

Remote Area Surveillance System Using Zigbee Networks

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ABSTRACT

Today, we live in a world of connectivity and wish to keep ourselves informed of each ongoing scenario from everywhere in the world. Such an awareness of ongoing activities becomes more important in remote areas that are to be monitored in order to maintain connectivity and security. The use of satellite monitoring for this is complex and expensive. The objective of this paper is to propose a means of communication using ZigBee sensors, Pyroelectric Infrared (PIR) sensor, Cameras, Arduino UNO R3 (the base station) and cloud computing programs. We are using ZigBee for this project as it is inexpensive, low-power consuming, less complex and reliable; most importantly because they can be used without licensed frequency band. ZigBee works without a network connection which may be exploited in the remote areas, devoid of network coverage. Hence two ZigBee modules in addition with cloud computing and Arduino UNO could be of use in monitoring the conditions of a selected area. This monitoring system can be used to sense the temperature change, unexpected movements etc., and hence they may be of use in defence and forestry departments.

Keywords: - *Arduino UNO R3¹, Zigbee², PIR Sensor³, Internet of Things⁴, Cloud Computing⁵*

1. INTRODUCTION

The importance of collecting data and processing it from every corner of a country is very important for military activities; especially for any developing country. This is difficult in remote areas where network availability is feeble and the setup of workstation for the processing of data is difficult and expensive to maintain like satellite surveillance. To overcome the above difficulty we are here proposing a system where remote area surveillance is done in a cheaper and reliable method. Using various sensors for sensing changes like sudden movement or suspicious activities, a communication link can be formed using ZigBee modules and microcontrollers as base station for processing the collected data.

1.1 WIRELESS SENSOR NETWORKS (WSN)

While many sensors connect to controllers and processing stations directly (e.g., using local area networks), an increasing number of sensors communicate the collected data wirelessly to a centralized processing station. This is important since many network applications require hundreds or thousands of sensor nodes, often deployed in remote and inaccessible areas. Therefore, a wireless sensor has not only a sensing component, but also on-board processing, communication, and storage capabilities. With these enhancements, a sensor node is often not only responsible for data collection, but also for in-network analysis, correlation, and fusion of its own sensor data and data from other sensor nodes. When many sensors cooperatively monitor large physical environments, they form a wireless sensor network (WSN). Sensor nodes communicate not only with each other but also with a base station (BS) using their wireless radios, allowing them to disseminate their sensor data to remote processing, visualization, analysis, and storage systems.

1.2 WHY ZIGBEE?

ZigBee is a wireless networking standard that is aimed at remote control and sensor applications which is suitable for operation in harsh radio environments and in isolated locations. Since we are deploying this system in a remote area, where there will not be any kind of mobile networks and internet facilities, ZigBee is the most preferred type of medium for communication. The other advantages of ZigBee are it requires less bandwidth and power. ZigBee mesh provides an easy to install, reliable, self-configuring, self-healing networks.

2. RELATED WORK

This work says Remote home surveillance system is implemented and tested successfully based on a readily available application resource used in this project to access remotely [1]. This literature says surveillance is used only when the user needs. In many places continuous video streaming is not required only single image is sufficient. This project uses Gmail server to communicate [2].

This work says smart surveillance system is capable of recording video or capturing images of the particular area using smart phone. Only the authenticated person can view the details [3]. This paper says ZigBee network is used to remotely monitor and control. An android application based smartphone is used to control. This system can be used in many areas like agriculture, home surveillance, fire monitoring, cultural heritage and so on [4].

2.1 EXISTING SYSTEM



Fig-1: CCTV surveillance system

In current systems many problems such as high cost, low intelligence, poor stability, and weak security can be seen. The continuous monitoring of the video is required. The complicated wiring also makes the installation and repair/replacement process difficult and expensive. The user should be present in the vicinity of the CCTV camera. So this work replaces all this problems.

