Design of an Event Based Surveillance System Using Advanced Technology

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Abstract—The proposed system is real time Embedded System which is capable of detecting an unauthorized human intrusion inside an apartment/office or any other protected indoor location and alerting the concerned person of a break-in, by sending him/her a SMS. Obstacle detector is used for detecting an intrusion, at the same time capturing the image of the intrusion through JPEG camera and storing it in USB. When the Obstacle detector detects the presence of a hostile being in the surrounding and sends a corresponding signal to the microcontroller. The microcontroller in turn sends a signal to a JPEG camera(CCGE-0638) which captures the image of the intrusion and a GSM modem(SIMCOMM SIM300) is used, which sends an alarm message(SMS) to the concerned person, the captured image is then stored in USB. The person can then see the obstacle which was detected by checking the images captured. The basic idea of this project is to implement surveillance system with motion detection. The main advantages of the proposed system are cost effective, high security, simple, easy to use and system with event based controlling mechanism.

Index Terms—Surveillance system, JPEG camera, USB Memory Stick, GSM, Obstacle detector.

I. INTRODUCTION

Humans have always felt very possessive of their belongings. The advancement of civilization witnessed better and improved means of security system being implemented by humans. Technological revolution of modern age has resulted in concept of security system finding widespread popularity. One can find latest technological innovations being employed to protect not only houses but also offices, buildings and warehouses etc. Nobody likes to be robbed of his precious possessions and hence opting for a secure system makes sense.

A simple way used to indicate the opening of a door or a window or Detect motion can be done via an obstacle detector. Obstacle detectors are usually designed to provide an indication to an alarm panel in response to detect IR rays that is indicative of motion of the object. It is the most common detectors found in household and small business environments because it offers affordable functionality. If someone enters a secured place, immediately it will detect a motion and sends an alarm to the corresponding user. The user will get to know that something is happening in the surveillance area. In our design we make use of microcontrollers which takes the obstacle detector output as its input and which in turn activates the camera and GSM modem and the images taken by the camera are stored on to the USB. Then the user can connect the USB to computer and view the images.

II. PROPOSED SYSTEM

Security systems have become necessary nowadays due to the increase in theft rate. The present systems available in the market doesn’t consists of event based controlling mechanism of camera i.e. the camera present in the system captures data continuously and keeps storing it, which unnecessarily wastes a lot electronic space. Our subsystem can prove itself useful in areas where constant surveillance is not needed but certain events should trigger the capturing process.

The concept was inspired from various such security systems available in the market, but is expensive. This event based controlling mechanism of camera provides similar facilities at affordable prices and requires less memory space compared to ones available in the market.

The basic components required to achieve this are a Microcontroller, Obstacle detector, storage medium and camera. After extensive research found that, PIC from Microchip is the most appropriate microcontroller as it has all features required to make a system with event based controlling mechanism.

The three main file formats for digital photographs are RAW, JIFF and JPEG. Both RAW and JIFF formats do not apply any compression to the photo to save space on memory card. When the camera saves a digital photo as a RAW or JIFF, the photo includes all of the information captured by camera’s image sensor.
JPEG is far more common file format, and it does use compression. It is a much more popular format with the consumer market because it allows a 128 MB card to store up to a ton of photographs. To detect the motion, an Obstacle detector which is simple and available at low cost and using USB drive to store the image captured.

![Functional Block diagram](image)

### III. HARDWARE IMPLEMENTATION

#### A. PIC MICROCONTROLLER
PIC is a family of modified Harvard architecture microcontroller made by Microchip technology, derived from the PIC1650 originally developed by General Instrument’s Microelectronics Division. The name PIC is referred to as "Peripheral Interface Controller". PICs are popular with both industrial developers and hobbyists due to their low cost, wide availability, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability.

Microchip introduced the new PIC32MX family of 32-bit microcontrollers operates at 2.3V to 3.6V supply voltage with 80 MHz frequency. The initial device line-up is based on the industry standard MIPS32 M4K Core. The device can be programmed using the Microchip MPLAB C Compiler for PIC32 MCUs.

