if the farmer gets to see all the data from his field and also gets help to take an informed decision? This is where IOT can help achieve the much-needed boost of productivity in the Indian farmlands.

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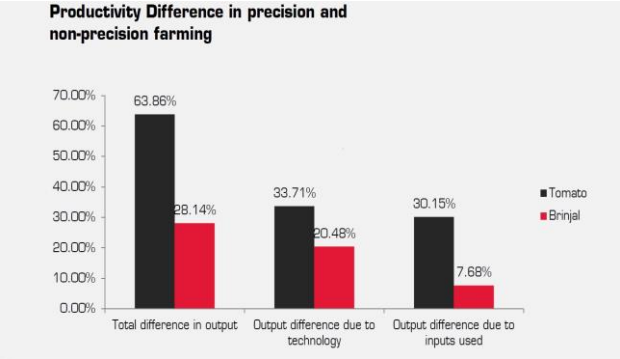

Fig. 2.1 Productivity Difference in Precision Farming

The above fig. 2.1 demonstrates an examination that was embraced to comprehend the effect of accuracy cultivating on asset poor districts and underprivileged ranchers. In particular, the investigation has centered into profitability, salary, work, and selection conduct of innovation in agribusiness. The investigation, led in the Dharmapuri region in Tamil Nadu, India, has gathered information on accuracy and non-exactness cultivating through the meeting plan amid the year 2007. The examination has uncovered that selection of exactness cultivating has prompted 80 for every penny increment in yield in tomato and 34 for each penny in eggplant creation.

Amir Abbas Bakhtiari and Amir Hermitian: "Precision Farming, its opportunities, and difficulties."[#5]

This paper covers the concept and the technologies that have been used in precision farming to date.
The first wave of this agricultural revolution came in the forms of satellite and aerial imagery, weather prediction, variable rate fertilizer application and crop health indicators. Precision agriculture is characterized by a number of sophisticated tools that assist in monitoring variation and managing inputs. These include:

Global Positioning System (GPS):

GPS can be defined as a referencing device capable of identifying sites within a field. It is widely used in the agricultural community and its potential is growing. Without GPS, precision farming would not have existed. As indicated by an investigation, it has been discovered that as far back as the creation of GPS satellites in the 1990's, administrators and makers have found have different approaches to make overseeing field work significantly simpler and precise. For instance, farmers in U.S. and Europe make use of the GPS guided tractor to till straight razor lines and with a GPS connected computer, they barely have to drive. The GPS computer receives signals from Earth-orbiting satellites to keep track of where his tractor is and where it goes. Hoses (a tool

that is used to deliver fertilizers into the field) delivers the correct amounts of seeds and fertilizers into the grooves that the trailer cuts. This whole process is so smooth and accurate. This type of information is mapped and used as a reference to guide farmers to efficiently and economically treat soil problems. With the help of GPS, farmers know the right amount of seeds and fertilizers to be delivered which helps them save money. It also lets them know the most and the least productive areas of the field.

Geographical Information System (GIS):

The GIS was probably the first precision farming tool developed in the 1970's that was used by many research institutions. A GIS integrates hardware, software, and data for capturing analyzing and displaying all forms of geographically referenced information. A GIS is the task of any exactness cultivating activity. It is a spatial information supply from which you can attract request to settle on educated choices in a convenient and productive way. Utilizing a GIS as a data center in any exactness cultivating activity guarantees that the client is appearing to be identical and finish information and knows what is happening and allowed to respond in like manner.

Remote Sensing:

Remote Sensing is a technology of collecting data and information from Earth's surface without actually being involved with it. Remote sensing is basically a collection of data from a distance. Remote sensing works as an early warning system for the grower to intervene & encounter Plant-related diseases. This technology helps the grower avoid an enormous loss.
When the sunshine falls on a plant, some part of it is used for the photosynthesis process whereas the other part is reflected which is read by the sensors mounted on the Earth-orbiting satellites.
This information received from the sensors can be read or misinterpreted, to see if the life of the plant is healthy also helps in evaluating the plant health, estimate yield, assess crop loss, identify crop stress and map a field. Data sensors can simply be hand-held devices, mounted on aircraft or satellite-based. Variety of sensors are available to perform one or more of these tasks.

3. PROPOSED SYSTEM

Our system proposes to make a model that solves the problem of irrigation by monitoring the micro-climatic conditions in farms. We will be using the following components to design and implement our system:

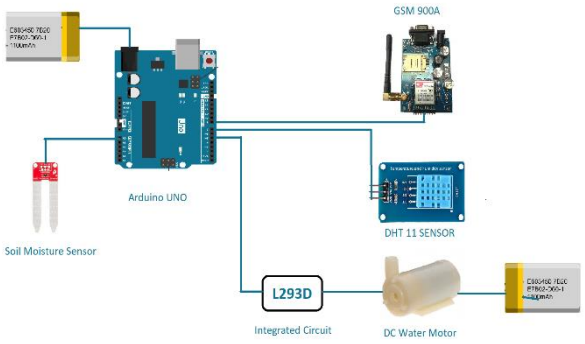

Fig. 3.1 Design of the system

In our system, Arduino is considered as the heart of our system since it is responsible for the main functioning of our system. The other things we will be using are soil moisture sensor, a temp-humidity sensor which is responsible for processing the moisture content of the soil and the temperature and humidity value in the atmosphere. An IC circuit (L293D) which would establish a connection between the Arduino controller and water pump. A water pump for driving water to the plants. A GSM module to notify the user every time water motor is turned on. To connect all the components together, we shall make use of humper pins.

