A Smart Home Security System Based On Arm7 Processor

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Abstract

Security has becoming an important issue everywhere. Home security is becoming necessary nowadays as the possibilities of intrusion are increasing day by day. Safety from theft, leaking of raw gas and fire are the most important requirements of home security system for people. A traditional communications based security systems provides enhanced security as whenever a signal from sensor occurs, a text message is sent to a desired number to take necessary actions.

This paper suggests two methods for home security system. The first system uses web camera. Whenever there is a motion in front of the camera, it gives security alert in terms of sound and a mail is delivered to the owner. The second method sends SMS which uses GSM-GPS Module (sim548c) and lpc2148 microcontroller, sensors, relays and buzzers.

1. Introduction

Smart Home can be also known as Automated Home or intelligent home which indicates the automation of daily tasks with electrical appliances used in homes. This could be the control of lights, fans, viewing of the house interiors for surveillance purposes or giving the alarm alteration or indication in case of gas leakage.

Home security has changed a lot from the last century and will be changing in coming years . Security is an important aspect or feature in the smart home applications. The new and emerging concept of smart homes offers a comfortable, convenient, and safe environment for occupants. Conventional security systems keep homeowners, and their property, safe from intruders by giving the indication in terms of alarm. However, a smart home security system offers many more benefits.

This paper mainly focuses on the security of a home when the user is away from the place. Two systems are proposed, one is based on GSM technology and other uses web camera to detect the intruder.

The first security system uses a web camera, installed in house premises, which is operated by software installed on the PC and it uses Internet for communication. The camera detects motion of any intruder in front of the camera dimensions or camera range. The software communicates to the intended user via Internet network and at the same time it gives sound alert.

The second security system is SMS based and uses GSM technology to send the SMS to the owner. The proposed system is aimed at the security of Home against Intruders and Fire.

In any of the above cases happens while the owners are out of their home then the device sends SMS to the emergency number which is provided to the system. The system is made up of three components: sensors, GSM Module , arm7 processor, relays to control the device and buzzers to give security alert signal in terms of sound and also 3 algorithms are used in the system: a) LDA b) HMM c) SVM

2. Proposed System

A model of smart home is prepared using low cost materials like acrylic, plywood *etc.*, having sufficient strength to test the prototype of developed system. It consists of various sensors like IR, temperature sensor, gas sensors, light sensor etc. Home appliances like LED lights and fans are also connected to make the home energy efficient. The proposed system is

controlled by an lpc2148 processor. It collects information from the sensors, makes a decision and sends SMS to a corresponding number by using a GSM modem. If it finds any interruption in its sensors (for example IR sensor) then microcontroller will send a SMS to the home owner. In the same way if the temperature is increased above certain point or gas sensor sensors is ON, a SMS will be sent to the home owner 'Fire at home' giving the indication of fire.

Basic Functional Block diagram
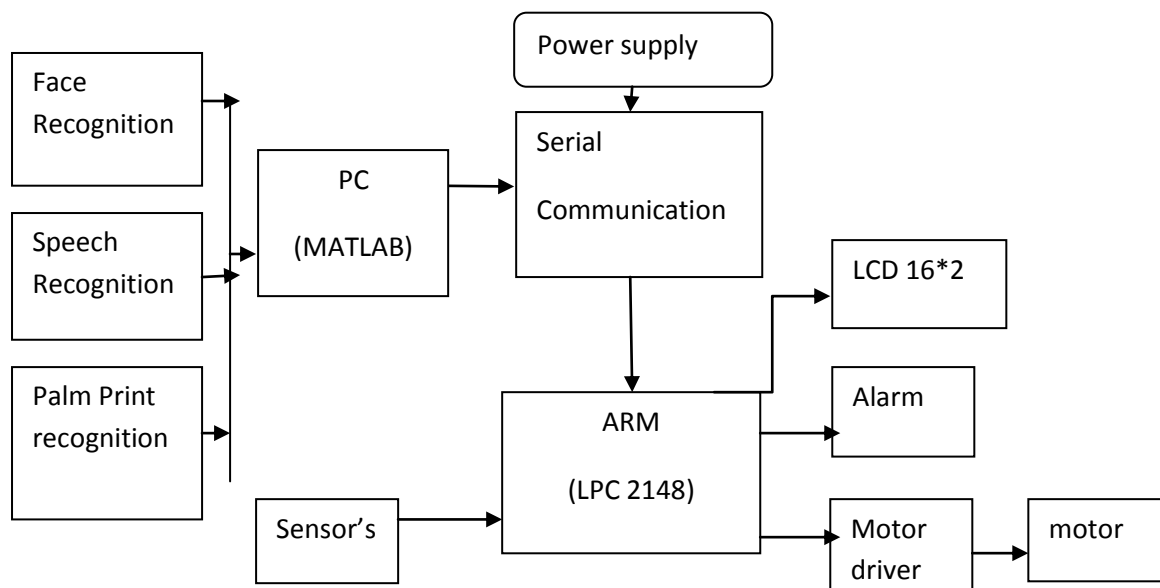
3. Hardware Design