**Communication Interfaces**
- USB 2.0-compliant Full-Speed OTG controller
- 10/100 Mbps Ethernet MAC with MII and RMII interface
- CAN module
- Six UART modules (20 Mbps):
  - Supports LIN 1.2 protocols and IrDA support
  - Up to four 4-wire SPI modules (25 Mbps)
  - Up to five I²C modules (up to 1 M baud) with SM Bus support
- Parallel Master Port (PMP)

The main reason for selecting this PIC32MX795F512L family controller is, our design requires three UART protocol for the interface of JPEG Camera, GSM Modem and Ultrasonic sensor, High Speed USB protocol for the interface of USB memory Stick.
B. Obstacle Detector-IR Sensor

Obstacle detectors can perform desired tasks in unstructured environments by finding and overcoming obstacles in their way without continuous human guidance. IR pair is used as sensor to detect the presence of objects. IR LEDs are used for detecting objects. These two LEDs are capable of transmitting and receiving IR respectively.

Fig. 2 Working of Obstacle Detector

IR LED emits infrared radiation. This radiation illuminates the surface in front of LED. Surface reflects the infrared light. This reflected light is made incident on reverse biased IR of the obstacle detector. When photons are incident on reverse biased junction of this diode, electron-hole pairs are generated, which results in reverse leakage current. Amount of electron-hole pairs generated depends on intensity of incident IR radiation. More intense radiation results in more reverse leakage current. This current can be passed through a resistor so as to get proportional voltage. Thus as intensity of incident ray varies, voltage across resistor will vary accordingly. IR LED is used as a source of infrared rays. It comes in two packages 3mm and 5mm. 3mm is better as it requires less space. IR sensor is nothing but a diode, which is sensitive for infrared radiation. The pair of infrared transmitter and receiver is called as IR TX-RX pair.

C. Obstacle Detector-Ultrasonic Sensor

Low cost compact ultrasonic sonar (distance measuring) sensor with up to 3.5-meters range. A host microcontroller circuit determines distance by triggering the US-100 and then measuring the echo time indicated by the pulse width output of the sensor. The module automatically sends eight 40 kHz square wave and automatically detect whether receive the returning pulse signal. If there is a signal returning, through outputting high level and the time of high level continuing is the time of that from the ultrasonic transmitting to receiving. The sensor module and its pin description is given below Fig. 3.

Fig. 3 Ultrasonic Sensor US-100 Breakout board

Pin details:
1: VCC
2: Trig (TX)
3: Echo (RX)
4: GND

The ultra sonic sensor is interfaced with UART protocol of PIC controller and it is shown in Fig.4
D. JPEG Camera:
The term "JPEG" is an acronym for the Joint Photographic Experts Group. JPEG is a commonly used method of lossy compression for digital photography. The degree of compression can be adjusted, allowing selectable tradeoffs between storage size and image quality. JPEG typically achieves 10:1 compression with little perceptible loss in image quality. JPEG compression is used in a number of image file formats. JPEG is one of the most common image format used by digital cameras and other photographic image capture devices, it is the most common format for storing and transmitting photographic images on the World Wide Web.
Capture JPEG images and send them via RS232 UART interface. This serial camera module makes it very easy for your microcontroller circuits to add image capture functions for various applications. VGA 640x480 image resolution, 115kbps UART rate.

Fig. 4 Ultrasonic Sensor interface to PIC Microcontroller

Fig. 5 JPEG camera (CCGE-0638) Breakout board

Fig. 6 JPEG camera interface to PIC Microcontroller
E. GSM modem(sim300)

SIMCOM GSM modem is used to communicate; it operates at a baud rate of 9600bps in standard UART mode through AT Commands. This GSM Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. Applications like SMS Control, data transfer, remote control and logging can be developed easily. The modem can either be connected to PC serial port directly or to any microcontroller. It can be used to send and receive SMS or make/receive voice calls. It can also be used in GPRS mode to connect to internet and do many applications for data logging and control. In GPRS mode you can also connect to any remote FTP server and upload files for data logging. This GSM modem is a highly flexible plug and play quad band GSM modem for direct and easy integration to RS232 applications. Supports features like Voice, SMS, Data/Fax, GPRS and integrated TCP/IP stack.

This is interfaced to the Microcontroller through serial port is shown in Fig 6. Serial Cable provided has following pins connected with RS232 level (+12V / -12V) output, Pin 2 is RS232 level TX output ,Pin 3 is RS232 level RX input and Pin 5 is Ground.

