

IOT BASED MONITORING SYSTEM IN SMART AGRICULTURE

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ABSTRACT

Agriculture plays the vital role in the development of country. In India about 70% of population depends upon farming and one-third of the nation's capital comes from farming. Issues concerning agriculture have been always hindering the development of the country. The only solution to this problem is smart agriculture by modernizing the current traditional methods of agriculture. Hence the project aims at making agriculture smart using automation and IoT technologies. The highlighting features of this project includes smart GPS based remote controlled robot to perform tasks like weeding, spraying, moisture sensing, bird and animal scaring, keeping vigilance, etc. Secondly it includes smart irrigation with smart control and intelligent decision-making based on right real-time field data. Thirdly, smart warehouse management which includes temperature maintenance, humidity maintenance and theft detection in the warehouse. Controlling of all these operations will be through any remote smart device or computer connected to Internet and the operations will be performed by interfacing sensors, Wi-Fi or ZigBee modules.

Keyword: Smart agriculture, Wi-Fi or ZigBee modules.

Introduction

Agriculture is considered as the basis of life for the human species as it is the main source of food grains and other raw materials. It plays vital role in the growth of country's economy. It also provides large ample employment opportunities to the people. Growth in agricultural sector is necessary for the development of economic condition of the country. Unfortunately, many farmers still use the traditional methods of farming which results in low yielding of crops and fruits. But wherever automation had been implemented and human beings had been replaced by automatic machineries, the yield has been improved. Hence there is need to implement modern science and technology in the agriculture sector for increasing the yield. Most of the papers signifies the use of wireless sensor network which collects the data from different types of sensors and then send it to main server using wireless protocol. The collected data provides the information about different environmental factors which in turns helps to monitor the system.

Monitoring environmental factors is not enough and complete solution to improve the yield of the crops. There are number of other factors that affect the productivity to great extent. These factors include attack of insects and pests which can be controlled by spraying the crop with proper insecticide and pesticides. Secondly, attack of wild animals and birds when the crop grows up. There is also possibility of thefts when crop is at the stage of harvesting. Even after harvesting, farmers also face problems in storage of harvested crop. So, in order to provide solutions to all such problems, it is necessary to develop integrated system which will take care of all factors affecting the productivity in every stages like; cultivation, harvesting and post harvesting storage.

This paper therefore proposes a system which is useful in monitoring the field data as well as controlling the field operations which provides the flexibility. The paper aims at making agriculture smart using automation and IoT technologies. The highlighting features of this paper includes smart GPS based remote controlled robot to perform tasks like; weeding, spraying, moisture sensing, bird and animal scaring, keeping vigilance, etc. Secondly, it includes smart irrigation with smart control based on real time field data. Thirdly, smart warehouse management which includes; temperature maintenance, humidity maintenance and theft detection in the warehouse. Controlling of all these operations will be through any remote smart 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.

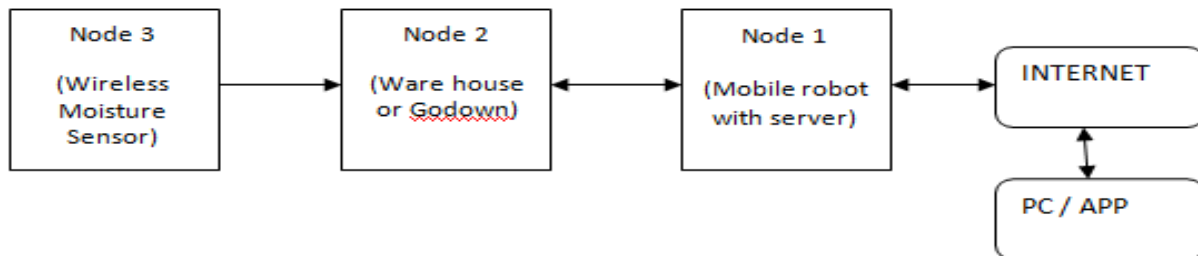
IOT

IOT is an intelligent technology which includes identification, sensing and intelligence. Life and even intelligence of life itself can also be regarded as part of IOT technology. It is used in pattern identification fields like measurement and computing as well as computer and communication fields like sensing, communication, information collection and processing. The definition of IOT changes as the time of

cloud computing comes. It is now defined as IOT =cloud computing + ubiquitous network + intelligent sensing network.

