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Study of Various Sensors Used in Farming

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***Abstract*—The world population is increasing abruptly, and resources are depleting very fast. To feed such a large population, we need innovation, especially in the field of agriculture. Agriculture is the most untouched and demanding field in terms of technology involvement until this time. IoT and sensor network are playing a pivotal role in the development of various applications and sensors for agricultural development. In this paper, we are going to discuss multiple sensors that may have application in agriculture and forestry.**

***Keywords*— Agriculture, IoT, Precision farming, Wireless Sensor Network.**

I. INTRODUCTION

India is a land of farmers. Almost 70% of Indians are living in villages. Agriculture is the backbone of Indian economy. The population in India is rapidly increasing every year, and we will become the most populated country by 2030 in the world. According to the world hunger index, India is holding 103 positions, which is a very alarming position for us. As we are aware of the world population is growing with a rapid rate of 1.05% per year, we are about 9.7 billion by 2050. The quality of land is depleting very fast, which is of great concern. To overcome hunger and to improve the economic position of the farmer and indirectly the economic position of the country, we have to use modern aids for farming. Precision farming or Smart farming is one of the most tossed terms nowadays, with the advancement of technology, especially in the field of IoT and Artificial Intelligence agriculture is also getting new heights. The resources, especially the available land for agriculture is reducing day by day due to the increasing population and growing demand in the market. The fertility of the land is also reducing due to the application of chemical fertilizers and the scarcity of water. The underground water level is falling very fast due to excessive use of water in different overcoming the day to day requirement of water by people, industry and agriculture. With increasing demand and reducing resources, it is required to device a mechanism with the help of technology to fulfill the demand of people with proper utilization of available resources like land and water in a most appropriate manner. IoT and artificial intelligence have to play a vital role to overcome all these issues [1]. IoT is creating a deep impact in our life with its versatile applications like farming, healthcare, transport, power management, manufacturing, etc. IoT, sensors, Drones, Precision farming, farm management software are collectively creating the ecosystem, which is helping the farmer in increasing his production and decreasing his work. IoT is improving the efficiency of the farmer by providing accurate and timely information on soil, crops, and weather [2]. In this paper, we are going to discuss various sensors which can be used in agriculture to meet the demand of the future and also take care of the quality of the soil.

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II. PROBLEM STATEMENT

There are many problems that are faced by the farmers few of them are listed here [3].

A. Dried land or the scarcity of water due to less rainfall.

B. Water logging or filling of water in the field due to flood irrigation, higher rainfall or flood.

C. Application of chemical fertilizers plummeting soil quality.

D. Growth of weeds in the agricultural field

E. Attack of pests on the crops

F. Post-harvest problems

To tackle these problems information technology (IT) and Information Technology Enabled Services

(ITES) can play a vital role. IoT, along with sensors can resolve most of the problems faced by the farmers in and outside the field.

III. SENSORS USED IN FARMING

Smart farming or precision agriculture is a solution for most of the problems faced by farmers. They can get better yield with less- resources such as seeds, fertilizers, water. Sensors can help you to map your field so that you can be aware of about every single inch of soil in your field. Sensors can help you in analyzing the requirement of soil based on the readings taken by the sensors and then actuators can apply the same amount of nutrients or water in the soil. With the advent of the Global Positioning System (GPS) and other sensors, you can easily create the map of the field and can also analyze or predict the production of the crops in the field.

In this section, we are going to discuss various sensors available for agricultural purposes.

1) Location Sensors

These sensors are used to determine the longitude and latitude in the field with an accuracy of around one foot. These sensors use three satellites to calculate the location and equipped with GPS as well [5]. Example NJR NJG1157PCD-TE1, NJG1157PCD-TE1.

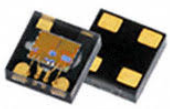

Fig. 1 NJR NJG1157PCD-TE1

2) Optical Sensors

These sensors use light to measure soil properties. These sensors use different frequency light reflectance to calculate the soil and properties such as soil texture, organic matter, the moisture content in the soil. They are also used to analyze the health of a plant based on its leaf [5].

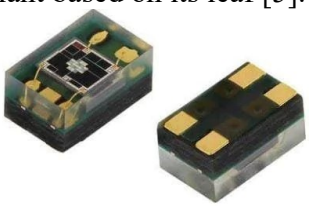

Fig. 2. Vishay Photo IC Sensor

3) Electrochemical Sensors

These sensors are in use for a long time. These sensors identify the chemical properties of soil like pH and other nutrients. The electrodes of these sensors detect the ions present in the soil, and on its basis, it tells us the configuration of soil [6].