![GSM Modem interface to PIC Microcontroller](image)

**Fig. 7 GSM Modem interface to PIC Microcontroller**

AT commands are also known as Hayes AT commands. There are different views to understand the meanings of “AT”. Some call it “Attention telephone”, whereas others implemented interpret it as “Attention Terminal” commands. AT commands allow giving instructions to both mobile devices and ordinary landline telephones. The commands are sent to the phone’s modem, which can be a GSM modem or PC modem. Different manufacturers may have different sets of AT commands. Fortunately, many AT commands are the same. Mobile device manufacturers may also give attention to operators to allow or not to allow some commands on phones.

Syntax:
Commands always start with AT (which means Attention) and finish with a <CR> character. The <address> field is the address of the terminal to which the message is sent. To send the message, simply type, <Ctrl-Z> character. The text can contain all existing characters expect <ctrl-Z> and <ESC>. This command can be aborted using the <ESC> character when entering text. In PDU mode, only hexadecimal characters are used.

Command syntax in text mode:
AT+CMGS=<da>[<toda>]<CR>
Text is entered<ctrl-Z/ESC>

<table>
<thead>
<tr>
<th>COMMAND</th>
<th>POSSIBLE RESPONSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT+CMGS=&quot;+8095324464&quot;&lt;CR&gt;</td>
<td>+CMGS:&lt;mr&gt;</td>
</tr>
<tr>
<td>Intruder detected, &lt;ctrl-Z&gt;</td>
<td>OK</td>
</tr>
</tbody>
</table>

**TABLE I : AT commands and their response**
The message reference, \(<mr>\), which is returned to the application, is allocated by the product. This number begins with 0 and is incremented by one for each outgoing message; it is cyclic on one byte.

### IV. SOFTWARE IMPLEMENTATION

**A. MPLAB Integrated Development Environment Software**

The MPLAB IDE software brings an ease of software development. The MPLAB IDE is a Windows® operating system-based application that contains:

- A single graphical interface to all debugging tools
- Simulator
  - Programmer
  - In-Circuit Emulator
  - In-Circuit Debugger
- A full-featured editor with colour-coded context

**B. COMPILER 32**

The MPLAB C Compiler for PIC32 is a full-featured ANSI compliant C compiler for Microchip's PIC32 family of 32-bit microcontrollers. The MPLAB C is a 32-bit Windows console application as well as a fully integrated component of Microchip’s MPLAB Integrated Development Environment (IDE), allowing source level debugging with MPLAB’s software and hardware debug engines.

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**Fig. 8 Flow chart**

### V. RESULTS AND DISCUSSION

- This is our implemented system with GSM modem, jpeg camera and USB drive
- We could see the LED glows whenever the obstacle is detected

- Whenever an obstacle is detected, the host gets a SMS like this "motion detected image captured and stored in to the USB Drive"
This is the complete prototype of a model, which can be placed in Surveillance restricted area

VI. CONCLUSION

A basic model of a security system has been implemented, where in the images captured as a result of intrusion in the restricted area is stored in USB and can be viewed by connecting the USB to computer. Obstacle detector plays an important role in this system. Once the obstacle is detected by the detector, the host gets a SMS to his mobile that intruder has been detected. Whenever an obstacle is detected, an image of the obstacle is captured and an SMS sent to the host alerting of the host about the obstacle being detected. The image captured is stored in the USB drive. This system is implemented by considering a restricted area, obstacle detectors are placed outside the
restricted area. This system is economical, reliable and user friendly. The system can also be extended to real time video capture when ever their intrusion and also instead of sending SMS, mailing directly the captured image over internet using GPRS.

REFERENCES


AUTHOR BIOGRAPHY

Mr. Sunil MP, currently working as an Assistant Professor in the department of Electronics & Communication Engineering, School of Engineering and Technology, Jain University, Karnataka, India. He has received B.E degree in Electronics and Communication from VTU in 2009. He has received M.Tech degree in Electronics Design and Technology from National Institute of Technology, Calicut, Kerala in 2011. His research interests include Embedded Systems Design, Analog and Mixed signal VLSI Design, Ultra-Thin Gate insulators for VLSI Technologies, RF VLSI Design, Microelectronics System Packaging, Microelectronics, Micro/Nano Sensor Technology, High-speed CMOS analog/RF-wave integrated circuits and systems.