Hardware of the system contains sensors, LPC2148 microcontroller, Buzzer, in system programmer and relays to control the appliances. The outputs of all the sensors are connected to ADC. One IR is connected at window and other is at door. The entry from the window is treated as unauthorized entry and entry from door is treated as authorized entry. If there is authorized entry inside the home, lights will be turn ON after checking the light intensity in a room and for unauthorized entry buzzer will be turned ON. Temperature is continuously monitored, if it is high (greater than 45 degree) in case of fire, a SMS is sent ("Fire at home") to the home owner. If gas sensor is ON indicating the gas leakage then SMS will be send to the owner ('Gas Leakage').

3.1. Microcontroller Unit

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The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S

CPU with real-time emulation and embedded trace support, that combine microcontrollerwith embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit widememory interface and a unique accelerator architecture enable 32-bit code execution atthe maximum clock rate. For critical code size applications, the alternative 16-bit Thumbmode reduces code by more than 30 % with minimal performance penalty.Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal forapplications where miniaturization is a key requirement, such as access control andpoint-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device,multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kB up to 40 kB, make thesedevices very well suited for communication gateways and protocol converters, softmodems, voice recognition and low end imaging, providing both large buffer size and highprocessing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWMchannels and 45 fast GPIO lines with up to nine edge or level sensitive external interruptpins make these microcontrollers suitable for industrial control and medical systems

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3.2. Sensors used in the System

Infrared (IR) sensors are used to detect the intruder. They are used at doors and at windows. The IR pair that is IR transmitter and IR receiver detects the obstacle within the range of 5-6 feet. The LM35 is used as temperature sensor whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. It gives linear output 10.0 mV/0 C as scale factor.

3.3 GSM

GSM was designed with a moderate level of service security. The system was designed to authenticate the subscriber using apre-shared key and challenge-response. Communications between the subscriber and the base station can be encrypted. The development ofUMTS introduces an optional Universal Subscriber Identity Module (USIM), that uses a longer authentication key to give greater security, as well as mutually authenticating the network and the user - whereas GSM only authenticates the user to the network (and not vice versa). The security model therefore offers confidentiality and authentication, but limited authorization capabilities, and no non-repudiation.

GSM uses several cryptographic algorithms for security. Although security issues remain for GSM newer standards and algorithms may address this. New attacks are growing in the wild which take advantage of poor security implementations, architecture and development for smart phone applications.

4. Software Design

MATLAB is a software package for high performance numerical computation & visualization. It provides an iterative environment with hundreds of built in function for technical computation, graphics & animations. MATLAB is an abbreviation of Matrix Laboratory. It is a popular Mathematical Programming Environment used extensively in Education as well as in Industry. The trick behind MATLAB is that everything is represented in the form of arrays or matrices. Mathematical Operations starting from simple algebra to complex calculus may be conveniently carried out using this environment. The main use of MATLAB in Software Development is Algorithm Design and Development. Code developed in MATLAB can be converted into C, C++ or Visual C++. Additionally MATLAB may be called as ActiveX Object from still higher level languages like Visual Basic, etc.

