

Automatic Security System Based on Wireless Sensor Network and GSM Technology.

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Abstract: Today, primary concern of any shop owner is the security of valuables in shop, especially from thefts in the absence or presence of owner. In this paper, an automatic security system developed by applying RFID (wireless sensor network) and GSM technology is presented. It can detect and read any RFID tag, capture image, initiate buzzer and send a short message to security personnel and Police. The hardware of this system includes RFID reader, AVR Atmega16 development board, SIMCOM SIM 900 GSM module, Intex IT-305WC web camera and buzzer. The system is designed such that it detects a RFID tag attached to any valuable which initiates the web camera to capture image of the thief and at the same time an alarming buzzer sounds an alarm along with sending a short message to the police or security guard informing about the theft.

Keywords: RFID reader and tag, Global system for mobile communication, image capturing, short message.

I. INTRODUCTION

Security is considered as one of most important and most essential requirement for people owning shops with valuable items on sale. RFID (radio frequency identification) is a wireless non-contact use of radio frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information which is read by the RFID reader. Thus, RFID can be regarded as wireless sensor network that reads information on tags wirelessly. GSM (global system for mobile communication) has become the first choice for mobile users over CDMA as it has several advantages over CDMA like improved spectrum efficiency, high quality speech, and use of single mobile phone for change of number. Also, GSM technology has the advantages of fast transmission of data like short message without much delay, call forwarding, call waiting etc. making it desirable by users. When taken a survey of few shops in market, especially a jewelry shop then it was noticed that there was need of an advance security system that could curtail thefts taking place very often. The primary need was to know about the thief the instant theft takes place in the form of image and alarming buzzer. This need is fulfilled by the system designed in this paper.

II. RELATED WORK

A home security monitoring system comprising of combination of wireless sensor network and GSM technology with advantages of detection of theft, leaking of raw gas and fire along with sending an alarming message to the house owner's mobile is proposed by the authors of [1]. Here the wireless sensor network comprises of node modules connected with pyroelectric infrared detector to detect presence of any intruder, temperature sensor to detect too high indoor temperature, smoke detector to detect excess smoke concentration and gas sensor to detect presence of combustible gas separately and send information to home control centre and further send alarming message to the house owner through GSM. Here the use of GSM technology teaches how sending information through SMS could curb hazards at homes. In [2], a system to monitor actions of old and elderly people living alone in home is proposed. In this system, a sensor unit comprising of sensors connected to each device that detects whether the device is active or inactive is present. And the system is designed in such a way that it checks if the device is active for within or more than prescribed amount of time and if the rule is violated then an alarming message is sent to the family member or relative. Thus, it exhibits a system that emphasizes on security of old and elderly people. Another system designed by the authors of [3] showcases their idea about reminding people of the objects required for their day's work before leaving their homes. The system is based on RFID technology which is used to detect things carried by the person and reminds him or her to carry things which were in reminder list of event calendar and which he or she has forgotten to take along. Also, they have designed a security system which informs about any intrusion by unknown person depending upon the rise of temperature of home. In this way, two concepts are understood which are the use of RFID technology and the need of efficient security system. A system based on GSM technology that monitors vehicles travelling at a speed higher than the prescribed speed limit by sending image of the over-speeding vehicle to the Head Quarters Database for further analysis is designed by the authors of [4]. The system works such that a camera captures image of the vehicle violating speed limit and is stored in destined folder in the laptop and using GSM, a MMS (multimedia message service) is sent to central database system where details of vehicle are found. From this system, it could be inferred that

use of GSM can be done for sending picture image as well and monitor speed of vehicles.

III. SYSTEM STRUCTURE AND WORKING PRINCIPLE

The system structure is shown in Fig. 1, which consists of web camera and RFID interfaced with ATMEGA16 microcontroller along with buzzer and GSM module. The system works such that the moment thief trying to escape with the valuables from any shop comes across RFID reader, the RFID tag is read and an image of the thief is captured by the web camera triggered by the microcontroller and gets saved at a specified folder in the shop owner's PC or in the security department's computer as well as sends short message through GSM module to security along with initiating the alarming sound of buzzer which informs the security guard to take the necessary action.

All the actions take place simultaneously thus increasing the efficiency of the designed system. The existing security system in shops consist of CCTV cameras that are capable of taking continuous video footage of the actions taking place in and around the shops but it lacks immediate capturing of image and informing security at the instant the theft takes place which is achieved with the designed system presented in this paper.

