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J O U R N A L S

Embedded Phone Call Based Burglary Security Alert System

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Abstract

The importance of security in our society cannot be overemphasised, as it drives economic growth. This research reviewed the problems associated with embedded alarm systems together with other embedded security system like SMS based security system. In this paper, Embedded Phone Call Burglary Security Alert System was developed which calls the house owner on detection of an intruder, so that adequate security measures may be taken to catch the burglar. It is implemented to be used with any kind of mobile phones. Also, adequate security measures can be taken by the appropriate agencies to apprehend the intruder/burglar. The system was built using Atmega32 microcontroller, GSM/GPRS modem, infra-red sensor and proximity sensors and Embedded Basic/programming. The proximity sensor is placed to sense the door and window entrance while the infrared is placed to have line of sight communication in order to capture intrusion from the ceilings. SIM900 Module is a cellular protocol that interoperates with a Universal Asynchronous Receiver and Transmitter (UART) onboard communication protocol.

Keywords: *SIM900, Protocols, Burglar, Intruder, UART, AT command, Embedded BASIC, Microcontroller, Security, GSM MODEM, ZigBee*

INTRODUCTION

Security implies guarding against unauthorized access to assets. It is an important and vital aspect of life, as everybody wants to secure life and property [1]. Homes need to be secured, as crime rate is increasing and home security has become an issue of major concern today [2]. Home and office owners require a system that can report information in the event of any intrusion when they are away from their homes or offices. There are different kind of security system, it earlier started with night guards, security dogs, weapons and so forth. The recent trend talks about sensor networked security system achieved through embedded programming. This usually sends reports in form of alarm trigger which can alert the local police or vigilante groups. Some basic automated system has only alarm while some are embedded with a monitoring service. Nowadays, automated systems are designed to send SMS to homes or office owners when intruders are detected. The challenge here is that the home owners may not be able to notice the SMS at the time it arrives. This research introduces a phone call based automated system which immediately calls the home owner in the event of burglary. This paper is an improvement to the android based GSM alert system. The previous system worked with android phones or other smart devices that can receives calls. As a result of people being busy with their work/duty, instances of burglary has been on the increase [3], and because of growing instances in cases of intrusion in people's homes, this paper introduces Zigbee Technology and its application in wireless home automation [4].

RELATED WORKS

In this paper [3], the authors sought to get around, or solve burglary-related problems by creating an SMS-based intruder detection system, in which sensors detect an intruder in event of a burglary and relays it to a microcontroller, which

instantly sends an SMS to the house-owner in real time, thus informing him of the burglary attempt.

In [5], cases of intruders interfering with transmission of data in the opening of doors, were given a lasting solution by the authors, by creating a Home/Office automation system based on wireless technologies like ZigBee, GSM and RFID. RFID tags and reader are present in the system. Also GSM could be used to wirelessly send an SMS to the user on detection of bad conditions. GSM and ZigBee are used for automating the house wirelessly.

The authors, tried solving in [4], the problem of lack of cost-effective and power-saving technologies, which make users spend much on electricity bills each time, by using ZigBee to implement smart homes, as the technology is cheap, and power-saving.

The authors [6], tried solving the problem of lack of ability in smart homes to send notice to the user(s) in occasion of adverse conditions such as burglary, by implementing a smart home, supported by a GSM embedded mobile module, which alerts users of a breach in security of their homes and central security offices too, by means of sending an SMS to their GSM/phone numbers.

Jadhav et al. [1], sought to solve the security problems created by limitations of human beings as security guards and CCTV cameras for security information, through interfacing a buzzer, a GSM modem, two cameras and sensors with an Arduino micro-controller so that on intrusion, the micro-controller calls the user, thus aiding in catching the thief. The author developed a smart home system equipped with motion sensor, smoke detector, temperature sensor, humidity sensor and light sensor that could help keep the users safe and secure [7].

Hasan et. al. [8], implemented a Bluetooth based system that uses password to open the user's door. This paper, solve the problem of alerting of intrusion through alarms in smart homes by developing a system in which on detection of an intruder, a micro-controller automatically sends an SMS to the user so that appropriate steps can be taken to catch the thief, even without the thief/burglar knowing [2].

