A Review: Development of Smart Agriculture Using IOT, Agriculture Robots and Wireless Sensory Network

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Concerns about food security have skyrocketed in recent years. As agriculture is the backbone of India and about 70 percent of the people in our country depend on agriculture and agricultural production must increase rapidly to meet the food needs of people around the world. Agricultural challenges need to be addressed by adopting new approaches to improve soil capacity and the protection of natural resources. Therefore, the internet of things will bring unimaginable benefits to help people to live smarter and more comfortable lives. In this paper, the utilization of IOT in farming and agricultural sector has been investigated and analyzed with functional agricultural robots relying solely on the development of agricultural robots in operation, which includes reliable interaction (HRI) between robots and agricultural workers, as well as on existing infrastructure and also Wireless sensory networks (WSNs) can be used in agriculture to provide farmers with a large amount of information. A number of sensory technologies are used in precise agriculture, providing data that helps farmers to monitor and prepare crops that measure temperature, soil moisture, and location-based humidity.

Keywords: Sensor technology, IOT, Agricultural Robots, WSN.

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1. Introduction

Smart farming is not just about bringing technological know-how to agriculture, but rather about creating and using information technology. Sensor is used to measure location, such as pressure, temperature, or acceleration, and response. Sensor allows farmers to increase yields using smaller resources such as water, fertilizer, and seeds. By sending sensors and map fields, farmers can begin to understand their crops on a smaller scale, conserve resources, and minimize environmental impacts. The ITU (Worldwide Media transmission Union) depicted the IOT. "IOT is an innovation that fundamentally bargains with the interaction between individual and thing, question to protest, and individual to person." Around19.5Million square miles (39.47% of the worlds arrive) was recorded for nourishment generation in 1991, which was decreased to around 18.6 million square miles (37.73% of the worlds arrive zone) in 2013. Still Agricultural robots are exceptionally productive, and are distant from being utilized in any major rural activities. So this paper is being structured as follows: in section II; the application and types of sensors in presented. Section III; Shows the comparison of structural framework for IOT-base farming systems. Section IV; Shows the Robotics design and Challenges of Implementing Agriculture Robots. Section V; WSN and its architecture. Section VI; Proposes the conclusion.

2. The Application and Types of Sensors

In smart agriculture, sensors nodes that measure different body numbers can be automatically programmed to form a sensory network. In the planting industry, temperature and humidity sensors can be used to determine the temperature and humidity of air and soil, the pH value of the soil can be determined by the pH probe, the concentration of carbon dioxide can be obtained through gas, and a visual value similar to sunlight can be obtained using a light sensor. The application of sensor in smart agriculture is shown in Fig.1

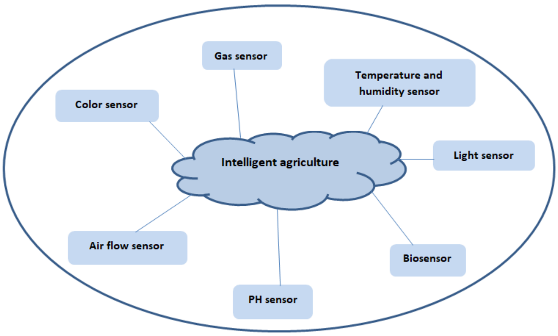

Fig. 1. The application of sensor in smart agriculture

A number of sensory technologies are used in precise agriculture, that helps farmers to monitor and prepare crops like –

(a) Location Sensors

Local Sensors use signals from GPS satellites to determine latitude, longitude, and altitude between feet. Location sensor as shown in fig.2

Fig.2. Location Sensor

(b) Optical Sensors

It uses light to measure ground structures, and various light waves. These sensors are mounted on vehicles or drones, allowing the appearance of soil and plant color data to be collected and processed. The optic nerve can detect clay, organic matter, and soil moisture.

(c) Electrochemical Sensors

It helps to collect soil chemical data. Electrochemical sensors provide sensory information to detect soil elements. Soil samples were sent to a soil testing laboratory. Specific measurements, especially pH determination, were performed using a selected ion electrode. These electrodes sense the activity of certain ions, such as nitrate, potassium, or hydrogen. Electrochemical sensors as shown in fig.3

