

Surveillance and Steering of Agricultural Field using Zigbee

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Abstract— An agricultural automated system is designed for supervising and controlling the variegated factors such as humidity, water level, temperature and human machination. This system is a wireless sensor network using ZigBee as the transmission medium for the sensed values of the facets of agriculture. Sensors gather the various agricultural factors in real time and transmit it using IoT application. Internet of things collaborates with one another to perform action on behalf of people to reduce or eliminate the need of human labor. IoT will become a reality over the next few years, with omnipresent smart devices will be able to execute autonomously according to the change in their surroundings. There is also inclusion of the GSM gateway administering the sensor statistics from the coordinator to the router ZigBee, which is used to disseminate data to the web application. The coding was instigated with threshold values of the factors monitored and was programmed into micro-controller with uses IoT application to send an alert to the user mobile phone to be aware of the adverse conditions of the field. It also helps to control the condition to avoid the major loss of crops.

Keywords- *Wireless Sensor Network (WSN), ZigBee, Universal asynchronous receiver transmitter (UART), Internet of Things (IoT), GSM Module, LCD Display, ARM microcontroller;*

INTRODUCTION

Wireless communication is one of the most vivacious provinces in the communication sphere contemporarily. This technology seeks the detachment of obstructions related to extravagant and cumbersome wires and cables in any environment underground or over the surface. It incorporates the various strategies of communicating among devices using wireless signals. This technology works through electromagnetic signals that are broadcast by authorized devices within the air, physical environment or atmosphere. The communication between two devices occurs when the destination seizes the signals, creating a wireless communication bridge between the sender and the receiver devices. Wireless communication has various forms ,technology including satellite communications, mobile communications, wireless networks, Bluetooth communication, infrared communications, etc.

WIRELESS SENSOR NETWORK

A wireless sensor network (WSN) is a collection of spatially dispersed and dedicated sensors for accumulating and disseminating environmental data.

Wireless sensor network catalyze scanning and restraining of the physical changes for the secluded location with superior precision. A group of sensors work collaborates for a common application.

The WSN is built of nodes from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting.

A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network.[1] The propagation technique between the hops of the network can be routing or flooding. The main characteristics of a WSN include:

- Power consumption constrains for nodes using batteries or energy harvesting
- Ability to cope with node failures
- Mobility of nodes
- Communication failures

- Heterogeneity of nodes
- Scalability to large scale of deployment
- Ability to withstand harsh environmental conditions
- Ease of use

AGRICULTURAL SIGNIFICANCE

Agriculture has always been accorded an important position in the Indian society. Agriculture in India was incomparable with other countries. But due to education system and modernization our traditional agriculture system has decayed. Due to this the economy of our country has got declined with increase in poverty and malnutrition. Thus Indian agriculture requires sophistication in farming and maintaining the field so that people with other business and dwelling in other place also can control and maintain the field with the help of internet. In our proposed system it is made possible with the help of sensors such as humidity sensor which checks the humidity of soil which gathers data, according to the threshold value i.e. if value is low, water is sprinkled if value is high, irrigation is not required at present. Same way temperature sensor, water level indicator sensor and animal detection sensor is used. The reading that is gathered is stored continuously and then an alert is sent to the owner of the field when required.

Precision farming clinches swift time responses to dreadful environmental and weather forecasting issues with efficient controlling capacity for production and reduced labor machination. This arrangement of highly self-directing agricultural system requires vigorous sensing at the field and fleeting communication in the air for the information transmission is necessary. The prominent and advanced features of computational gathering of data, self-decision making ability and the controlling of the vivacious factors of the farm is highly required for increasing the production value of our country and for the development and enormous magnification of our motherland. The variegated sections of smart agricultural field are as follows

- Observing agricultural circumstances
- Recognition of sensing whereabouts and data assembling
- Fetching data from crop field and directing it to the control station
- Message alert and steering action based on the sensed data values

THESIS REVIEW

Agriculture is backbone of our economy. It produces food and raw materials, but the production has completely declined in our country due to many natural and manly factors. The development of agriculture provides

necessary capital for the enlargement of many sectors and foreign trade. As technology is developing day by day in all fields, technology in agriculture has also been developed. By initiating new technologies in agriculture the crops can be under regular maintenance without any need of manpower which will produce accurate measurement. It also provides surplus production of crops. Few researches that have been carried out for the abundant yield of crops are depicted below.