MATERIAL AND METHOD
Proposed System
The proposed system is designed using Atmega32 microcontroller. Amega32 has three onboard communication protocols namely; UART (Universal Asynchronous Receiver and Transmitter), Inter Integrated Circuit (I2C) and Serial Peripheral Interface. It is made up of several sub-systems interfaced and designed to communicate with one another. The sub-systems are intelligent electronic systems interfaced with SIM900 GPRS MODEM and a sensing unit which include proximity and infrared sensors. The proximity sensor is placed to sense the door and window entrance while the infrared is placed to have line of sight communication in order to capture intrusion from the ceilings. SIM900 Module is a cellular protocol that interoperates with a Universal Asynchronous Receiver and Transmitter (UART) onboard communication protocol. UART is a serial communication protocol that operate in simple, half-duplex or full duplex mode. The SIM900 Tx pin is connected to UART Rx of PD0 (port 0 of Atmega32) and SIM900 Rx pin is connected to Tx of PD1 (port 1 of Atmega32) of microcontroller. This operates in full duplex mode.

The functionality of the system is implemented in software (firmware) which was written in embedded BASIC language. The various sub-systems communicate in order to make sure that the intruder detection system works. When an intruder forces open the door, proximity sensor detects instruction and communicate same to the microcontroller, which serially transmit to SIM card in the SIM900

module and thus calls the owner of the house, alerting the intrusion.

The system can be in armed and disarmed states, and it is developed such that the owner of the home can enter the home, without being seen as an intruder/thief by the system.

The system was programmed, using OSHONSOFT integrated development suite for embedded BASIC. The embedded BASIC has to be converted to a form which can be executed by the microchip. The system needs a hex file which is generated after compiling the program written in embedded BASIC. This program (called hex-file) is subsequently embedded into the microchip using Top2008 universal programmer to

ensure that all the definitions in the embedded BASIC code are actually implemented by the microcontroller.

Embedded BASIC was used because, it is simple and easy to program. With few lines of codes, you get the system working properly. Embedded BASIC is not yet popular in embedded system programming and the codes are rarely seen in the Internet. Though, it has been tested to work perfectly with real life practical model as shown in Figure 4.2 below. SIM900 Module works with AT (Attention) commands and it is used to control MODEMs. The program starts with port initialization. Here, Port D is initialized as Output and Port C is initialized as Input.