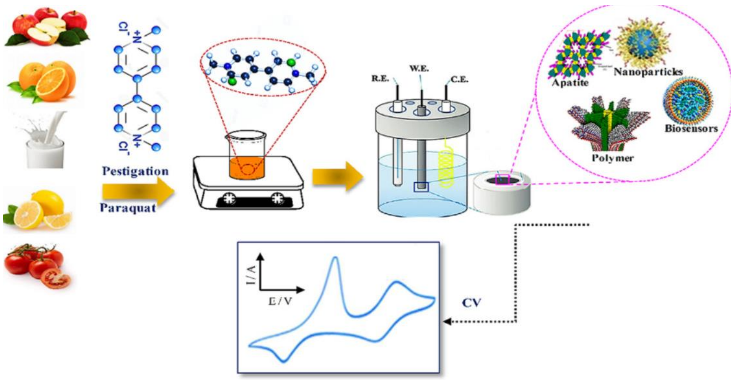

Fig.3. Electrochemical Sensors

(d) Dielectric Soil Moisture Sensors

Earth's Moisture Dielectric Soil Moisture Sensors measure moisture levels by measuring the dielectric constant (the area of electricity that changes depending on the amount of moisture present) in the ground. Information such as air temperature, soil temperature at various depths, rainfall, leaf moisture, chlorophyll, wind speed, dew temperature, air temperature, moderate humidity, sunlight, and atmospheric pressure are measured and recorded at predetermined times. Dielectric soil moisture sensors as shown in fig.4

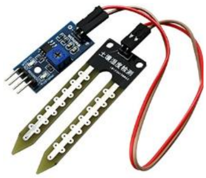

Fig.4. Dielectric soil moisture sensors

(e)Mechanical Soil Sensors

These sensors use a ground-breaking mechanism and record energy measured by pressure scales or load cells. When the sensor crosses the ground, it records the gripping force caused by cutting, breaking, and moving the soil. The ground machine resistance is measured by the compression unit and represents the amount of force required to penetrate the soil in the front of the ground-bound tool.

(f) Airflow Sensors

Air flow sensor is a tool that allows you to measure air flow rate. This means that the air flow sensor measures the wind speed. Above speed, the air flow sensor has the ability to measure air pressure. Some air flow sensors can even detect the direction of the wind. Airflow Sensors as shown in fig.5

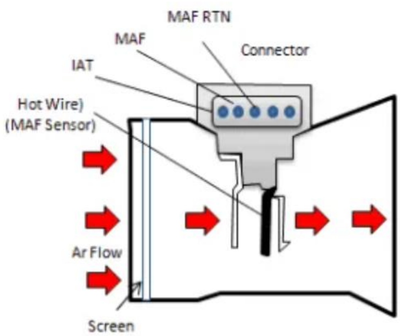

Fig.5. Airflow Sensors

3. Comparison of Structural Framework for IOT Based Farming System

Internet of things communication technology is primarily used in the production and circulation of farming commodities in intelligent agriculture. Communication technology is an important link in the Internet of Things industry. It plays a role in making sensors and other products in the sensor layer and docking with terminal products in the application layer. Each communication mode has its advantages and disadvantages. The application of sensor in intelligent agriculture is shown Fig.6

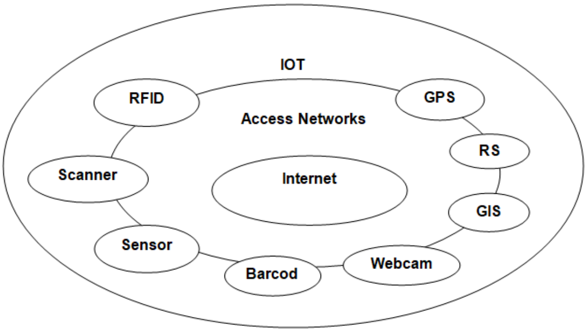

Fig.6 The application of sensor in intelligent agriculture

Technologies Used	**Advantages**	**Disadvantages**
Microcontroller: CC3200 Chip, MCU Communication Technology: MMS, Wi- Fi Module Sensors: Camera, temperature sensor, Moisture Sensor Microcontroller: RPi	- Sending information abouthumidity as well temperature in the air of the stadium tofarmer - Uses MMS technology to send photographs	- MMS adds additional costs - No default support system
Cloud Server: Google Cloud Sensors: Temperature sensor, soil Moisture sensor	-Water supply is regulated based on historical data	- Data transfer adjustment isnot availablementioned - No intelligent support system
Microcontroller: Arduino Cloud Server: Web server Communication Technology: Wi-Fi module Sensors: Moisture Sensor	- Reduced damage to water andwork - Threshold value is set to controlthe wateradd	- Data transfer adjustment is not available mentioned - No intelligent support system
Microcontroller: Arduino Cloud Server: ThingSpeak Communication Technology: Wi-Fi Module Sensors: Temperature sensor, soil Moisture Sensor	- Live monitoring center	-Manage yourself
Minor control: MSP4305419A Cloud Based WSAN, Communication Technology: ZigBee, GPRS Sensors: Soil Moisture Sensor	- Measure moisture - Weather - Irrigation based on set limit number	- No default support system
Mini controller: STM32L152RE Communication Technology: Bluetooth Sensors: pH sensor, Temperature	- Internal system - Provides sensory information on user-on-user phone with Bluetooth	- Lack of default resolution support system