Soil Moisture sensor (model- YL69)[#6]

The soil moisture sensor is responsible for measuring the water content of the soil. The two long conductors separated by a distance are called as electrodes. The two long electrodes measure the conductivity of the soil. The voltage value between the electrodes is the potential drop that changes according to the conductance of the soil.

Temperature Humidity sensor (model- LM35)[#7]

Temperature is the most often-measured environmental quantity. This might be expected since most physical, electronic, chemical, mechanical, and biological systems are affected by temperature. Temperature-Humidity sensors work by detecting changes that alter electrical currents or temperature in the air. There are three basic types of humidity sensors: capacitive, resistive and thermal. All three types of sensors monitor minute changes in the atmosphere in order to calculate the humidity in the air.

Arduino UNO controller[#8]

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button and turn it into an output - activating a motor, turning on an LED, publishing something online.

GSM Module (SIM 900A)[#9]

GSM modem RS232 is built with dual-band GSM engine which works on frequencies 900/1800MHz. The baud rate is configurable from 9600-115200 through AT command. The GSM/GPRS Modem is having internal TCP/IP stack to enable you to connect to internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface.

4. IMPLEMENTATION DETAILS

We will be programming the Arduino using sketch language (an Arduino-specific) language which is a combination of C and Java. In our program, we have assigned values in the loop which would keep on repeating again and again and trigger the motor to turn on only after the Arduino hits a value less than the assigned value. It keeps on monitoring the moisture content and temp-humidity values and only notifies the user when the motor turns on. The notification will be sent via a text message. A SIM card will be inserted into the GSM module which would send a text message to the registered contact number after the release of water. The text message will consist of the current micro-climatic values of the soil. And based on these records, our system will create a graph which the user can refer to whenever he wants to.

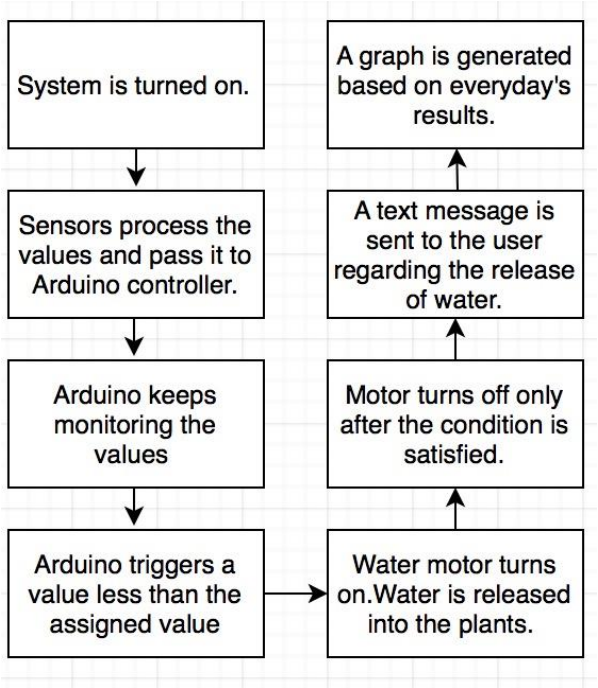

Fig. 4.1 Implementation of the system

5. DATA AND RESULTS

Our automated system aims at enhancing the quality of the crop, increase the rate of production, deteriorate the waste on the field and gradually raise the country's economy. So, to achieve the above-mentioned parameters, it proposes the following results:

- The temperature humidity sensor would help us know the present temperature-humidity level of the environment around the field. If the humidity level in the air is high, the amount of water required would be less whereas the requirement would be more if the humidity level is low.
- The final reduction in operating costs increases the profitability of the farmers.
- The soil-moisture sensor would process and compute the value of the moisture content in the soil. The amount of water required would be more if the soil is dry, and less if the soil is wet. This completely depends on humidity level around the field. If the temperature rises, the soil would get dry and the field will require more water in less time interval and vice versa.

6. PROJECT OUTCOME

a) It allows more efficiency and therefore, profit maximization.
b) It reduces the wastage of the yield, allows the maximum yield with least wastage.
c) Reduces the use of pesticides, and other harmful preservatives.
d) Increases the economy of the country.
e) Improves the quality of life of farmers and aids sustainable development.

7. CONCLUSION

We have proposed an automated system which monitors micro-climatic conditions which will result in the reduction of the rate of loss of production of crops. Our project enables the farmers with even limited resources to adopt the idea of automated systems and increase their yield which in turn will improve their economy and eventually the quality of life.

8. FUTURE WORK

According to a study, it has been found that by 2050 the human race will have to grow 70% more food than we produce today to feed the ever growing population; in this case, automated precision farming would be a very important element.

In future, elements such as motion detector can be added which will aid the farmers by protecting the yield from aerial creatures such as birds, or even rodents. Motion detectors sense movement and release ultrasonic sound waves which result in rodents or birds fleeing from the farms.

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