

Next Generation Innovations In Agriculture: The Role of Technology In Sustainable Economic Development

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ABSTRACT:

Agriculture plays an important role in Indian economic development. 60.5% of the Indian population depends on agriculture. One third of the nation's income from agriculture. Issues concerning agriculture have hindered the development of the country. The solution to this is to make agriculture smart using IoT technologies. Thus adopting modern techniques will increase the yield and solves many issues that arise from traditional farming. In this proposed system, it uses smart GPS based remote controlled robot to perform tasks like weeding, spraying, moisture sensing, bird and animal scaring, attack from insects and pests, thefts of crops etc. These operations are performed and controlled by devices such as sensors, Wi-Fi, camera, actuators with micro-controller and raspberry pi system.

The object of this paper is to provide solutions to the various issues those arise during farming. The outcome of the designed system improves the yield of the crops, overall production and thus increases the overall economic development of the country.

Keywords: agriculture, techniques, farming.

I. INTRODUCTION

Agriculture is the main basis for the human being as it is the main source of food grains and other raw material. It plays a vital role in the growth of any country's economy. It provides employment opportunities to the people. Agricultural sector growth is important for the development of the economic of the country. Unfortunately, many farmers still use the traditional methods of farming which results in low yielding of crops, vegetables and fruits. But the automation in this area has yielded good result in the yield of crops . Hence there is a need to implement modern science and technology in the agriculture sector for increasing the yield. Monitoring environmental factors is not only the factor to improve the yield of the crops. There are number of factors that affect the productivity to great extent. These factors include attack of insects and pests.. Attack of wild animals and birds when the crop grows up. So, in order to provide solutions to all such problems, it is necessary to develop integrated system that will take care of the factors affecting the productivity in every stages like; cultivation, harvesting etc. The main objective of this paper is to make agriculture smart using automation and IoT technologies. The weeding ,spraying, moisture sensing ,bird and animal scaring tasks are performed by smart GPS

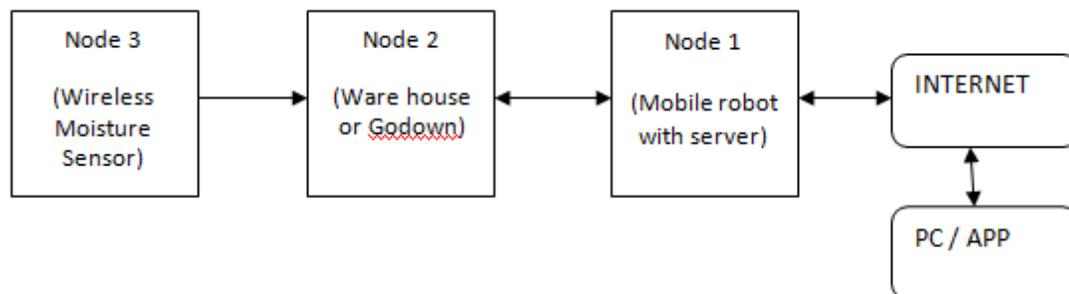
based remote controlled robot. Controlling of these operations is done through a remote device or computer connected to Internet and the operations will be performed by interfacing sensors, Wi-Fi or ZigBee modules, camera and actuators with micro-controller and the raspberry pi computer.

II. LITERATURE REVIEW

The present day scenario of decreasing water tables, drying up of rivers and tanks, unpredictable environment, present an urgent need of proper utilization of water. Therefore to check the temperature and moisture of the soil, sensor at suitable locations for monitoring of crops is required.

The threshold values of the temperature and soil moisture is programmed into a microcontroller-based gateway that will control the water quantity. The technological development in Wireless Sensor Networks has made it realistic to monitor and control of greenhouse parameter in agriculture. The research in the agricultural field, researchers realised that the yield of crops is decreasing day by day. The use of technology however in the field of agriculture plays important role in increasing the production as well as in reducing the extra man power efforts. . The entire system is developed using five field sensor stations which collect the data and send it to the base station using global positioning system (GPS). At the base station necessary action is taken for controlling irrigation according to the data arrived from the sensors. The system provides a low cost wireless solution as well as remote controlling for irrigation. Sensors placed below the soil are used to communicate with the relay nodes. Transmission of data is done hourly and buffering the data, transmit it and then checking the status messages

III. SYSTEM OVERVIEW



The system consist of four sections; node1, node2, node3 and PC or mobile app to control system. Here every node has got different sensors and devices and these are interconnected to one central server via wireless communication modules. The server sends and receives information from user end using internet communication. There are two modes of operating the system; auto mode and manual mode. In auto mode the system takes its own decisions and controls the installed devices whereas in manual mode user can control the operations of the system using android app or PC commands.

