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Application of Sensor Technologies for Improved Precision Farming- A Review

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ABSTRACT

Agriculture is the backbone of our country and economy, which accounts for almost 30 per cent of GDP and employs 70 per cent of the population. Though this is a rosy picture of our agriculture, how long will it meet the growing demands of the ever-increasing population? This is a difficult question to be answered, if we depend only on traditional farming. To meet the forthcoming demand and challenge we have to divert towards new technologies, for revolutionizing our agricultural productivity. In the post-green revolution period agricultural production has become stagnant, and horizontal expansion of cultivable lands became limited due to burgeoning population and industrialization.

Key words: GDP, Precision Agriculture, Sensor technology.

1. INTRODUCTION

Precision Agriculture avails the recent developments in sensors, green-house and protected agriculture structures. This technology can be meaningfully deployed for hot and extremely dry regions where water is scarce, soil is salty, temperature is high and rainfall low. It is also certain that even in developing countries, availability of labor for agricultural activities is going to be in short supply in future [1-3]. The time has now arrived to exploit all the modern tools available by bringing information technology and agricultural science together for improved economic and environmentally sustainable crop production. Precision Agriculture is an integrated crop management system that attempts to match the kind and amount of inputs with the actual crop needs for small areas within a farm field. This goal is not new, but new technologies now available allow the concept of Precision Agriculture to be realized in a practical production setting. Precision Agriculture avails the recent developments in sensors, green-house and protected agriculture structures [4-5]. This technology can be meaningfully deployed for hot and extremely dry regions where water is scarce, soil is salty, temperature is high and rainfall low. It is also certain that even in developing countries, availability of labor for agricultural activities is going to be in short supply in future. The time has now arrived to exploit all the modern tools available by bringing information technology and agricultural science together for improved economic and environmentally sustainable crop production. Precision Agriculture is an integrated crop management system that attempts to match the kind and amount of inputs with the actual crop needs for small areas within a farm field. This goal is not new, but new technologies now available allow the concept of Precision Agriculture to be realized in a practical production setting.

2. HISTORY OF PRECISION AGRICULTURE

The concept of precision agriculture first emerged in the United States in the early 1980s. In 1985, researchers at the University of Minnesota varied lime inputs in crop fields. It was also at this time that the practice of grid sampling appeared (applying a fixed grid of one sample per hectare). Towards the end of the 1980s, this technique was used to

derive the first input recommendation maps for fertilizers and pH corrections. The use of yield sensors developed from new technologies, combined with the advent of GPS receivers, has been gaining ground ever since. Today, such systems cover several million hectares [6-7].

In the American Midwest (US), it is associated not with sustainable agriculture but with mainstream farmers who are trying to maximize profits by spending money only in areas that require fertilizer. This practice allows the farmer to vary the rate of fertilizer across the field according to the need identified by GPS guided Grid or Zone Sampling. Fertilizer that would have been spread in areas that don't need it can be placed in areas that do, thereby optimizing its use.

3. THE NEED FOR PRECISION AGRICULTURE

The potential of precision farming for economical and environmental benefits could be visualized through reduced use of water, fertilizers, herbicides and pesticides besides the farm equipments. Instead of managing an entire field based upon some hypothetical average condition, which may not exist anywhere in the field, a precision farming approach recognizes site-specific differences within fields and adjusts management actions accordingly. Precision Agriculture offers the potential to automate and simplify the collection and analysis of information. It allows management decisions to be made and quickly implemented on small areas within larger fields.

Precision agriculture advantages for farmers

- Make record of their farm;
- Improve decision-making
- Greater traceability
- Improves marketing of farm products
- improve lease arrangements and relationship with landlord

Components of Precision Agriculture

1. **Information:**
2. **Global Positioning System**
3. **Yield Monitor Data**
4. **Yield Maps**
5. **Soil Sampling**

4. APPLICATION OF SENSORS

Sensors captures, analyzes and transmits the information like temperature, humidity, pressure, water content etc. using radio signals. Sensors collect the information and send it to the base station. Base station then analyses the data and carries it for further processing. Usually sensor networks have a base station known as sink and number of other sensors too, which sense and transmit the signals along with sending information to other nodes. . A path between sink and source is being established to send the data to the base station. On the occurrence of any event the data is transmitted or it could be done periodically as well [8-9].