Cloud computing management platform is the “brain” of cloud computing and relevant data. It involves management of accession of cloud computing customization application by users of this IOT, computing and processing what is involved in customization service; organizing and coordinating service nodes in the data center. Ubiquitous network includes 3G, LTE, GSM, WLAN, WPAN, WiMax, RFID, Zigbee, NFC, blue tooth and other wireless communication protocol technology. It also includes optical cable and other wire communication protocol and technology. The principle of cloud computing for IOT.

Block diagram

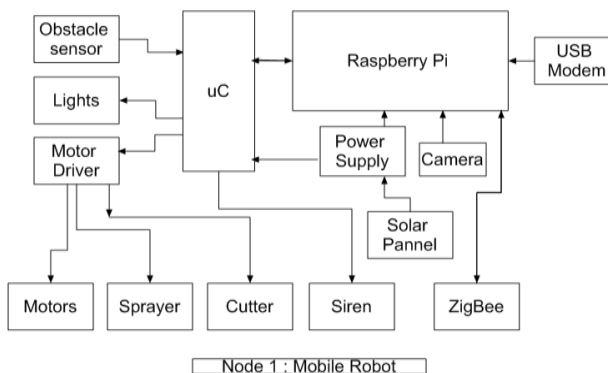


The paper consist of four sections; node1, node2, node3 and PC or mobile app to control system. In the present system, every node is integration with different sensors and devices and they are interconnected to one central server via wireless communication modules. The server sends and receives information from user end using internet connectivity.

NODE 1

Node1 is GPS based mobile robot which can be controlled remotely using computer as well as it can be programmed so as to navigate autonomously within the boundary of field using the co-ordinates given by GPS module. The Remote controlled robot have various sensors and devices like camera, obstacle sensor, siren, cutter, sprayer and using them it will perform tasks like; Keeping vigilance, Bird and animal scaring, Weeding, and Spraying.

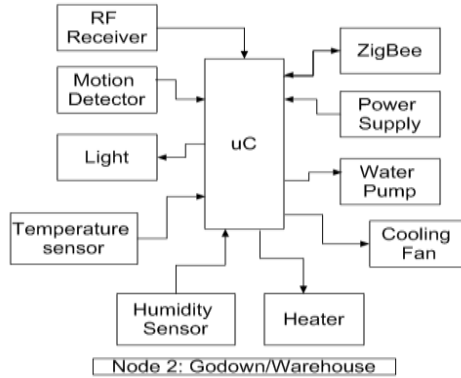
Node 1 : Block Diagram



NODE 2

Node2 will be the warehouse. It consists of motion detector, light sensor, humidity sensor, temperature sensor, room heater, cooling fan altogether interfaced with AVR microcontroller. Motion detector will detect the motion in the room when security mode will be ON and on detection of motion, it will send the alert signal to user via Raspberry pi and thus providing theft detection. Temperature sensor and Humidity sensor senses 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. Node2 will also controls water pump depending upon the soil moisture data sent by node3.

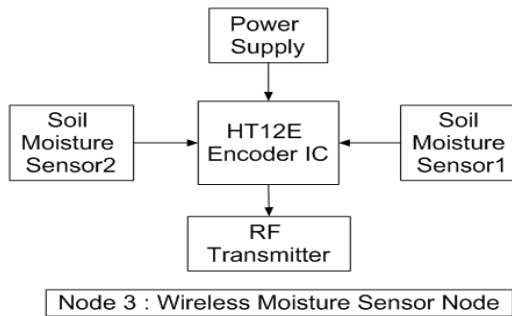
Node 2 : Block Diagram



Node 3:

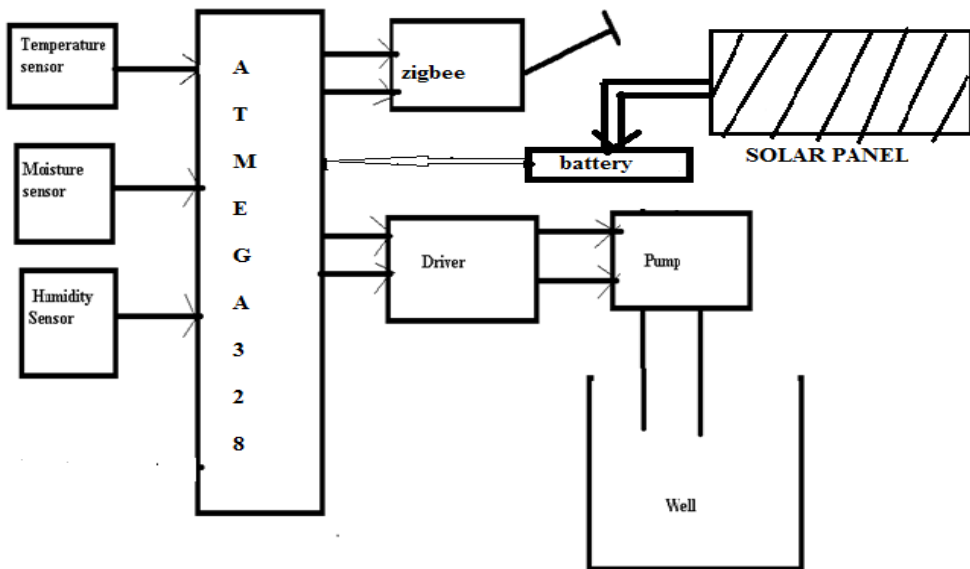
Node3 is a smart irrigation node with features like ; Smart control of water pump based on real time field data i.e. automatically turning on/off the pump after attaining the required soil moisture level in auto mode, Switching water pump on/off remotely via mobile or computer in manual mode, and continuous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

Node 3 : Block Diagram



Smart irrigation system using solar panel

The block diagram of the system consists of two sections: transmitter and receiver section which effectively measures parameters by using different sensors like temperature sensor, humidity sensor, soil moisture sensor and the system also consist of microcontroller 328P, GSM module, LCD, and zigbee module.



As shown in the transmitter block there are three sensors used in the system, which are mainly as follows:

- a. Temperature
- b. Soil moisture
- c. Humidity

The LM35 precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in °Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. LM35 is temperature sensor is used to sensing the temperature. It is integrated circuit that can be used to measure temperature with electrical output. It is more accurate and its operating temperature range is from -55 to 150 degree C. A humidity sensor senses relative humidity. This means that it measures both air temperature and moisture. Relative humidity, expressed as a percent, is the ratio of actual moisture in the air to the highest amount of moisture air at that temperature can hold. The warmer the air is, the more moisture it can hold, so relative humidity changes with fluctuations in temperature. HS1100 is used for sensing humidity. Humidity is measured in percentage of vapour in the air. HS1100 gives the output in terms of frequency range 5 kHz to 10 kHz. Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. One common type of soil moisture sensors in commercial use is a Frequency domain sensor such as a capacitance sensor.

Hardware components:

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 for achieving wireless communication between Node1 and Node2. The range for ZigBee is roughly 50 meters and it can be increased using high power modules or by using network of modules. It operates on 2.4 GHz frequency. Its power consumption is very low and it is less expensive as compared to other wireless modules like Wi-Fi or Bluetooth. It is usually used to establish wireless local area networks.

c) Temperature Sensor LM35:

The LM35 is precision IC temperature sensor. Output voltage of LM35 is directly proportional to the Centigrade/Celsius of temperature. The LM35 does not need external calibration or trimming to provide accurate temperature range. It is very low cost sensor. It has low output impedance and linear output. The operating temperature range for LM35 is -55° to +150°C. With rise in temperature, the output voltage of the sensor increases linearly and the value of voltage is given to the microcontroller which is multiplied by the conversion factor in order to give the value of actual temperature.

d) Moisture sensor:

Soil moisture sensor measures the water content in soil. It uses the property of the electrical resistance of the soil. The relationship among the measured property and soil moisture is calibrated and it may vary depending on environmental factors such as temperature, soil type, or electric conductivity. 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. Humidity sensor: The DHT11 is a basic, low-cost digital temperature and humidity sensor. It gives out digital value and hence there is no need to use conversion algorithm at ADC of the microcontroller and hence we can give its output directly to data pin instead of ADC. It has a capacitive sensor for measuring humidity. The only real 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 two parts; ultra-sonic transmitter and ultra-sonic receiver. Transmitter transmits the 40 KHz sound wave and receiver receives the reflected 40 KHz wave and on its reception, it sends the electrical signal to the microcontroller. The speed of sound in air is already known. Hence from time required to receive back the transmitted sound wave, the distance of obstacle is calculated. Here, it is used for obstacle detection in case of mobile robot and as a motion detector in 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. The range of operation of ultra-sonic sensor is 10 cm to 30 cm.

f) Raspberry Pi :

The Raspberry Pi is small pocket size computer used to do small computing and networking operations. It is the main element in the field of internet of things. It provides access to the internet and hence the connection of automation system with remote location controlling device becomes possible. Raspberry Pi is available in various versions. Here, model Pi 2 model B is used and it has quad-core ARM Cortex-A53 CPU of 900 MHz, and RAM of 1GB. it also has: 40 GPIO pins, Full HDMI port, 4 USB ports, Ethernet port, 3.5mm audio jack, video Camera interface (CSI), the Display interface (DSI), and Micro SD card slot.

Software

a) AVR Studio Version 4:

It is used to write, build, compile and debug the embedded c program codes which are needed to be burned in the microcontroller in order to perform desired operations. This software directly provides .hex file which can be easily 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 it is widely used simulator. It can be used to test programs and embedded designs for electronics before actual hardware testing. The simulation of programming of microcontroller can also be done in Proteus. Simulation avoids the risk of damaging hardware due to wrong design.

c) Dip Trace:

Dip trace is EDA/CAD software for creating schematic diagrams and printed circuit boards. The developers provide multi-lingual interface and tutorials (currently available in English and 21 other languages). DipTrace has 4 modules: Schematic Capture Editor, PCB Layout Editor with built-in shape-based auto router and 3D Preview & Export, Component Editor, and Pattern Editor.

d) SinaProg:

SinaProg is a Hex downloader application with AVR Dude and Fuse Bit Calculator. This is used to download code/program and to set fuse bits of all AVR based microcontrollers.

e) Raspbian Operating System:

Raspbian operating system is the free and open source operating system which Debian based and optimized for Raspberry Pi. It provides the basic set of programs and utilities for operating Raspberry Pi. It comes with around 35,000 packages which are pre-compiled software that are bundled in a nice format for hassle free installation on Raspberry Pi. It has good community of developers which runs the discussion forms and provides solutions to many relevant problems. However, Raspbian OS is still under consistent development with a main focus on improving the performance and the stability of as many Debian packages as possible.

CONCLUSION

The sensors and microcontrollers of all three Nodes are successfully interfaced with raspberry pi and wireless communication is achieved between various Nodes. IOT is closely related to cloud computing in a way that IOT obtains powerful computing tools through cloud computing and cloud computing finds the best practicing channel based on Smart Agriculture Based on Cloud Computing and IOT Fan TongKe IOT. Agricultural information cloud is constructed based on cloud computing and smart agriculture is constructed with combination of IOT and RFID. Hardware resources in agricultural information network are integrated into resource pool by using vitalization technology, achieving dynamic distribution of resource and balance of load, significantly improve efficiency of resource using.

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