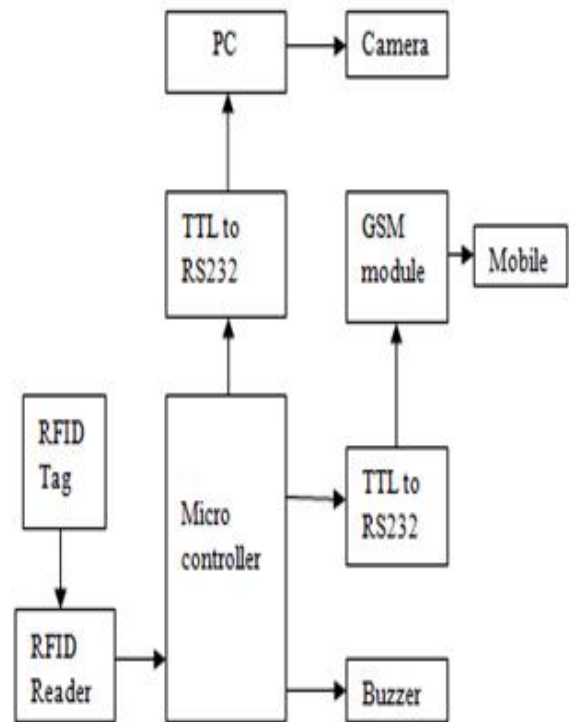


Figure1. System Structural diagram

IV. SELECTION AND DESIGN OF SYSTEM

A. RFID tag and RFID reader: A radio-frequency identification system has the feature of using tags, labels or stickers attached to the objects to be detected and identified. An RFID reader transmits an encoded radio signal to discern the tag. The RFID tag receives the signal from the reader and then responds with its identification and other information. The information on tag may be a unique tag number, or may be product-related information such as manufacture date, or other specific information. There are various RFID systems designed for various purposes and are differentiated based on the kind of range required by any system to read the tag. The system designed in this paper consists of RFID system that can detect an RFID tag within the range of 8-12 cm away from RFID reader.

B. MICRONTROLLER : There are several microcontrollers available like 8051, PIC, AVR, ARM in the market but as per our system requirements we choose to use ATMEGA16 AVR. As the name suggests AVR stands for advanced virtual RISC (Reduced Instruction Set Computer) architecture which is the primary reason for choosing ATMEGA 16 because in RISC architecture, there are only fewer number of instructions which are simpler and faster in operation and we need fast execution of all the activities being designed in the system. It consists of 16KB

of flash memory, 1KB of SRAM, 512 Bytes of EEPROM, One 8-bit and two 16-bit Timers/Counters, In System Programmer (ISP), Serial USART for serial communication, 8-Channel 10-bit ADC, Digital to analog comparator, 4 PWM Channels, and SPI Interface. There are four 8-bit Input/output ports providing 32 general purpose registers. AVRs are very fast microcontrollers because it executes most of the instructions in single execution cycle. It can execute 16 Million Instructions per second.

C. GSM MODULE: SIMCOM SIM 900 is the GSM module used in our system. It is used to send short alarming message to security guard or Police or owner of the jewelry shop. It works on four frequencies -850/ 900/ 1800/ 1900 MHz called as Quad-Band. It is available with RS232 serial interface, which allows connecting to PC as well as microcontroller with RS232 Chip (MAX232). We have used AT commands to configure GSM module to send SMS. In this module, baud rate is configurable from 9600-115200 through AT commands. It offers improved GPRS functionalities useful in web enabled applications. It provides good receiving facility and range of reception is good.

HARDWARE

D. **CAMERA:** We are using web camera for capturing image. It is INTEX-IT 305WC camera. It is 16 Mega Pixels camera having 4608*3456 resolutions. It provides a frame rate of 30 frames per second. The image format is RGB 24 bit per pixel (bpp). It consists of CMOS sensor. CMOS sensors like the one we are using have low power consumption than CCDs. CMOS sensors combine the image sensor function and image processing functions within the same integrated circuit. CMOS type sensors are widely used, especially in digital photography and cameras of mobile phones. And the most important feature of such cameras is that they are less expensive than others. Also, it was easier to program such that the camera is triggered to capture image using MATLAB R2010a.

