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A Survey on Innovative Smart IoT Applications trending in Agriculture

[1]**R.P.Shyni Vinse[1]**, *AP, Department of IT, Bethlahem Institute of Engineering, Karungal.*
[2]**B.Mary Nathisiya[2]**, *AP, Department of CSE,HKBK College of Engineering, Bangalore.*

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Abstract:- The idea of embedded internet was coined a term "Internet of Things "by Kevin Ashton in 1999. From then on, IOT has shown its prominence in various studies not only in industries but also in agriculture. A Smart farming is the application of IOT, i.e., making use of various devices interconnected to each other. IoT are applicable in different perspectives of agriculture. Few applications of IoT in agriculture includes precision farming, Smart Water, Agricultural drones, Livestock monitoring, smart greenhouses etc. 'Internet of Things' is based on device which is capable of analysing the sensed information and then transmitting it to the user. In this paper we have discussed about the different types of IOT used in recent years in the field of agriculture and a comparative analysis of those methods are also summed up.

I. Introduction

In many countries like India, majority of the population depends on farming, and its national income comes from farming. In spite of this and even the modern technology is found everywhere, the agriculture area is following the old conventional technology. Our farmers still resort to traditional methods like manual distribution of seeds and ploughing, two crops per year pattern, unscientific systems of cultivation. The monsoons are irregular, and unevenness of availability of water throughout the year poses a major problem. All this leads to inadequate yield and low productivity. The implementation of scientific methods in the field of agriculture can bring about radical changes in the productivity of crops, due to improved efficiency in the farming techniques.

Of the various advantages that IoT brings to the table, its ability to innovate the current scenario of farming methods is absolutely ground-breaking. Mostly, we come across ideas that suggest a wireless sensor network that collects data from the various sensors present in the field and sends the data to the main central server. This method focuses on studying the environmental factors to improve crop yield. But it turns out, monitoring environmental factors alone are never adequate to increase productivity of crops since a lot of other factors have a role to play. This may include spraying of insecticides and pesticides to prevent invasion of pests and insects, monitoring the fields at all times to stay aware of attacks by animals and birds, and thefts of crops during the stages of harvesting.

We need to implement an integrated system that will ensure increased levels of productivity, and crop monitoring at all stages of cultivation and harvesting.

II. Related Work

Smart GPS based remote controlled vehicle

The system is aimed to have two different sections or blocks, and a central computer or mobile application to control and monitor the entire system. Each of these blocks/nodes comprises of different sensors and devices and they are further connected to one central server via wireless Zigbee modules[3]. The central device sends and receives information from user end using internet connectivity. The system operates mainly on two modes, namely: automatic mode and manual mode. In the automatic mode, the system takes its own decisions while controlling the various devices, while in manual mode, the user can himself operate the system with the help of a mobile app or PC commands.

Figure 1: Interconnection between blocks and main server

A. Block 1

Block 1 is a GPS based vehicle which can be controlled remotely using central PC in the manual mode as well as it can be programmed so that it can navigate autonomously within the boundary of the entire field using the coordinates given by GPS module[4]. The remote controlled vehicle will have various sensors and devices like obstacle sensor, soil moisture sensor, cutter, sprayer and using them it will perform tasks like spraying fertilizers and pesticides, scaring birds and animals, detecting thefts, monitoring, etc. The soil moisture sensor collects data from each individual field, and this in turn is sent to the microcontroller[5] of block 2, which then operates the water pump ON/OFF

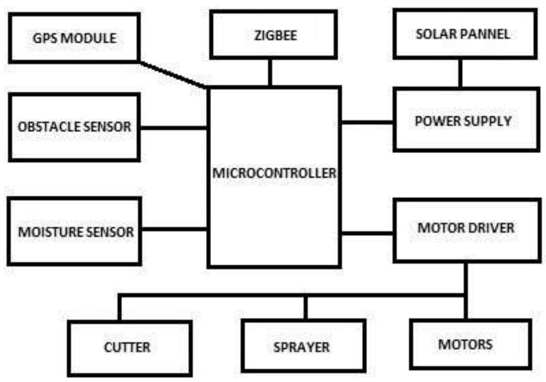

FIGURE 2 : GPS BASED VEHICLE

B. Block 2

Block 2 will be the warehouse. It comprises of the AVR[1] microcontroller in the centre, connected to the various sensors like temperature sensor, humidity sensor, motion detection sensor(obstacle sensor), and depending on data received through the sensors, the heater, cooling fan, alarm and bulb will be switched ON/OFF. Motion detector will detect motion in the room when security mode will be ON.

C. Smart Ware House

Temperature and humidity sensors sense the temperature and humidity respectively and if the value crosses, the threshold then room heater or cooling fan will be switched ON/OFF automatically providing temperature and humidity maintenance. This block will also controls water pump depending upon the soil moisture data sent by block .Temperature Sensor[6] is mainly used inside the warehouse, and connected to the microcontroller. It detects temperature inside the warehouse, which can then be modified by switching the heater ON/OFF. Humidity sensor is used in the warehouse to detect the humidity inside. Accordingly, the cooling fan is switched ON/OFF.