MATLAB Basics:

In MATLAB we can declare matrix in various forms like simple declaration, null matrix and matrix with ones, identity matrix, random matrix, vector matrix, scalar matrix. In MATLAB four types of arithmetic can be performed on matrices such as addition, subtraction, multiplication and division. Using MATLAB it is easy to manipulate matrices by addressing of individual element, complete row addressing, complete column addressing and transposing one matrix to another required matrix.

Saving and loading data, defining functions and m-files is user friendly in MATLAB. Commonly used commands in MATLAB are Whos, Help, Clear, Path, Cd, Dir, Look for.

5.FLOWCHART

```
          ┌───────────┐
          │   start   │
          └─────┬─────┘
                │
    ┌───────────────────────────┐
    │ Initialize lcd, relay, adc etc.. │
    └───────────┬───────────────┘
                │
    ┌───────────────────────────┐
    │ Take output of all sensors │
    └───────────┬───────────────┘
                │
          ╱─────────────╲        yes
         ╱ If window      ╲──────────────▶ ┌──────────────────────────────┐
         ╲ sensor is on   ╱                │ Turn on buzzer (unauthorized entry) │
          ╲─────────────╱                  └──────────────────────────────┘
                │ no
          ╱─────────────╲        yes
         ╱ If temp sensor ╲──────────────▶ ┌──────────────────────────────┐
         ╲ on             ╱                │ Turn on buzzer ,sentsms 'fire at home' │
          ╲─────────────╱                  └──────────────────────────────┘
                │ no
          ╱─────────────╲        yes
         ╱ If smoke sensor ╲─────────────▶ ┌──────────────────────────────┐
         ╲ on              ╱               │ Turn on buzzer, sent sms 'fire at home' │
          ╲─────────────╱                  └──────────────────────────────┘
                │ no
          ┌───────────┐
          │   stop    │
          └───────────┘
```
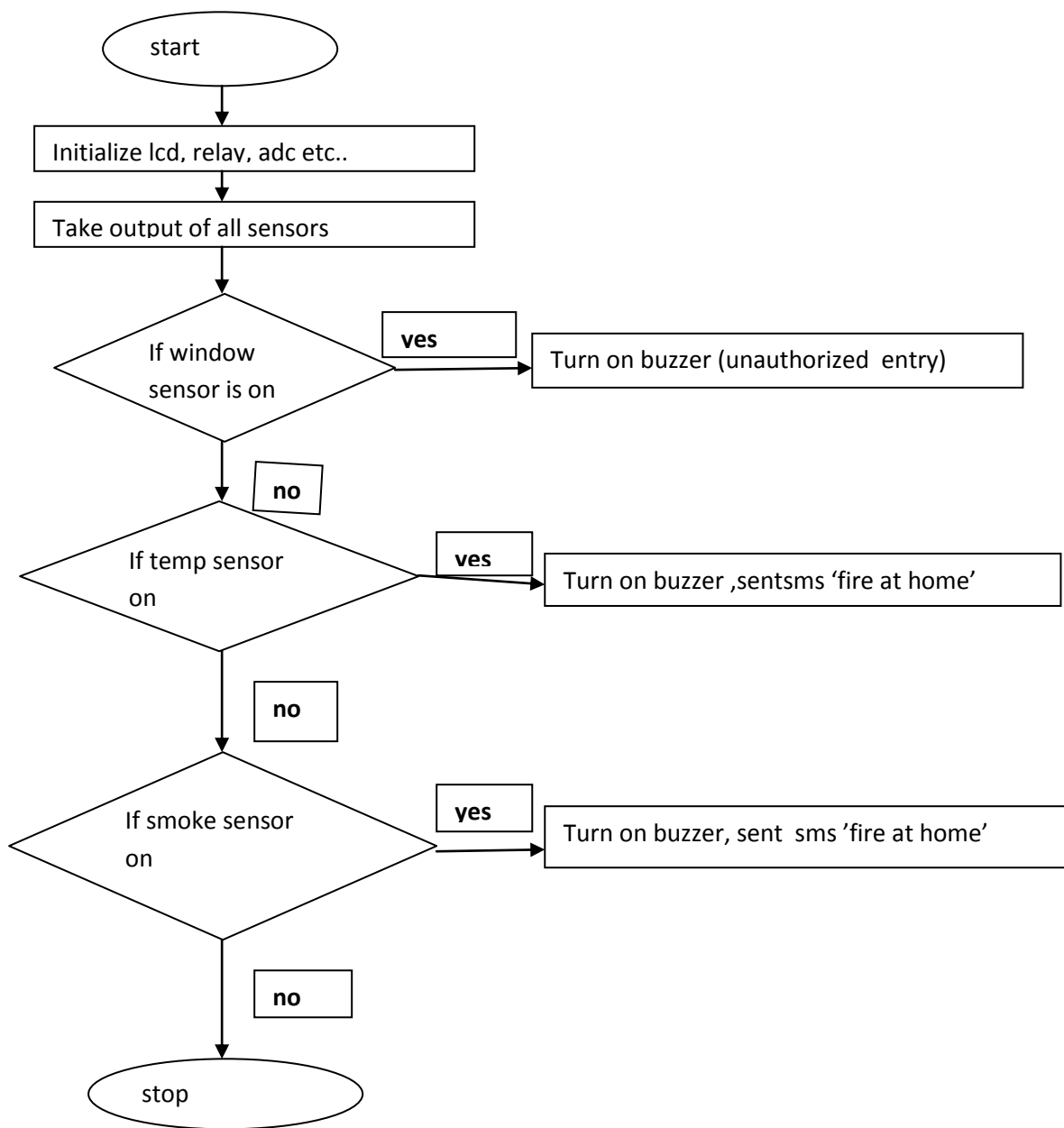
6. Results and Discussions