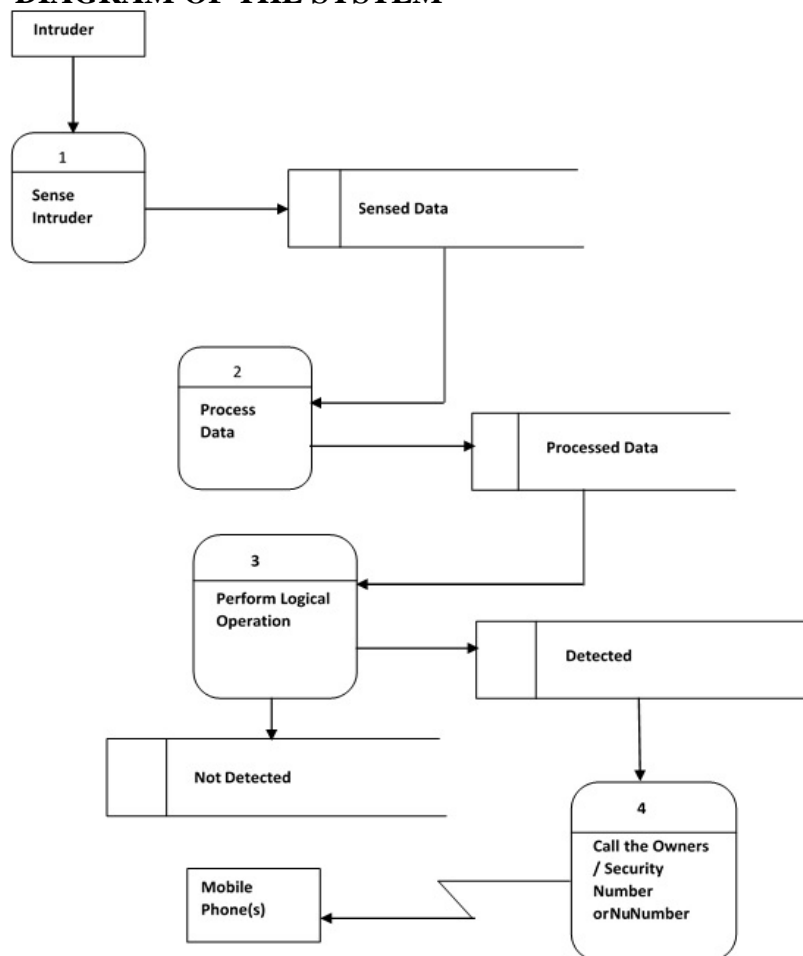## DATA FLOW DIAGRAM OF THE SYSTEM

Figure 1: Data flow Diagram

Pin description of Atmega32 Microcontroller

The system is built around the processing strength of ATMEGA32 microcontroller, which uses the Reduced Instruction Set Computing (RISC) technology. Below is the pin layout of Atmega32.
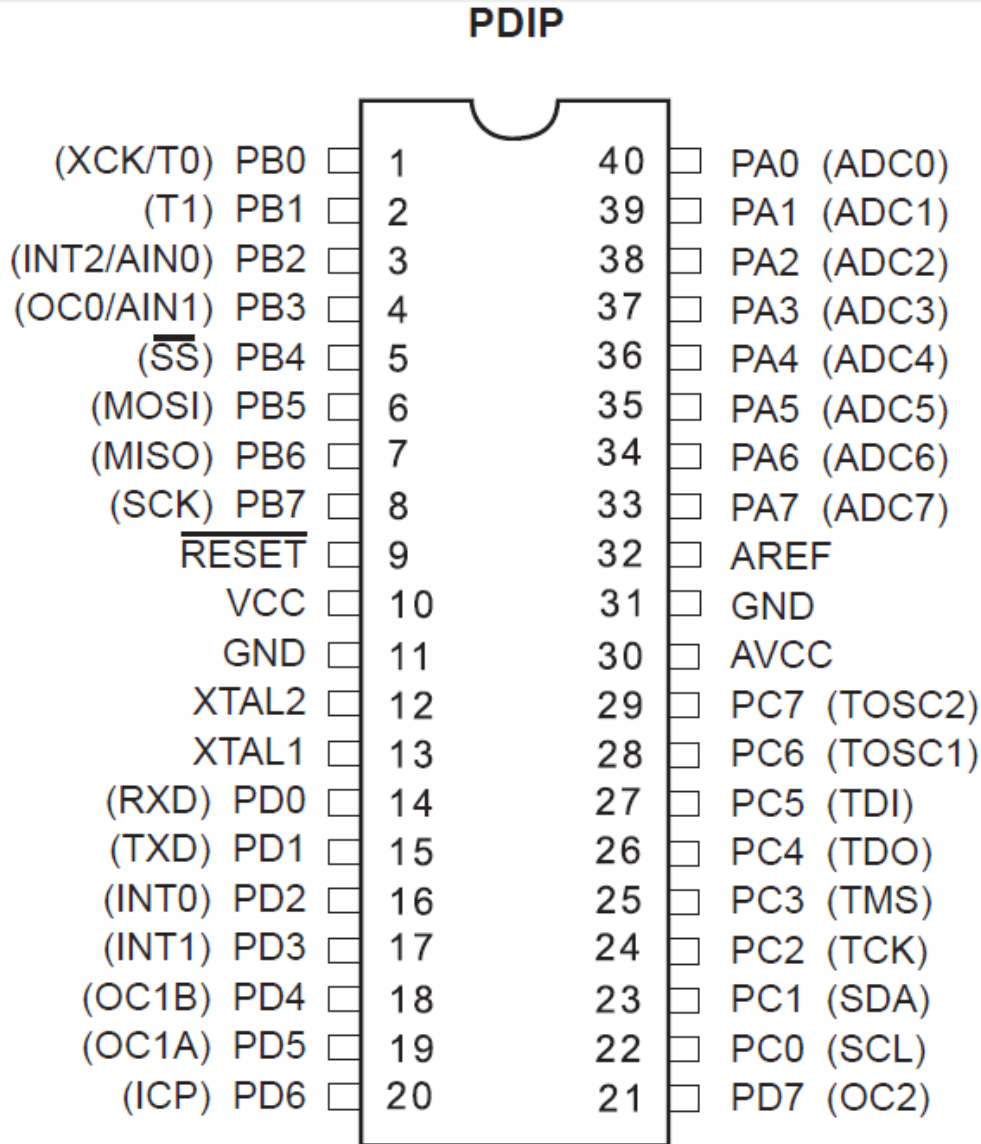