Senor, Moisture Sensor		
Minor control: MCP3008 Communication Technology: Wi-Fi Sensors: pH sensor, Temperature Senor, Moisture Sensor	- Suggestion center about watering and pregnancy	- No default support system
Microcontroller: Node MCU V3 Cloud Server: ThingSpeak Communication Technology: Wi-Fi Sensors: Moisture of soil moisture, Humidity Sensor, LM35Temperature Sensor, Water Level Sensor	- Real-time access to sensors data via thingsSpeak	- Lack of default resolution support system
Microcontroller: Wi-Fi microcontroller Cloud Server: AWS Sensors: Temperature Sensor, Moisture Sensor, moisture sensor, CO2 sensor, Light sensor	- Control of heat sinks supported doors / windows soil moisture previously described number	- No intelligent support system
Mini controller: ESP8266 NodeMCU Communication Technology: MQTT Protocol Sensors: Soil Moisture Senor, Temperature sensor, humidity sensor, Ultrasonic Sensor	- Controlling actions of car pump (ON / OFF) based on the limit number - MQTT Protocol	- No default support system
Mini controller: ATMEGA328P Cloud Server: Adafruit Server Communication Technology: Wi-Fi Sensors: Soil Moisture Sensor	- Controlling actions of car pump (ON / OFF) based on the limit number	- No sprinkles - No clever drain - No default support system
Microcontroller: Arduino Sensors: Temperature Sensor, Moisture Sensor, Soil Moisture Sensor	- Data about sensors stored on server and user You can watch through the GUI app	- Making decisions depends on the user or a farmer - No default support system
Microcontroller: Arduino Cloud Server: Web server Communication Technology: WiFi / 3G / 4G, GSM capability Sensors: Temperature Sensor, Moisture Sensor, Moisture Sensor, Movement Sensor	- Give the center to set planning irrigation according to the period through android app - Warning notification place	- Personal control - Lack of automatic support system
Microcontroller: AVR Communication Technologies: ZigBee Sensors: Ultrasonic Obstacle Sensor, Motion detector, Light Sensor, humidity Sensor, Temperature Sensor	- Remote control of the robot system - The program has a manual as well default mode - Automatic control supported at threshold value	- No default support system

Minor control: R Pi 2 Model B Communication Technology: ZigBee, Wi-Fi module Sensors: Moisture Sensor, Obstacle Sensor, pH sensor, CO_2 sensor, ground Moisture sensor, ThermoHygro Sensor, UV sensor, PIR sensor	- Control of mobile robots spraying of pesticides - Switch ON / OFF the motor and scaring the criminal	- No default support system
Minor control: PIC16877A Communication Technology: Wi-Fi, GSM model Sensors: Temperature Sensor, Moisture Sensor, PIR Sensor	- Remote-based GPS caution - The program has a manual as well default mode - Automatic control supported at threshold value	- Lack of automated decision support system

4. Robotics Design and Challenges of Implementing Agriculture Robots

With increased interest in Agricultural Robots, global spending increased from $ 817 million in 2013 to more than $16 billion by 2020. Agricultural robots, operating outside and in harsh environments, create a unique set of engineering and technological challenges. We usually divide testing of Robots into four categories: cultivating, harvesting, planting seeds, and irrigating crops. Few challenges are shown in Fig.7