4) Mechanical Sensors

These sensors are used to identify the compaction of soil, mechanical resistance of the soil. These sensors can be used to identify the force used by the roots of the plant for absorbing water and can help us in regulating irrigation interventions [7]. An example is Honeywell FSG15N1A.

Fig. 3. Honeywell force sensor

5) Soil Electrical Resistivity Sensors

These are used to measure the change on-resistance of soil due to change in moisture content in the soil. They can also be used to identify the friction angle of soil and the physical characteristics of soil as well [8].

Fig. 4. Decagon 10HS Moisture sensor

6) Airflow Sensors

In this sensor prescribed amount of air is pushed into the soil at defined depth. It is used to measure the soil permeability. This is used to identify various soil parameters like moisture, compaction, the structure of soil etc [9]. Since all the properties create a different signature.

Fig.4 Siemens airflow sensor

7) Agricultural Weather Station

These are the small blocks placed across the field to sense various parameters in the field, it may consist of many sensors like temperature, relative humidity, location, wind speed, solar radiation and many more depends on your requirements [10].

Fig. 5. Meteohelix weather station

8) Yield Monitoring

A yield monitoring system is usually placed on the harvester, which measures the weight of food grain like wheat or corn. They provide the output based on time, distance, and even GPS and the accuracy are up to 30 cm [11].

9) Variable Rate fertilizer

Based on the field map and the output of the optical sensors, these tools can apply the liquid, granular or gaseous fertilizers in the field. They can automatically dispense the required amount of fertilizers based on the GPS map [12].

10) Weed Mapping

This can be performed with the help of image processing equipment placed over some vehicle or drone which takes the image or video of field. This method can also be used to analyze the yield as well. The device is also equipped with GPS, which creates the map of the weeds, which can be manually or automatically picked from the fields [13] [14].

11) Variable Spraying

Once the weed map is prepared, the automated spraying system will spray herbicides, and it can also manage the concentration of herbicides based on the requirements of the field [15].

12) Salinity Mapping

This can be performed with the help of salinity meter. Salinity meter helps us in identifying the change in salinity of field with time [9].

13) Mobile as a tool

A Smartphone can also be used as a tool for the variety of field applications like soil and crop observation by taking pictures of crop and soil, by identifying the color of soil and leafs, pinpointing the location of problems with the help of GPS [16] [17]. Different sensors of the mobile can have different applications few are listed below.

Table I: Mobile Sensors

Sensors	Applications
Camera	It will help in taking pictures of soil, and plant leaves for calculating leaf area index. Picture taken can be sent for further investigation to remote centers.
GPS	Help in pinpointing the location of problems in the field
Accelerometer	It can help us in identifying the leaf angle index and setting up alarm in case of device movement.
Gyroscope	It can help in identifying the movement of devices in the field.

IV. CONCLUSION

IoT based sensors can collect the data of various macro and micronutrients in the soil, based on the soil properties the software will suggest the right quantity of fertilizers appropriate for the specific

soil sample. The soil sensors placed in the field can predict the requirements of water, based on real-time moisture present in the soil. Once the sensors calculate the humidity, the moisture data is sent to the cloud with the help of IoT. Based on moisture content, the system took decision and actuator will automatically start the pump to feed the water in the field, once the desired level of moisture is reached the actuators will automatically switch off the pump. This will avoid the wastage of water and also prevent water logging in the field, which is one of the biggest problems in soil depletion. Weed detection and removal is another problem faced by farmers in the field. IoT based weed detection system automatically detects the weeds in the field and suggest the measure to overcome those weeds. Due to the changing climate and ecological issues, crops face a great problem of pests. The presence of pests in the field can spoil the entire crop. Different crops face a different type of pests; it is very difficult for the farmers to identify the pest and take preventive measure timely. IoT based image processing devices can continuously monitor the field and repot for every disease and pest occurring in the plants; it can also suggest and apply the pesticide in the right quantity to overcome the pest and disease. This will reduce the unwanted application of insecticide and hence reduce the mixing of harmful chemicals in the crops and soil. Post-harvest problems are one of the biggest problems faced by Indian farmers. In India, 40 percent of agriculture produce never came to market due to poor storage and transport infrastructure. IoT based smart warehouses can monitor the quality of products present in the Warehouse and suggest the preventive measure from spoiling it. It can also help farmers to identify the life of food grain present in the Warehouse. Smart transportation facility can also help us in transporting the produce from field to the appropriate marketplace where the farmers can get the right price of their products by eliminating the middlemen from the market by selling the product online or through e-mendies established by the government of India. IoT in farmlands can change the entire scenario and make farmer and nation prosperous.

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