Contents

1 Introduction

Lifestyle in the modern society along with human behaviour and thinking is changing dramatically with the advancement of technology, and the concept of a simple home is changing into a smart home. The advancement of technology has increased the safety and security of people along with their belongings. One of the reasons for the rise of the smart home is the increasing risk of burglary and robbery and the busy lifestyle. The busy lifestyle of people is leading to the necessity of controlling the devices at home remotely and increasing the necessity of keeping surveillance over their homes.

Mobile phones today are not just used to make calls. The use of mobile phones is changing with the development of technology and they can be used for different purposes. They can be used as clocks, calendars or controllers instead of being used just as phones. Today smart phones are available in the market with different applications and hardware which can be implemented without any further development or enhancement. With the help of the GSM network, a mobile can be used to implement a smart home by controlling devices and getting alerts on robbery and burglary.

There are different types of built smart home systems in the market, and they do not have flexibility over choosing the types and number of sensors used and the cost of the system. These systems are prebuilt devices with a limited number of sensors, with a limited area of coverage and with a limited capacity to control the electronic devices. Therefore the idea of a smart home system was proposed, to overcome the limitations of the systems already available in the market. The user can choose the number of sensors, types of sensors, the area of coverage of the systems along with the number and types of electronic devices to be controlled. The cost of the system can be determined by the user as the cost depends on the hardware used in the system chosen by the developer.

The goal of the project is to implement a smart home system by controlling the electronic devices at home remotely with the help of a mobile device and getting alerts on intrusion or movement around the restricted premises. The SIM900-GPRS module and the Arduino Uno Board are used to communicate between the mobile phone and the devices and sensors installed at home. The mobile phone can be used as a controller

from anywhere in the world if the GSM network is available. The project consists of a led light which is controlled by the mobile phone to show the demo of controlling mechanism of the household devices such as light, fan or television. In addition, three sensors are used as a heat detector, motion detector and intrusion detector which trigger the alarm upon reaching the critical limit. The system is limited to the area with the GSM network available and the whole system does not work without the network.

The block diagram of AVR CPU Core architecture is shown in figure 3. The fast-access Register File contains 32 x 8 bit general-purpose working registers with a single cycle access time which results in a single-cycle ALU operation. The arithmetic and logical operations between the registers or between the constant and a register are supported by the ALU. The status register is updated to reflect information about the result of the operation after an arithmetic operation. [3]

The boot program section and the application program section are the two main sections of the program flash memory. Stack stores the return address of the program counter during the interrupts and subroutine calls which is allocated in the general data SRAM. The size of the stack is limited by the total size and usage of the SRAM. The data SRAM is accessible through five different addressing modes supported in the AVR architecture while the stack pointer is read/write accessible in the I/O space. The memory spaces in the AVR architecture are all linear and regular memory maps. [3]

2.2 GPRS/GSM Network

Literally, the GSM stands for Global System for Mobile Communication. The subscription and the mobile equipment are separated in the GSM, unlike in analog networks where the two are not separated. The smart card handling and storing a subscriber's data is the SIM (Subscriber Identity Module) card whereas the radio equipment is called mobile equipment. Hence, the combination of the Subscriber Identity Module and the mobile equipment is the mobile station. SMS (Short Messaging Service) is one of the services integrated in the GSM, which provides a means of sending messages of a limited size to and from the mobile stations. The handling of the SMS is done by the SMSC (Short Message Service Center) which has to be supported by the GSM network for the transfer of messages between the SMSC and the mobile stations. [4,212-216]

The GPRS (General Packet Radio Service) is a packet-switched transmission service supplementing the Circuit Switched data and Short Message Service over the mobile telephone network [4,229]. The circuit switched network architecture is upgraded to packet switched network by adding a couple of new infrastructure nodes and making a software upgrade to the existing network elements. The GPRS is a less costly mobile data service compared to SMS and Circuit Switched Data and the information is transmitted more quickly, immediately and efficiently across the mobile network. Several