4.1 Wireless Sensor Networks WSN

WSN is the ad-hoc wireless network which has nodes that have the sensing capability. The subset of nodes which consists of moving data over multiple hops collects and processes the distributed sensed data [10].

Wireless Sensor Networks (WSNs) consist of multiple unassisted embedded devices (nodes) which process and transmit data collected from different on-board physical sensors (temperature, humidity, pressure, etc

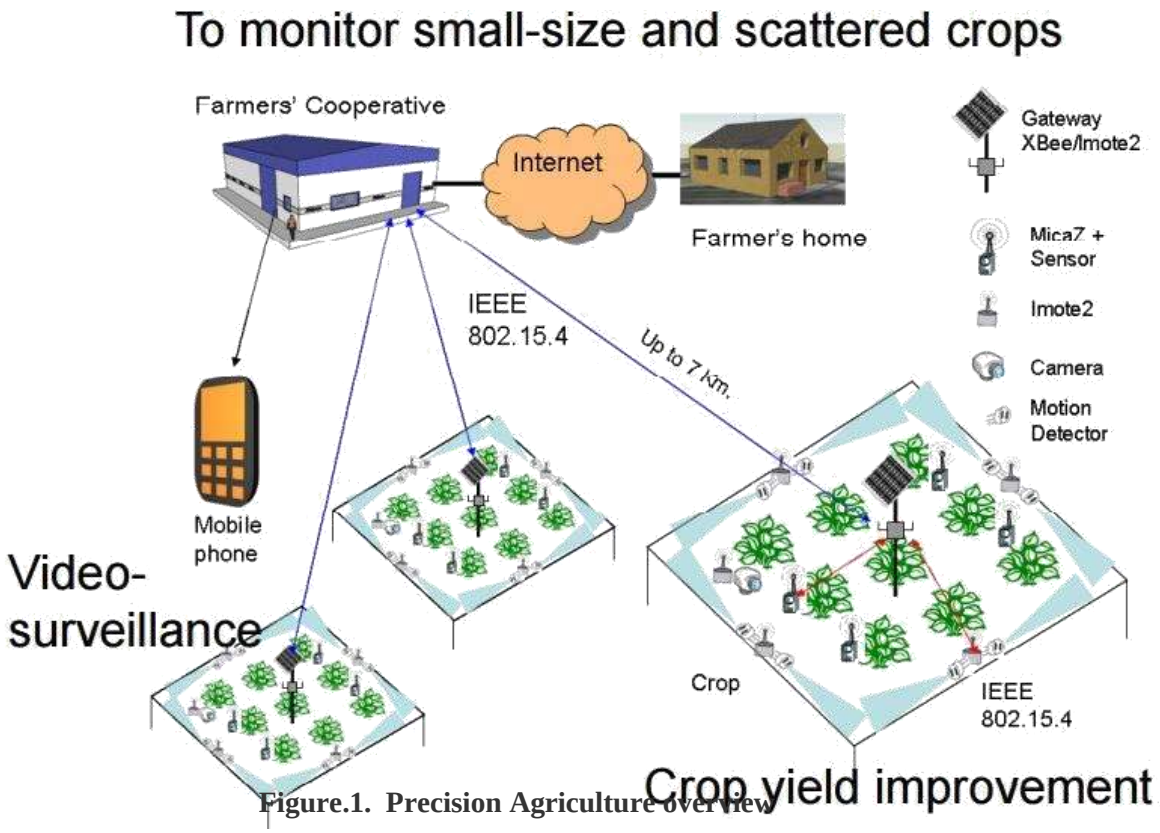

Figure.1. Precision Agriculture overview

4.2 System Architecture

The proposed hardware of this system includes 8 bit AVR, Blue tooth module, Temperature, humidity and soil moisture sensors, LCD. The system is low cost & low power consuming so that anybody can afford it. The data monitored is collected at the server. It can be used in precision farming.The system should be designed in such a way that even illiterate villagers can operate it. They themselves can check different parameters of the soil like salinity, acidity, moisture etc. from time to time. During irrigation period they have to monitor their distant pump house throughout the night as the electricity supply is not consistent. The system can be installed at the pump house located remotely from the village, it is interfaced with the pump starter & sensors are plugged at different location in the field for data acquisition. Using this system they can switch on their pump from their home whenever they want.

4.3 Temperature Sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. It is low cost and small size sensor. Its temperature range is -55° to +150°C.