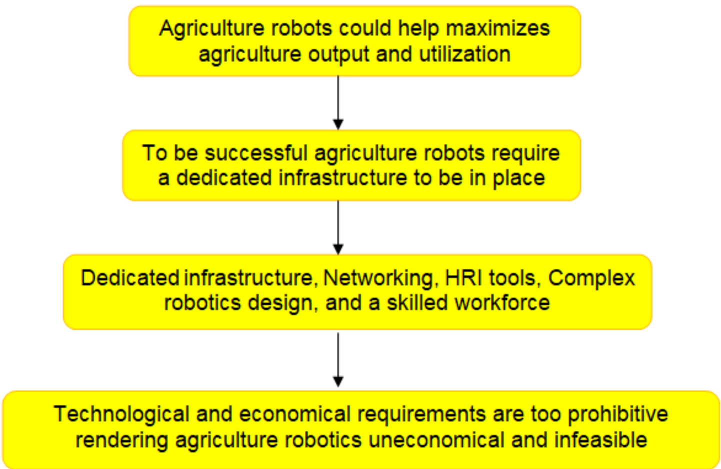

Fig.7 the Challenge of Implementing Agriculture Robots

CHALLENGES OF MAKING AGRICULTURE ROBOTS: Robots requires the development and implementation of the following:

a) Installation of agricultural equipment.

b) Installation of a wireless connection for short and long-distance.

c) Developing software for agricultural robots.

d) Uses of practical HRI devices.

e) Allowing software reuse and reliability.

As it turns out, apart from the construction of robots and technology, functional agricultural robots that needs to be configured, such as established communication, active HRI, and reuse of software. Collectively, let us address these issues as an Infrastructure Support for agricultural robots. This explains why agricultural robots today are constantly being tested and far from working.

5. WSN and Its Architecture

Wireless sensor network (WSN) is one of the most significant technologies of the 21st century. In recent years, low sensitivity technology and low power output have made WSN a reality in operating systems. Wireless sensor network covers soil moisture, humidity, temperature, etc. These sensors are used for a variety of real-time activities and perform tasks like data storage, collection, monitoring, and route between base channel and nodes. The sensor node is multi- functional and is a power-saving wireless device. The 5g network has the highest speed in terms of terms for GB and also provides higher bandwidth and improved quality spread.

WSN structures are based on the concept of OSI model. The model consists of five layers and three cross layers. The five categories of buildings are application, transport, network, data link, physical and cross layers are mobility management, task management, and power management. The sensor combines to do their job and improve their own overall efficiency. The architecture consists of five layers shown in Fig.8

Application Layer
Transport Layer
Network Layer
Data link Layer
Physical Layer

Fig.8: Architecture of wireless sensor network

a) Application Layer

This layer is responsible for traffic management and assists software for various applications that convert data in a useful way that can provide the required information. The purpose of the application layer is to abstract the physical topology of the wireless sensor network (WSN) for the applications. Besides, the application layer provides necessary interfaces to the user to interact with the physical world through the WSN. The application layer solutions in three categories: source coding (data compression), query processing, and network management.

b) Transport Layer

In this layer many protocols have been developed that can be used up or down the river (i.e., immersion ex: STCP, ESRT, and DSTN) for mono cast transfers and TCP or UDP traffic or downstream (i.e., submerged user, ex: PSFQ) is used for multicast transmission and UDP traffic due to limited memory.

c) Network Layer

The most challenging wireless function the sensory networks that carry the route of this layer .The protocols in this layer are subdivided into a flat or hierarchical or continuous route can be broken in Time driven, In-question query, or In-event event. In the event of a failure in node, unwanted nodes are used to ensure reliability. The data was then processed by merging the data and data consolidation. Data consolidation is used in a low-lying area route and its function to compile data from multiple sources nodes hear data into relevant information once remove inactivity that occurred during collection. Data fusion to process aggregated data as reduction audio from integrated data.

d) Data Link Layer

The data link layer is accountable for multiplexing data streams, data frame detection, medium access, and omission control. It ensures precise point-to-point and point-to-multipoint connections in a transmission network. The main function of data link layer is to move data from nodes to the visible layer.

e) Physical Layer

The main concern of the physical layer is modulation and demodulation of digital data, i.e. transmission and reception of the data. This is complete by the transceivers in the sensor nodes. The main function of physical layer is carrier frequency selection and generation and reception of data.

6. Conclusion

In this paper, intelligent agriculture using IOT, agricultural robots and wireless sensory networks are reviewed and brief analysis, benefits, and development suggestions are presented. Agricultural problems associated with accurate and automatic irrigation, fertilization to increase yields to meet food challenges in the world's growing population with declining arable land and thus reducing human intervention and labor are major challenges that farmers face in underdeveloped areas. In short, IOT-wise agriculture, agricultural robots and the wireless sensor network have been fully utilized to address food challenges in the world's growing population with declining arable land and thus reducing human intervention. Farms are now able to benefit as well, using tools built on smart phones, smart apps, and small-sized machines. By sending sensors and map fields, farmers can begin to understand their crops on a small scale, conserve resources, and minimize environmental impacts.

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