PDIP

(XCK/T0) PB0	1	40	PA0 (ADC0)
(T1) PB1	2	39	PA1 (ADC1)
(INT2/AIN0) PB2	3	38	PA2 (ADC2)
(OC0/AIN1) PB3	4	37	PA3 (ADC3)
(SS) PB4	5	36	PA4 (ADC4)
(MOSI) PB5	6	35	PA5 (ADC5)
(MISO) PB6	7	34	PA6 (ADC6)
(SCK) PB7	8	33	PA7 (ADC7)
RESET	9	32	AREF
VCC	10	31	GND
GND	11	30	AVCC
XTAL2	12	29	PC7 (TOSC2)
XTAL1	13	28	PC6 (TOSC1)
(RXD) PD0	14	27	PC5 (TDI)
(TXD) PD1	15	26	PC4 (TDO)
(INT0) PD2	16	25	PC3 (TMS)
(INT1) PD3	17	24	PC2 (TCK)
(OC1B) PD4	18	23	PC1 (SDA)
(OC1A) PD5	19	22	PC0 (SCL)
(ICP) PD6	20	21	PD7 (OC2)

Figure 2: Atmega32 Pinouts [9]

PIN DESCRIPTIONS

Port a (PA0-PA7): Atmegat32 Port A are used for two functions; first as analog inputs which is embedded with analog-to-digital converter, second, it is used as an 8-bit bidirectional input/output port if the first function is not used internally.

Port B (PB0-PB7), and Port D (PD0-PD7): port B pins are 8-bit bi-directional input/output ports. Their output buffers have symmetrical drive properties with high source and sink capability. As inputs, these are pulled low if the pull-up resistors are used. Also, it provides various special functional features of the ATmega32. Port B has SPI (Serial Peripheral Interface) protocol and port D has UART protocol.

Port C (PC0-PC7): Port C is an 8-bit bi-directional input/output port. When the Joint Test Action Group (JTAG) interface is enabled, the pull-up resistors on pins PC2 (TCK), PC3 (TMS), and PC5 (TDI)

will be activated. Port C also consists of Inter Integrated Circuit Protocol.

VCC: Digital voltage supply

GND: Ground

RESET: Reset pin is used for setting the microcontroller ATmega32 to its primary value. During the beginning of an application the RESET pin is to be set elevated for two machine rotations.

XTAL1: It is an input for the inverting oscillator amplifier and input to an internal clock operating circuit.

XTAL2: It is an output from an inverting oscillator amplifier.

AVCC: It is a supply voltage pin for analog-to-digital converter on Port A. It must be connected to VCC.

AREF: This is an analog signal reference pin for the analog to digital converter [9].

ALGORITHM AND CODE

Initialize port D as Output

(DDRD = 0xff or config Port D = Output)

Initialize port C as Input

(Config PORTC = Input or DDRC = 0x00)

Start execution

(start:)

Initiate a serial communication between the MODEM and the UART protocol of the MCU.

Delay for 1000 milliseconds

Turn echo off

Delay for 1000 milliseconds

If intruder is sensed by the sensors THEN Call phone number.

If switch is press off THEN

Deactivate the system by setting the port D to zero

Delay for 1000 milliseconds

Stop

RESULT AND DISCUSSION

The system was tested, and after powering the system, on detection of an intruder by the sensors, the system made an automatic call to the phone number stored in its memory. The system was found, after testing, to work on various kinds of phone with different mobile operating systems, ranging from smart phones like Android, to small, non-internet-connected phones like Nokia Torch.

Figure 3: Call Alert on Intruder Detection by the System.

CONCLUSION

The issue of keeping a secure home and office is not as easy as one may think. Research has shown that many security systems are vulnerable to penetration by intruders. The fact that security personnel are not adequately enough for security, and that alarm systems are too common to effectively repel an intrusion, limits the effectiveness of the SMS based and other GSM based existing system.

Embedded BASIC Based Phone Call Burglary Security Alert System as introduced in this paper effectively solves the above-mentioned problems, as intrusions are detected and the home/office owner alerted of the intrusion via phone calls in real time, so that the appropriate security agencies may be contacted in time for security measures to be taken to catch the intruder. An embedded BASIC was introduced as the programming language used in developing the system.

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