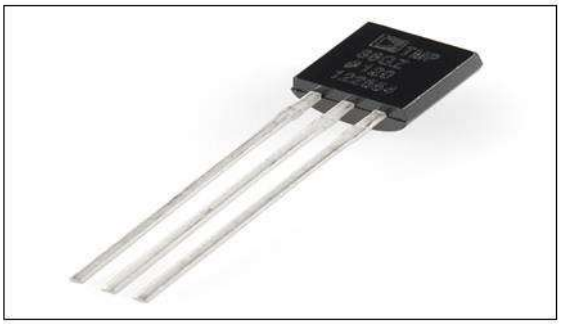

Figure. Temperature sensor

4.4 Humidity sensor

Humidity measurement instruments usually rely on measurements of some other quantity such as temperature, pressure, mass or a mechanical or electrical change in a substance as moisture is absorbed. By calibration and calculation, these measured quantities can lead to a Measurement of humidity

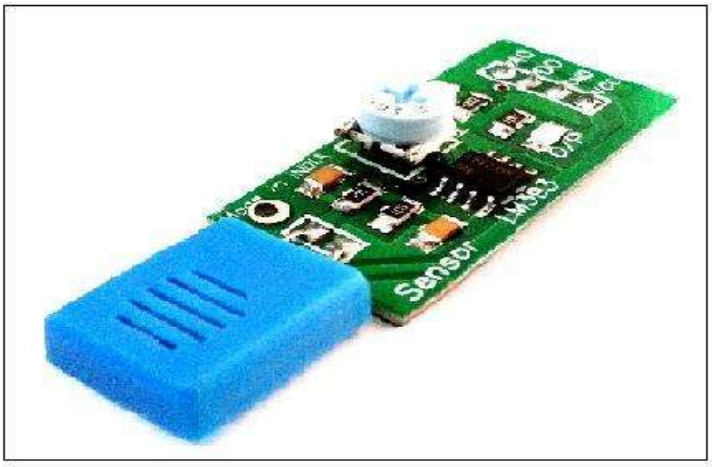

Figure.2. Humidity Sensor

4.4 Soil Moisture Sensor

The soil moisture sensor used is capacitive type. The sensor gives analog output of zero volt when there is 100% moisture and 5V for 0% moisture

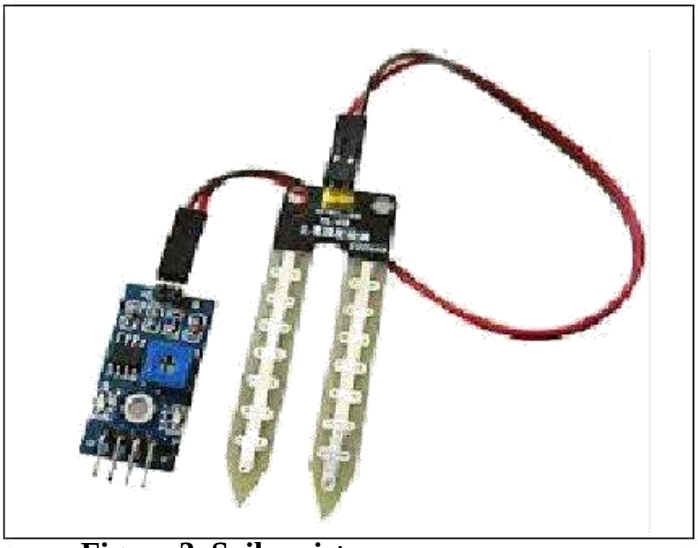

Figure 3. Soil moisture sensor

5. CONCLUSIONS

Precision Agriculture gives farmers the ability to use crop inputs more effectively including fertilizers, pesticides, and tillage and irrigation water. More effective use of inputs means greater crop yield and/or quality, without polluting the environment. However, it has proven difficult to determine the cost benefits of Precision Agriculture management.

At present, many of the technologies used are in their infancy, and pricing of equipment and services is hard to pin down. This can make our current economic statements about a particular technology dated. Precision Agriculture can address both economic and environmental issues that surround production agriculture today. Questions remain about cost-effectiveness and the most effective ways to use the technological tools we now have, but the concept of "doing the right thing in the right place at the right time" has a strong intuitive appeal. Ultimately, the success of Precision Agriculture depends largely on how well and how quickly the knowledge needed to guide the new technologies can be found.

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