IV. ARCHITECTURE OF THE SYSTEM

Node 1: Node1 is GPS based mobile robot which is to be controlled remotely using computer as well as it can be programmed so as , it can be navigated autonomously within the boundary of field using the co-ordinates given by GPS module.

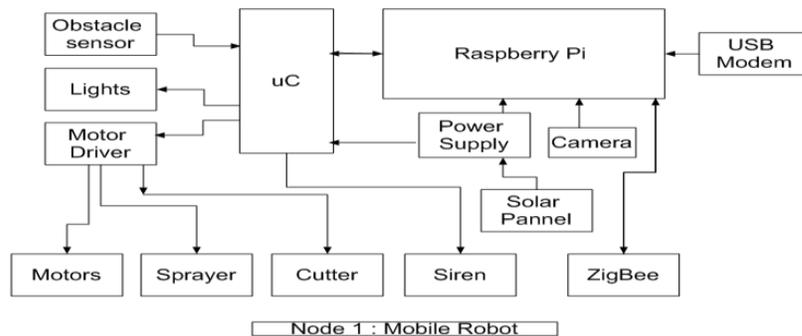
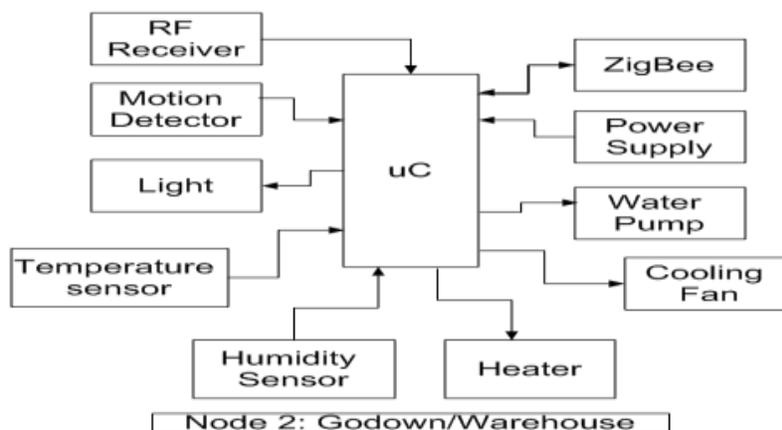


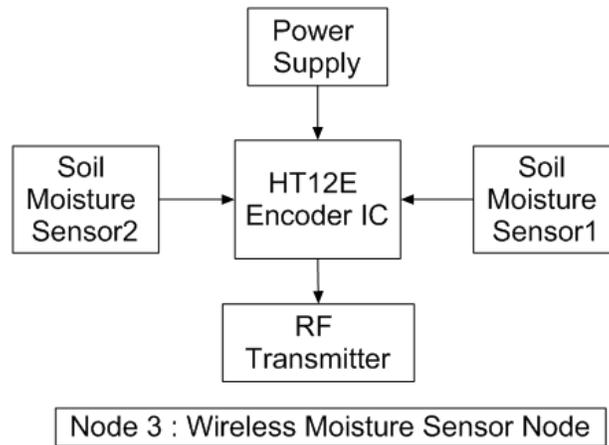
Figure 2: Node 1

The Remote controlled robot has many sensors and devices like camera, obstacle sensor, siren, cutter, sprayer . Using these we can perform tasks like; Keeping vigilance, Bird and animal scaring, Weeding, and Spraying.

Node 2: It will be the warehouse. It consists of motion detector, light sensor, humidity sensor, temperature sensor, room heater, cooling fan interfaced with AVR microcontroller. Motion detector detects the motion in the room when security mode is ON and on detection of motion, it sends the alert signal to user via Raspberry Pi and thus alerting the theft detection. Temperature sensor and Humidity sensor senses the temperature and humidity respectively .If the value crosses the threshold ,then room heater or cooling fan will be switched ON/OFF automatically providing temperature and humidity maintenance. Node2 also controls water pump depending upon the soil moisture data sent by Node3.



Node3: It is a smart irrigation Node with features like smart control of the water pump based on real time field data i.e. automatically turning on/off the pump after it attains the required soil moisture level in auto mode, switching the water pump on/off remotely via mobile or computer in manual, mode, and continuous monitoring of soil moisture.



In node3, the moisture sensor transmits the data it has received using HT12E Encoder IC and a RF transmitter. The transmitted data is received by node2. At node2 it is processed by the microcontroller to control the operation of water pump.