KAY RÖMER AND FRIEDEMANN MATTERN, ETH ZURICH elucidates the design space of wireless sensor network. It is salient to study the design of wireless sensor network because the construction of the hardware should support a wide range of application which means any hardware should not be application specific. All the hardware used in the sensor nodes should be easily replaceable or should be easily modified. The main aim of their paper is to make an efficient design space with less complexity in hardware and software. A proper modular software and hardware has to be designed in order to form systematic sensor node so that the observed readings being registered in the sensor can be stored and transmitted.[1]

WEN-ZHAN SONG, RENJIE HUANG MINGSEN XU, BEHROOZ A. SHIRAZI AND RICHARD LAHUSEN illustrates the rapid deployment of sensor nodes during volcanic ejections. It also describes attaining real time outrageous fidelity node, remote configurability and high degree of durability. The design system distribution verifies the working of low cost sensor network, efficiently working in peculiar environments. Meticulous timing is necessary for employing the material and spatial equivalence of signals. It helps to differentiate seismic and volcanic activities through usage of specific sensors.[2]

JOAQUÍN GUTIÉRREZ, JUAN FRANCISCO VILLA-MEDINA, ALEJANDRA NIETO-GARIBAY, AND MIGUEL ÁNGEL PORTA-GÁNDARA The automated irrigation system enacted was viable and cost effective for maintaining water accumulation for crop cultivation. This system helps in efficient cultivation even in water scarcity areas. It improves conservation of the system. The solar power can be significantly utilized for the cultivation of organic as well as other crops in the remote areas where electric power supply is complicated. This system can be used in green houses or open fields controlled by internet for steering diverse cultivation framework.[3]

R. PITCHAI RAMASAMY, M. PRAVEEN KUMAR, S. SARATH KUMAR AND R. RAGHU RAMAN proposes the detection and controlling the fire accidents in the running train the main aim of this system is to maintain the safety of people and government property. A relevant system of firefighting alarming and automatic remedy option has been suggested.[4]

P.S. JADHAV, V.U. DESHMUKH proposes in their paper that a wireless sensor network is created in a forest with few

types of sensors to monitor the forest continuously. A proper hardware and software module is formed which will detect the factors such as temperature, smoke etc in the forest. Controlling these factors are economically high for time being hence only sensing and detection is carried out.[5]

GOPALAKRISHNA MOORTHY .K, DR.C.YAASHUWANTH, VENKATESH.K proposed in their paper that a wireless sensor network is formed in agricultural field using ZigBee which continuously monitors the field. It is much cheaper in cost and 254 different devices can be controlled. Hence using ZigBee the field is monitored efficiently in low expenditure. [6]

PROPOSED SYSTEM

The enhancement of the agricultural field and escalation depends on the miscellaneous factors such as the temperature, pH level, humidity, moisture, water level, light intensity, etc. The proposed system is shown in the Fig 1 consists of temperature sensor(LM 35), water level sensor, humidity sensor(SY-HS-220) and PIR sensor v-11(#555-28027) to monitor the minute to minute status of the field to help the farmer to maintain his fields with better technology n increase his production value. The proposed system is divided into three segments such as sensor node, wireless transmission and user module. In the first segment the different sensors are used to measure the parameters which is multiplexed and converted from analog to digital form with the help of the ZigBee API(Application programming interface) mode. The main features of the API mode are

- Adapt and sense the parameters in in absence of command mode
- Provides RSSI(Received signal strength indication) and source address information
- Receives the packet delivery recognition on every packet transmitted
- In this mode, we can send and receive data from both the coordinator and router ZigBee vice versa

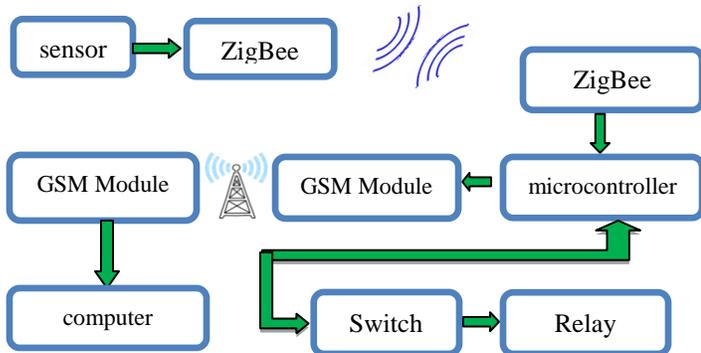


Fig 1:Block diagram of proposed system
 The data is transmitted to the router ZigBee wirelessly using the PAN(Personal Area Network) ID of the other router

ZigBee.[7] Due to the PAN ID feature the proposed system provides greater privacy policy and faster transmission of the data with security.

In the second segment, the ZigBee is connected to the ARM Microcontroller (LPC 2148 Microcontroller). The ARM microcontroller is used because it has two UART (Universal Asynchronous Receiver Transmitter), which helps in the serial transmission of data from the ZigBee to the microcontroller and from microcontroller to the GSM module respectively. The UART boot loader eliminates need of an additional programmer and allows you to program using serial port. The sensed values are sent from one GSM module to another to employ the IoT concept.

In the third segment, the data received by the second GSM module is interfaced with the personal computer for the purpose of the monitoring using the visual basic interface. The alert is also send to the farmer in case of emergency and controlling devices are also activates for quicker remedy execution.

AUTOMATED AGRICULTURAL SYSTEM

The automated agricultural system consists of the sensor units for the measurement of the values and the ZigBee technology is used for the wireless transmission of the values from the cultivation field to any corner of the world using the IoT application concept. The ZigBee used is the XBEE S2 module which ready platform based on the IEEE 802.15.4, 2.4 GHz. The software used for configuring the XBEE modules is X-CTU firmware and for connecting the coordinator to the router ZigBee.