Panasonic Passive Infrared Motion Sensor

The motion sensor is manufactured by Panasonic and it is available in different types and different colours with a varying detection range. The sensors have simplified circuitry with fully integrated sensor design which eliminates external sensing circuits. The robust design of the sensor prevents false detection. The adverse effects of the external electromagnetic fields are minimised by enclosing the sensing circuit of the sensors in a metallic can. In addition, the high S/N ratio minimises sensitivity to false tripping when operated under various conditions. In spite of the ferroelectric ceramic (PZT) containing lead, lithium tantalate are used as a sensing element which is lead-free. [18]

Despite the different measures used to minimise the false detection, sensor might give false detection in many cases, for example a small animal entering the detection area, light source directly hitting the sensor, a sudden temperature change in the detection area etc. Similarly there will be difficulty in sensing the source if there is glass, acrylic or similar materials in between the target and the sensor as these materials may not allow correct transmission of infrared rays. [18]

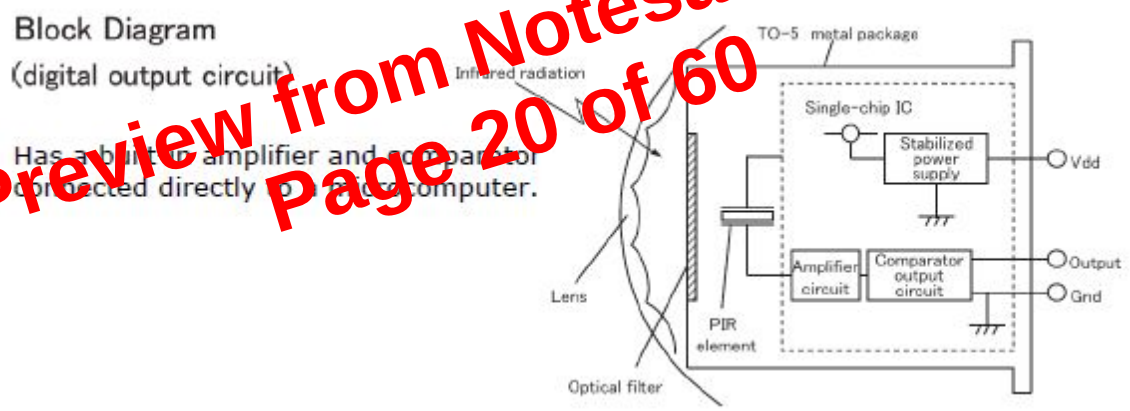

Figure 5: Block diagram of the Panasonic Passive Infrared Sensor
Reprinted from Datasheet of Infrared Sensor[18]

Figure 5 illustrates the block diagram of the Panasonic Passive Infrared Sensor. The sensing element (PIR element) along with the sensing circuit is enclosed inside the metal package. The output of the sensor is a digital output (either high or low). The stabilised power supply of 3.0 to 6.0 V should be used as the noise in the power supply

the frame, which means that the sensor moves far from the magnet and the output of the sensor goes high. The C-code implementation for interfacing the proximity sensor is shown below:

```
int door_sensor=9;
pinMode(door_sensor,INPUT);
door_output=digitalRead(door_sensor);
if(door_output == LOW){
          SMS_conten_flag_door=1;
          send_SMS();
}
```

Listing 5: C-code compilation for interfacing proximity sensor

The C-code language for the interfacing and implementation of a proximity sensor is shown in listing 5. The output of the sensor (either high or low) is read by the function digitalRead. The output of the sensor goes low whenever the south pole of the magnet comes close to the sensor and it sends the message. In this application, an SMS is sent whenever the south pole of the magnet comes close to the sensor opposite to the implementation of the door sensor installed at door/window explained above listing 5. However the mechanism is the same and the implementation of the application can be changed by changing a single C-code in the program.