The soil moisture sensor is used to sense the moisture in the soil of the field and transfer it to microcontroller of block 2 in order to take controlling action of switching water pump ON/OFF. We use an Ultra-Sonic obstacle sensor for obstacle detection in case of the remote controlled vehicle and as for theft detection in the warehouse. The AVR Microcontroller At mega 16/32, one in the warehouse and the other in the vehicle are connected to the sensors and other devices, to monitor and control them. ZigBee[3] is used for wireless communication between the two blocks: remote controlled vehicle and warehouse.

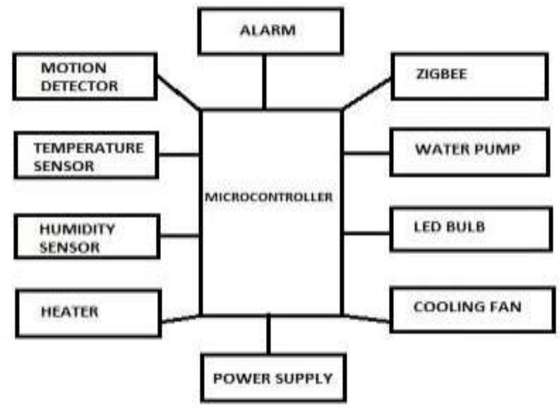

FIGURE 3 : SMART WAREHOUSE

Soil Moisture Sensor:

Soil moisture is one of the most important factors for plant growth. Plants behave differently at different levels of soil water content. If the soil is dry, plants feel stressed and the adverse effects of stress are reflected in their growth. Stress also makes them vulnerable to diseases and pests. The irrigation process can be optimized to precisely meet the demands of the crop by observing the moisture level. Listed in descending order of cost and accuracy, the Time domain reflectometry (TDR)[7], frequency domain reflectometry (FDR)[7], tensiometry, capacitance and resistance based methods are some of the popular methods used to measure soil water content. TDR sensors give most accurate results but are bulky and expensive. The resistance based technique is the cheapest method to measure soil moisture but, it offers poor accuracy and lifetime.

The in-house designed sensor has a probe structure like an Inter-digital Transducer (IDT)[2]. It is a comb-like structure whose two electrodes form a capacitor. The electrodes of the transducer represent the plates of a capacitor, which are coplanar to each other allowing the electric field to fringe out of the transducer. This electric field then interacts with the measurand altering the dielectric in between the electrodes thereby altering the capacitance. The dielectric permittivity of air is about ~1, and that of soil is anywhere between 3–12, which is small compared to dielectric permittivity of water which is about ~80. This huge difference is exploited by capacitancebased sensors to measure soil moisture. The probe is manufactured using standard PCB fabrication technology making it very cheap to mass-produce (Fig. 3. The probe's capacitance modulates the frequency of a square wave generator, which is measured by a high-speed timer circuit within a microcontroller. The frequency is then calibrated to soil moisture using gravimetric soil moisture measurement technique.

CC3200

Fig1 shows the block diagram of proposed system model

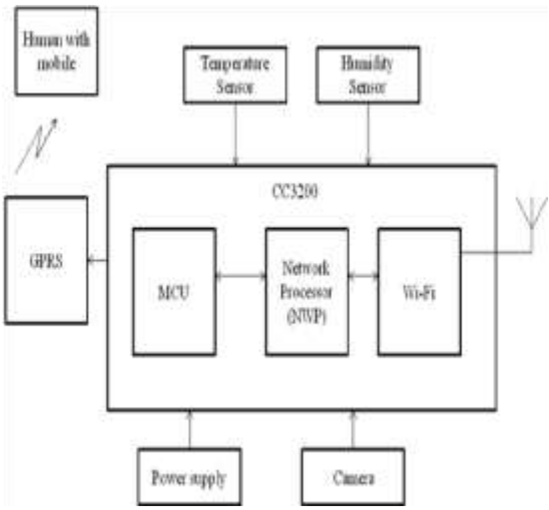

Fig1: Block diagram of proposed system

CC3200 is the main block of this proposed system consists of microcontroller, network processor and Wi-Fi unit on same die. It is portable, low power for battery-operated, secure and fast connection. Environmental conditions variations will affect the overall yield of the crop. Plants require proper very specific conditions for optimal growth and health. Monitoring the condition of crop field is very much necessary so sensors are used. Temperature infrared thermopile sensor- TMP007 is used, it has built in digital control and math engine. It senses the temperature values in real time and humidity sensor- HDC1010 track the relative moisture of air within the farming field. Camera is interfaced with CC3200 camera booster pack via PCB using MT9D111 camera sensor. This is used to capture current images of the particular field those images are sent to the farmer through GPRS.

Conclusion:

IOT based smart agriculture system can prove to be very helpful for farmers since over as well as less irrigation is not good for agriculture. It is really challenging task that needs to provide such knowledge because of highly localized nature of agriculture information specifically distinct conditions. This paper summarizes the different IOT based technologies that are available in recent years. This technologies will emerge growth again in few years to spectacular results. It can be achieved through complete real-time and historical environment information expecting to help to achieve efficient management and utilization of resources.

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