V. DESIGN OF SYSTEM SOFTWARE

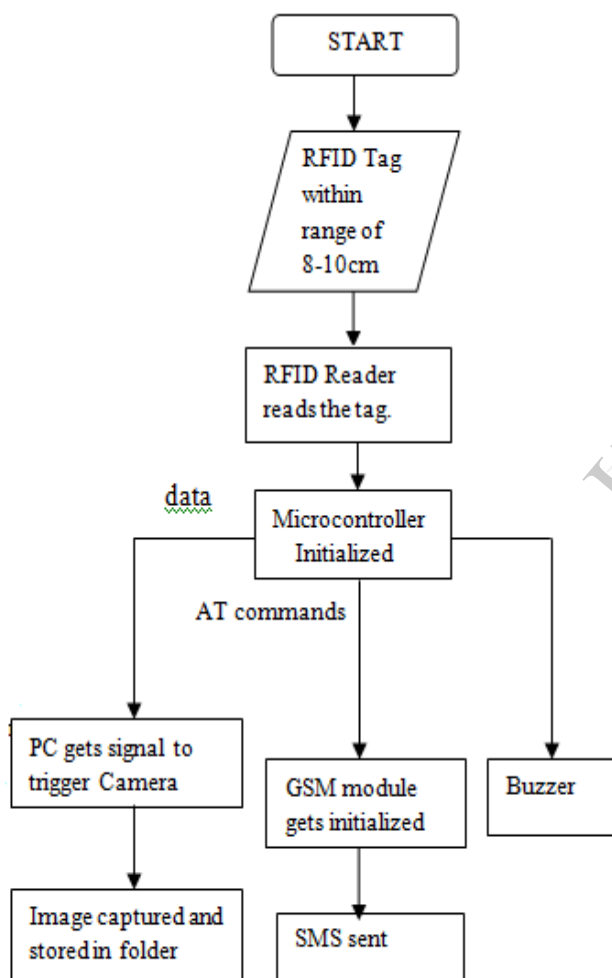


Figure2. System software flowchart

The flow of signal in the system through software is shown in Fig. 2. The microcontroller is programmed using AVR Studio4 software which causes flow of signals once the RFID tag is sensed in the following steps:

1. Once the RFID tag is sensed by RFID reader, it sends a high pulse to port pin PC0 of microcontroller.

2. The microcontroller sends this high pulse to port pin PA3 to which buzzer is connected causing an alarming sound.
3. The microcontroller is programmed such that there are two actions taking place simultaneously on transmission of 'data' and 'AT commands'.
4. If 'data' is serially transmitted, then the microcontroller sends signal to PC to trigger the camera to capture image.
5. Using MATLAB R2010a software, it is programmed in such a way that the PC triggers camera to capture image and save it in a destined folder.
6. If 'AT commands' are serially transmitted, then GSM module gets signal to send SMS to respective person. Table1 shows the AT commands used to configure GSM module.

TABLE1. AT COMMANDS USED

AT COMMAND	FUNCTION
AT+CMGF=1	Set short message encoding mode (1 for text mode, 0 for PDU mode).
AT+CMGS	Send Short Message

VI. TEST AND RESULT

The system is tested by using different RFID tags having different information stored and it was found that the system worked successfully as per the design. When the tags were held at different distances from 8-10cm, the RFID reader was able to sense the tag for every case. Thus it successfully could sense RFID tag, set an alarming buzzer, trigger camera to capture images in a set of four at an interval of 1 second between each image and simultaneously send short message through GSM module. There were no faults experienced during the working of the system. All the actions took place automatically without the interference of any man force.

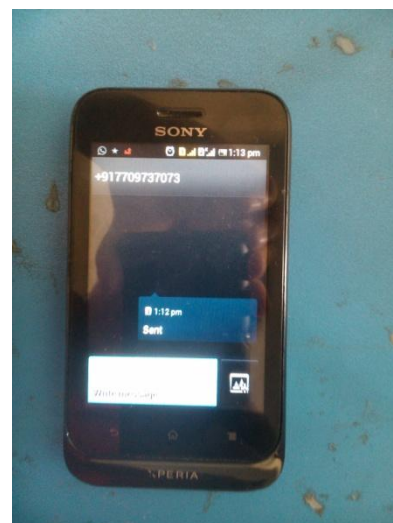


Figure3. Showing Short message sent



Figure4. Showing images captured by camera.

VII. CONCLUSION

The system designed in this paper thus fulfills this primary need of every person who owns a shop especially a jewelry shop in order to make him free from the worry of thefts. When taken a survey of existing security systems, it was observed that it lacked efficiency when the factor of instantaneous action was considered and hence our system proves to be efficient in taking instantaneous actions with faster speed and accuracy. The owner of the shop is able to take appropriate action without much delay with the help of system designed in this paper. Also, this system has several other applications like it can be used in Industrial monitoring as well where the proper functioning of machines and any malfunction of machines will be informed to the concerned person as fast as possible preventing any further loss. It can be effective for home security as well. Thus, using this system would be considered wise.

VIII. FUTURESCOPE

In the designed system of this paper, the image which is captured by the camera and stored in the destined folder can be further sent to user's mobile as an MMS (multimedia message service) in two different ways:

1. By using AT commands for MMS designed for SIMCOM SIM 900 GSM module.
2. With the help of SIMCOM SIM5216 GSM module we can automatically capture image as well as send it as MMS simultaneously by using AT commands designed for this module. It has special interface available with digital camera but it is an expensive module.

IX. REFERENCES

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