3.4 Implementation of remotely managed light system

There are many electronic devices in the home whose status is unknown (on or off) and which could be left on unknowingly or accidently. The status of the device has to be known by the owner, and if the device is on, it has to be turned off. It is not always possible to go back home and turn the devices off. There arises a need to manage the electronic devices remotely to prevent the risk of some accidents as well as to decrease the use of electricity. There are different ways to implement remotely managed electronic devices, for example management using the Ethernet, management using wireless devices or management using the GPRS/GSM module. The electronic device (the light system) is managed remotely using the GPRS/GSM module (especially using the SMS) in this project. In this application, light is managed remotely, and the light represents the electronic devices as a whole. Since the light uses a 220V AC current and the arduino can provide only a 5V DC current, a relay is used in between the ardu-

Figure 18: Screenshot of the mobile station managing the light remotely

Figure 18 shows a screenshot of management of electronic devices (light system) by the mobile station (i.e. the mobile phone). As can be seen from figure 18, the microcontroller will send a response to the mobile phone as an SMS mentioning whether the light is on or off upon the instruction (state of light) sent by the mobile phone. The light can be turned on and off by the SMS which can be visualised, and the response to the instruction will also be different when the light is on or off which can be seen in figure 18.

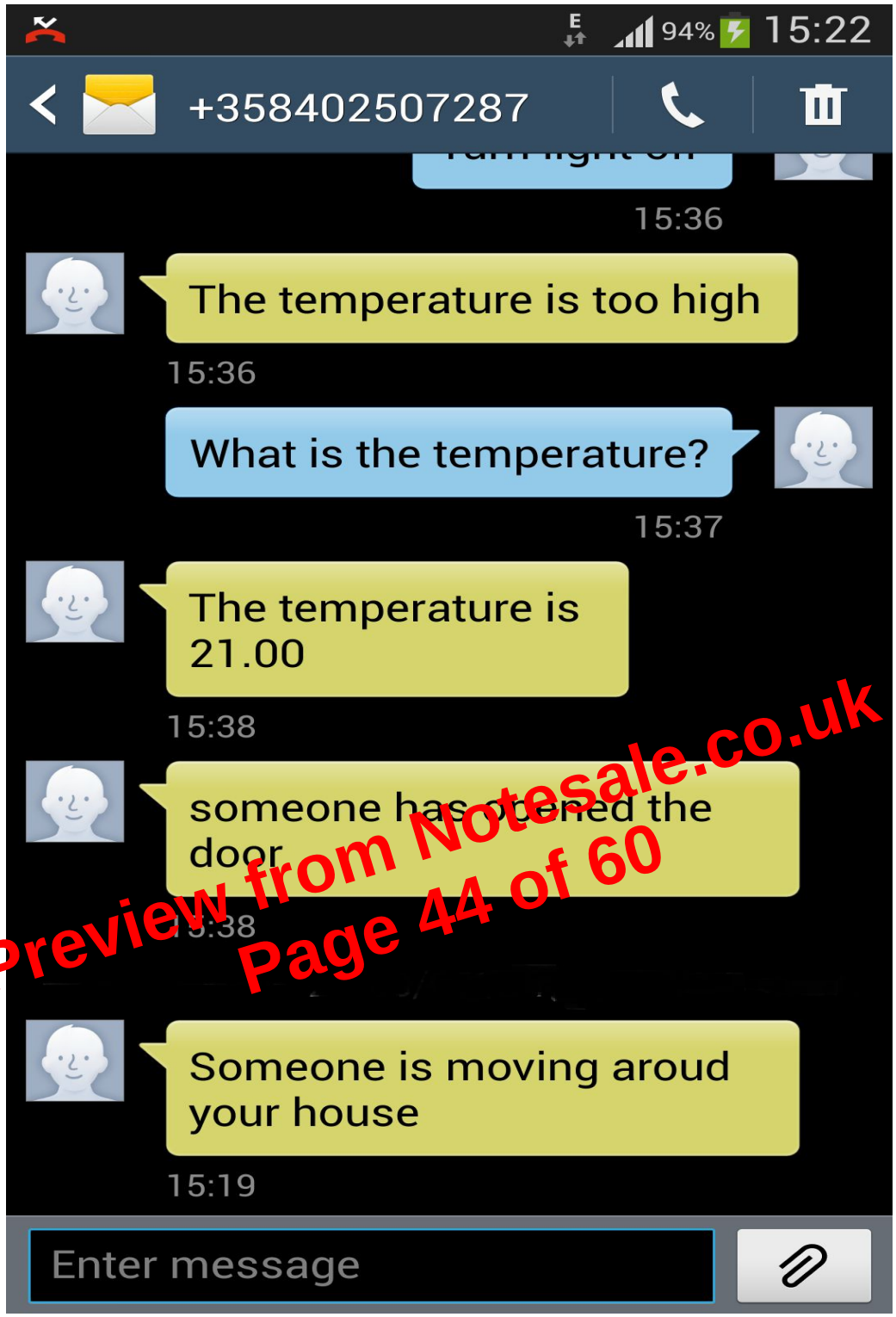

Figure 19: Screenshot of the response and alarms received by the mobile station

Figure 19 shows a response sent to the mobile station upon the instruction (What is the temperature?) sent by the mobile station and the alarms triggered upon the critical condition. The SMS sent by the microcontroller is different for the alarms triggered by

5 Discussion

The development of technology has been affecting the life style of people. They are dependent on technology even to carry out daily activities and technology has made the lifestyle more sophisticated and relaxing. It seems as if it was impossible to live without technology in this century. Advanced technology has replaced the traditional lifestyle of people. For example, a coffee machine has replaced the traditional way of coffee making, finger-print and voice-controlled electronic lock have replaced traditional locks, electronic news and media have replaced the traditional paper news and media, bank cards and online shopping have replaced the traditional cash and shopping. The examples mentioned above are a few least advanced technologies replacing the traditional lifestyle. Besides these, there are many advanced technologies used by people for different purposes, they are playing significant roles in changing the lifestyle of people. With the development of technology, the concept of simple home has also been changing into smart home and the concept of home has changed drastically during the last decade.