Hardware used:

- a) **AVR Microcontroller Atmega 16/32:** The microcontroller used is, Low-power AVR® 8-bit Microcontroller, having 8K Bytes of In-System Self-programmable Flash program memory, Programmable Serial USART, 8-channel, 10-bit ADC, 23 Programmable I/O lines.
- b) **ZigBee Module:** ZigBee is used here for achieving wireless communication between Node1 and Node2. The range for ZigBee is roughly 50 meters and it can be increased using a high power modules. The power consumption of it is very low and is less expensive compared to other wireless modules like Wi-Fi or Bluetooth. It is basically used to establish wireless local area network.
- c) **Moisture sensor:** Soil moisture sensor measures the water content in soil. Here, It is used to sense the moisture in field and transfer it to microcontroller in order to take controlling action of switching water pump ON/OFF
- d) **Humidity sensor:** The DHT11 is a basic, low-cost digital temperature and humidity sensor. It has a capacitive sensor for measuring the humidity. The shortcoming of this sensor is that one can only get new data from it only after every 2 seconds.
- e) **Obstacle sensor (Ultra-Sonic):** The ultra-sonic sensor operates on the principle of sound waves and their reflection property. It has basically two parts; ultra-sonic transmitter and ultra-sonic receiver. It is used as an obstacle detector in the case of mobile robot and as a motion detector in the case of warehouse, for preventing thefts. The ultra-sonic sensor enables the robot to detect and avoid obstacles and also to measure the distance from the obstacle.

- f) **Raspberry Pi:** The Raspberry Pi is small pocket size computer used to do small computing and networking operations. It is the mainly used in the field of internet of things. It provides access to the internet and hence it makes connection of automation system with remote location possible. Raspberry Pi is also available in various versions.

Software's used:

- a) **AVR Micro Controller Atmega 16/32:** It is a editor to write, build, compile and debug the embedded c program codes which is to be burned into the microcontroller in order to perform operations. This software directly generates .hex file which is burned into the microcontroller.
- b) **Proteus 8 Simulator:** Proteus 8 is one of the best simulation software for various circuit designs of microcontroller. It has almost all microcontrollers and electronic components readily available in it and hence a widely used simulator. It is to test programs and embedded designs for electronics before actual hardware testing. Proteus software is used to do the simulation of the microcontroller. It avoids the risk of spoling the parts due to wrong design.
- c) **Dip Trace:** It is a EDA/CAD software for creating schematic diagrams and printed circuit boards. The developers have provided multi-lingual interface and tutorials .
- d) **Raspbian Operating System:** Raspbian operating system is free and open source operating system which is Debian based and optimized for Raspberry Pi. The operating system provides the basic set of programs and utilities for operating Raspberry Pi. It comes with around 35,000 packages which are pre compiled software's that are bundled in a nice format for hustle free installation on Raspberry Pi.

V. TECHNIQUES USED

Node1 comprises of the mobile robot with a central server, GPS module, camera and other sensors. All sensors are interfaced with microcontroller The microcontroller is then interfaced with the raspberry pi. The GPS and camera are controlled and connected to raspberry pisystem. The robot is controlled remotely using wireless transmission of PC commands to R-Pi. R-Pi forwards the commands to the microcontroller and microcontroller gives signals to motor driver in order to drive the Robot. GPS module provides the co-ordinates for the location of the robot. Node2 consists of motion detector, temperature sensor, humidity sensor, cooling fan, water pump, etc. connected to the microcontroller board. The sensors gives input to the controller and accordingly to that microcontroller controls the devices in auto mode and also sends the value of sensors to R-Pi and R-Pi forwards it to user's smart device using internet. When temperature level increases above preset threshold level then cooling fan is started automatically in auto mode. If the threshold level goes below a fixed value the water pump gets ON. In manual

mode, microcontroller receives the controlling signals from R-Pi through ZigBee and accordingly takes the control action. Moisture sensor is connected to Node3.. Moisture sensor transmits the data using HT12E Encoder IC and a RF transmitter to the Node2 where it is computed by the microcontroller and accordingly water pump is switched ON/OFF.

VI. CONCLUSION

The sensors and microcontrollers of the three Nodes are interfaced with Raspberry Pi thus achieving wireless communication between the Nodes. By using remote controlled robot, smart irrigation system and a smart warehouse management system, it has in fact brought a solution to the problems in field activities, storage problems and irrigation problems. Implementation of such a system improves the yield of the crops, overall production and thus increases the overall economic development of the country. The government needs to provide subsidy to these gadgets to the farmers to improve their farming.

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