3. PROPOSED SYSTEM FOR REMOTE AREA SURVEILLANCE

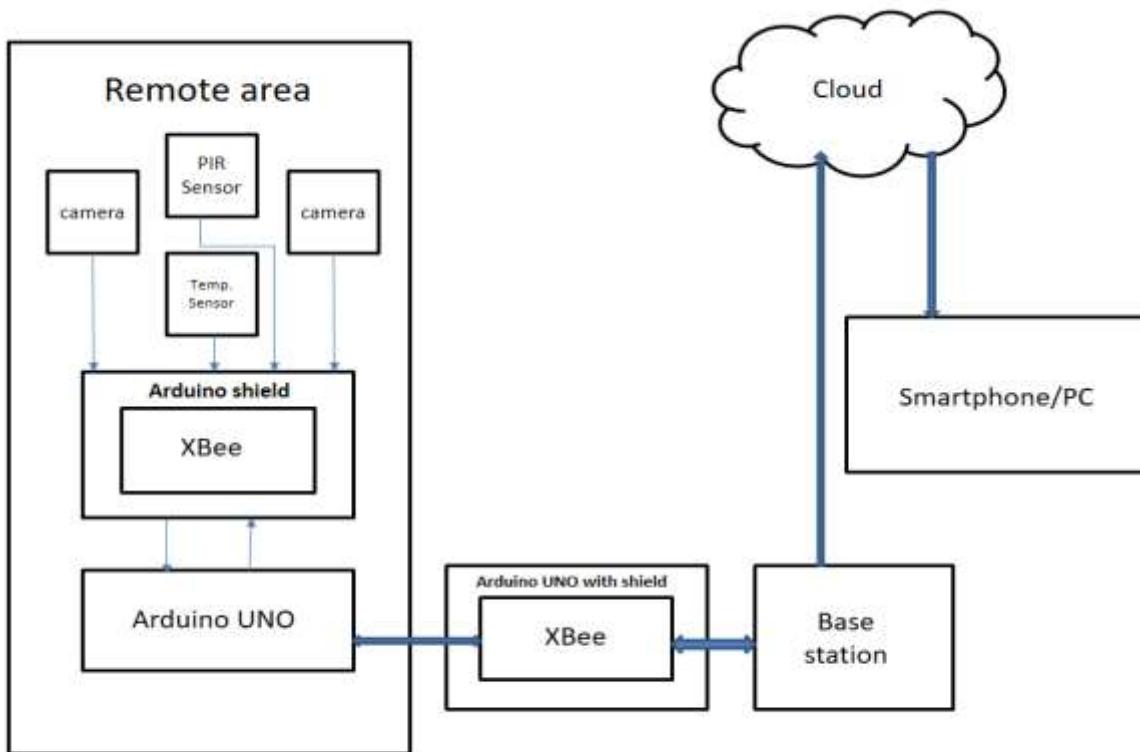


Fig-2: Block diagram of proposed system

The fig.2 shows the block diagram of the proposed system for Remote area surveillance. The sensors such as cameras, PIR sensors, temperature sensor needs to be installed in a remote area. These sensors collect the data from the surroundings and send it to the nearby ZigBee node which is in turn connected to Arduino UNO R3 controller card through an Arduino shield. The data is then sent to another ZigBee node wirelessly which is located outside the remote area. The received data is then pushed onto the cloud from the base station. An end user can retrieve those information from any part of the world with a help of a smartphone or a PC.

3.1 PIR SENSOR

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. A PIR-based motion detector is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-activated lighting systems etc. In this case it helps to find out unauthorized movement or trespassing in a remote area.

3.2 CAMERA

The camera used in this system is JPEG color camera. As soon as the motion is detected by the PIR sensor in the field, the camera is triggered and starts capturing images for some time with a less interval of pause.

3.3 TEMPERATURE SENSOR

The temperature sensor reads the temperature of the surroundings in analog. It transmits the temperature information to the connected ZigBee node. In this case temperature sensor TMP 36 is being used.

3.4 ZIGBEE

ZigBee is a wireless communication module which use IEEE 802.15.4 standard. 802.15.4 is an IEEE standard for low power applications of radio frequency. It is a low-cost, low-power, wireless mesh network standard targeted at the wide development of long battery life devices in wireless control and monitoring applications. It used in many products now a days for wireless communication functionality. It can be used as a transmitter and receiver both. It used serial communication to send and receive data. As we have already mentioned it use serial port to send and receive data. So its mean it can be easily interface with Arduino Uno R3, any type of microcontroller and computer. Because they all support serial communication and they all have serial port to send and receive data. It can also communicate with other ZigBee to form a mesh. In this scenario it collects all the data of sensors such as camera, PIR sensor and temperature sensor and sends all the information to the base station.

3.5 ARDUINO UNO R3

Arduino is an open source, computer hardware and software company, project, and user community that designs and manufactures Single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default bootloader of the Arduino UNO is the optiboot bootloader.^[14] Boards are loaded with program code via a serial connection to another computer.

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller.

Specification:

• Microcontroller	ATmega328
• Operating Voltage	5V
• Input Voltage (recommended)	7-12V
• Input Voltage (limits)	6-20V
• Digital I/O Pins	14 (of which 6 provide PWM output)
• Analog Input Pins	6
• DC Current per I/O Pin	40 mA
• DC Current for 3.3V Pin	50 mA
• Flash Memory	32 KB (ATmega328)
• SRAM	2 KB (ATmega328)
• EEPROM	1 KB (ATmega328)
• Clock Speed	16 MHz

4. RESULTS

The sensors and camera are deployed in the remote area. The sensors starts sensing as soon as the power is up. On detecting the intruder or unauthorized movement, the PIR sensor sends an analog signal to the nearby ZigBee node which is in turn sends the information to another ZigBee i.e. ZigBee located outside the remote area. The ZigBee is connected to the Arduino controller through an Arduino shield. The base station sends a message regarding the intruder detection to an authorized mail. On pushing the photo of the remote area on to the cloud from the base station, a user can retrieve all the details by accessing the cloud server. An immediate and required action can be taken.

5. CONCLUSION

This system is very advantageous for forest department in order to avoid smuggling and other illegal activities. This can also be used in industries and agriculture fields. It is further developed for precised location identification and control.

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