The proposed systems are tested on the model of smart home.The web camera based security system detects the motion and sends email to the home owner. The system is very simple and easy to use. There are various parameters which can be adjusted in this software. Streaming of videos is also possible with this software.
The developed GSM based security system gives good response to the sensor and sends SMS when it detects the fire or temperature is increased above desired level or detection of intrusion at the windows. The time taken by the system to deliver the SMS is dependent on the coverage area or range of the specified mobile network. If the mobile is in the range of the system then the SMS is delivered in 25-30 seconds.

Advantages of the proposed system:

1. As the system is SMS based, there is no need to have extra circuitry to transmit SMS. Mobile networks are used for transmission.
2. It is very cost effective, as day by day the cost of SMS is reducing.
3.Confidence in information4.Information cannot be lost5.Highly reliable6.More convenient7.Increases security

Drawbacks of the proposed system:

1. All over the world, there could be a area where the mobile network is not established, so no connectivity of mobile phones in that area. Therefore, SMS cannot be delivered.

2. Older people still are not familiar with the use of mobile and find it difficult to see the SMS on mobile.

7. Conclusions

The GSM based home security system has been designed and tested with the mobile network. The user can get alerts anywhere through the GSM technology thus making the system location independent. A flexible way to control and explore the services of the mobile. The communication of home is only through the SMS which has been tested with the mobile networks and is working on any mobile network.The web camera based security system is very easy, user friendly and software has many features. It will be more easy to use IP camera instead of web camera. However, the cost of IP camera is more. Similar softwares are available on internet which will perform the same task. This type of system is useful when the owner is out of station and the home is locked. By installing the web camera at the door site, intruder can be detected and owner can receive a mail telling the intruder entry in a home. If the nearby police station email id is also configured in the system, then the intrusion mail can be received by police also and necessary action can be taken.

The system has tested on the model of smart home and further it will be tested in actual home. The complexity of the algorithm of the system can be increased by introducing number of sensors to make the energy efficient home.

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