LPC2148 Pro Development Board is a powerful development platform based on LPC2148ARM7TDMI microcontroller with 512K on-chip memory. This board is ideal for developing embedded applications involving high speed wireless communication, USB based data logging, real time data monitoring and control, interactive control panels etc. The on-chip USB controller provides direct high speed interface to a PC/laptop with speeds up to 12Mb/s. The UART boot loader eliminates need of an additional programmer and allows you to program using serial port.

GSM SIM 300 MODULE is a class of wireless MODEM devices that are designed for communication of a computer with the GSM and GPRS network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification. The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the controller/processor.

The MODEM sends back a result after it receives a command. Different AT commands supported by the MODEM can be sent by the processor/controller/computer

to interact with the GSM and GPRS cellular network. AT commands are used to control MODEMs. AT is the abbreviation for Attention. These commands come from Hayes commands that were used by the Hayes smart

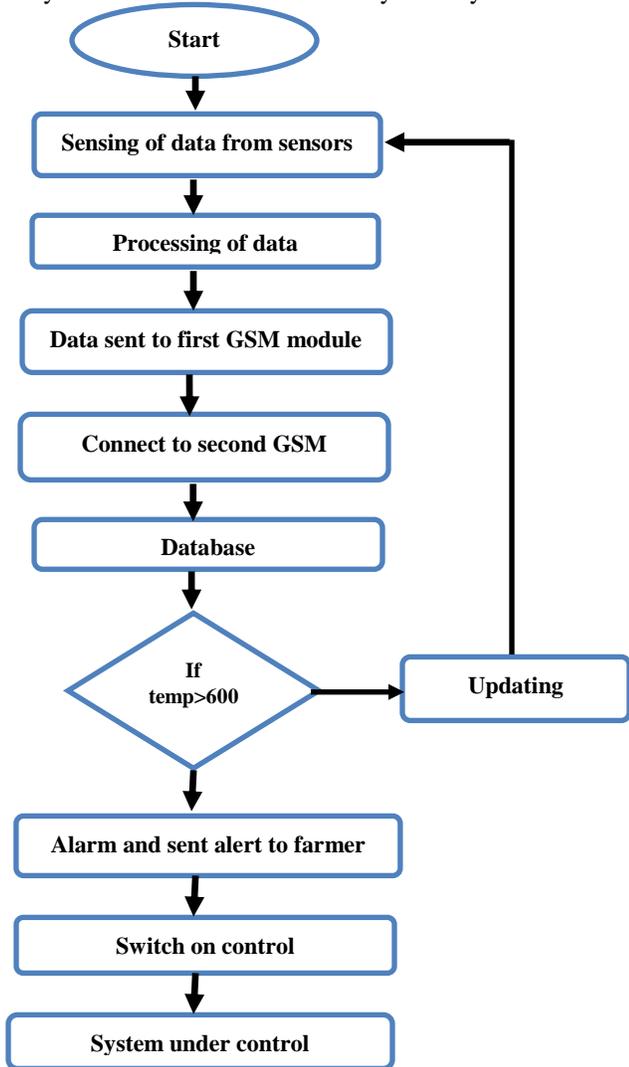


Fig 2: Flowchart of the proposed system processing

modems. AT commands with a GSM/GPRS MODEM or mobile phone can be used to access following information and service such as Information and configuration pertaining to mobile device or MODEM and SIM card, SMS services, Data and Voice link over mobile network. GSM/GPRS module assembles a GSM/GPRS modem with standard communication interfaces like RS-232 (Serial Port), USB etc., so that it can be easily interfaced with a computer or a microprocessor / microcontroller based system. The power supply circuit is also built in the module that can be activated by using a suitable adaptor.



Fig 3: Hardware setup of proposed system

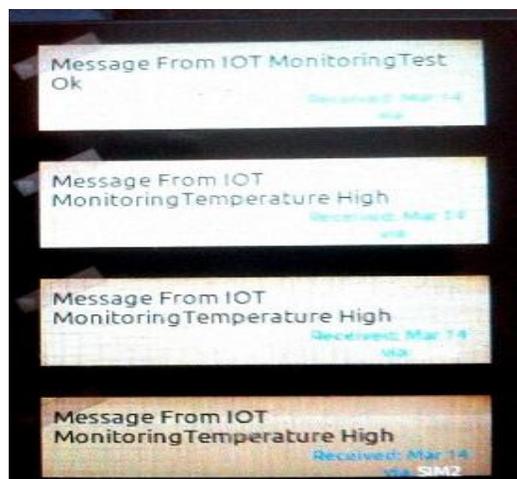


Fig 4: Message alert sent to the farmer

CONCLUSION

The automated agricultural system is used to proliferate the growth and flourishing of the cultivation crops. This can be done by the efficient surveillance of the environmental conditions as well as the agricultural factors necessary for the flourishing of the vegetation. This system provides control remedies in case of extreme conditions. This wireless sensor network using ZigBee technology helps the improvement of farming and it is highly durable and it is user-friendly. The proposed system is re-configurable at different environmental conditions and farming requirements.

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