The advancement of technology has not only played a significant role in the development of positive aspects but has also played an important role in the development of negative aspects. It has increased the risk of burglary and intrusion using the latest modern technologies available. The busy lifestyle of human beings along with the increasing risk has led to the necessity of remote surveillance of homes. There are different ways to have the surveillance but the easiest and most advanced technology accessible to everybody is mobile phone surveillance. The mobile phone can be used for different purposes with the help of the applications developed for the phones.

This project was a simple application project demonstrating a smart home system. The led light (representing the electronic devices) is controlled by the mobile phone using the SMS service and the surveillance of the home is done using the mobile phone. The mobile phone gets alerts on intrusion or movement around the restricted premises along with the rise in temperature above the limit. The movements and the temperature are detected by installing sensors at different places. The temperature of the premises where the sensors are installed can be known at any time before reaching the critical limit set by the user. The intrusion is detected by the hall effect proximity sensor, movement by the PIR sensor and temperature by the temperature sensor.

```
    if(temp > 23)                                          //if the
temperature exceeds 45C,sends an sms to the number
    {
      count_temp=count_temp+1;
      Serial.println(count_temp);

      if(count_temp == 1 || count_temp == 5*ind_temp){
//sends the sms message after each 5 temperature value
greater than critical set
        //digitalWrite(alarm_light,HIGH);
        sms_content_flag_critical = 1;
        send_sms();
      }

    }
  }


/*************************************************************
******
                        READ THE DOOR SENSOR

*************************************************************
******/

  void read_doorsensor()
  {
  door_output = digitalRead(door_snsr);
  delay(1000);
  Serial.println(door_output);

  if(door_output == LOW){
    sms_content_flag_door = 1;
    send_sms();
    }
  }


/*************************************************************
                            READ THE PIR SENSOR

*************************************************************
**/

  void read_pirsensor()
  {
  pir_output = digitalRead(pir_snsr);
  delay(1000);
```