Multi-effectiveness Smart Home Monitoring System Based Artificial Intelligence through Arduino

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Abstract: The growing presence of electronic systems and devices within the residential environment, Along with human desire to simplify the daily routine of life, these things combined have generated a growing interest in the pasture of home automation and smart environments. Home automation refers to the control of the local home appliances and features across the local network or via remote control. Artificial Intelligence equips us with the framework to make a decision in real-time automation of the Internet of things.

This paper provides a lower cost, safe and flexible integrated home automation and security system. It anticipates an integral part of the Arduino microcontroller and 1 Shield, by means of access and control of devices and appliances remotely. In order to prove the practicability and effectiveness of this system, the Arduino device controls sensors and motors that monitor a specific location and take appropriate action based on specific parameters such as ambient lighting, temperature etc.

Arduino can also send alerts if it detects any abnormalities. Voice recognition allows the user to use voice commands to control home devices such as light switches, power plug, and temperature sensors, gas sensors and motion sensors that have been incorporated with the proposed home control system. In this modern era, it will be a good application for people paralyzed and domestic security. The smart home system has been experienced and proven to be capable of performing intelligent home processes such as switching functions, automatic environmental control, and intrusion detection, in a later case where an email message, message, image and siren are generated and sent to the mobile phone.

Key words: Arduino, artificial intelligence, home automation, sensors, voice recognition.

1. Introduction

As technology advances, things become simpler and easier for us. Automation is the use of control and information technology systems to reduce the need for human labor in the production of goods and services. At present, security systems play an important role in shielding the lives and investment. This is achieved by establishing various subsystems in the security system with one control unit such as intruder control, access control, fire detection, etc. The smart home is deposit up with lighting, heating and electronic devices that can be controlled remotely by Smartphone [1], [2]. With the development of technology assistance has been provided, home security has become necessary at present and the chances of infiltration are increasing day by day. Safety from theft and fire are the most important requirements of the home security system for people. The traditional home security system gives signals in terms of alarm [3], [4].

Smart home is a very promising subject, which have different benefits such as providing more comfort, increase safety and security, and more rational use of energy and other resources and thus contribute to

significant savings [5]. In addition, smart homes offer more enhanced security measures, and reducing the number of remote tasks, and provide an increase in smart entertainment environment looks at the state of the house through the sensors and operate intelligently on the environment through [6].

Intelligence built-in smart homes through a large deployment of elements of the sensor computing and communications along with pattern recognition and prediction algorithms control the adaptive provide new opportunities to improve resources, security and automation management solutions and health monitoring in smart homes in the future. In particular, activity and demand forecasting of smart home residents are the key enabling factors for many of the smart home services such as efficient power management and automation of the house [7].

One of the important issues everywhere is security. Security of the house has become necessary at present as the chances of infiltration are increasing day by day. This research takes the opportunity to implement various techniques to help people to protect and monitor remote home appliances with advanced technology becoming simpler and easier for us. Automatic system preferred rather on the manual system [8].

The aim of this research is to develop a system that allows the user to remotely control and monitor multiple home / office devices using a cell phone. This system will be a powerful and flexible tool that will provide this service at any time, and from any place with no restrictions on the techniques that are being applied. Our system application comes in handy when people who forget to do simple things like run-on / off devices in their home or in their office, they can now do so without their presence through a simple voice command from their mobile phones.

We believe that this development will end up a lot of time, especially when people do not have to go home for simple things like converting on / off keys at home or in their office once they determine their work. This paper is organized into five sections presented as follows: **Section 2** gives a glimpse of previous work in the field of Smart Homes, **Section 3** a survey of Smart homes and their components are reviewed, **Section 4** gives elaborate details of the design and implementation of a smart home system, and **Section 5** presents the conclusion and suggestions for future work.

2.   Literature Review

A further important service smart home technology provides for its population is security. Traditional home security systems help secure the house from intruders, while the smart home security systems offer more benefits such as fire detection and smoke, intruder detection, monitoring and home monitoring. Here, we briefly review a few of the actions related to security smart home.

In [9], the authors converse smart home security application reviews and tools and technologies to provide security services for smart home residents. Devices such as fire, smoke and alarm sensors can protect the population by notifying them in the case of emergency. Motion detectors, cameras, and security codes, etc. provide a means for securing smart home buildings by determining whether a person is a resident or intruder. These passive sensors can also learn the normal movements of the population such as the elderly, and therefore, users are notified or family members in the event of an emergency or strange movement patterns.

A simple system was proposed by [10] which allowed the user to control the lights in their home via their mobile phones. The system consists of devices Arduino board with Bluetooth capability, Relay-related digital outputs to switch, Bluetooth phone capable of running any Symbian operating system. Easy-to-use hardware implementation and is also readily available.

The authors in [11] A system improves energy efficiency and comfort of the user at the same time. Using case described by the authors to manage the heating system in an innovative building. To do so accurately, the system requires knowledge of the required temperature, occupancy and detailed information on the buildings of thermal inertia table. Cases, not all of this information is available, so the system described makes use of the current degree of internal and external temperature, the temperature required, and a table filled.

3. Home Automation System

Home automation is home computing based business or home work. It may include home automation control unit to control lighting, , heating, , cooling machines ; in addition to various frameworks to provide enhanced isolation and provide better energy security, productivity and housing. The idea of home automation was around for a while, and the items were available for a large number of years, however, no one had gotten through to the standard yet. Household computing for the elderly and the physically challenged can increase personal satisfaction for people who may generally need parental numbers or institutionalized consideration. You can also give the interface to remote devices or home automation system itself, through the phone line, and move the remote or on the Internet, to give control and surveillance and control via smart phones or Web Explorer program [12], [13].

3.1. Smart Home Application Areas

One way to classify research efforts for a smart home is based on the areas of application or services offered by smart home technologies to its inhabitants. These actions focus on improving these services based on the areas of application. Here we mention the summary of the three main applications of smart homes including resources, health, and security and application management areas [14], [15].

3.1.1. Resource management applications

Intrinsically, numerous research efforts in the locus of smart homes spotlight on analyzing resource demands of residents, predicting demands and contemplate new algorithms for ameliorating the resource utilization in the smart homes. A huge share of such works concentrates on automation and optimization of the heating/cooling systems and lighting systems for smart homes. Furthermore the heating/cooling and lighting systems, a large body of work is emerging in general electricity consumption management for smart homes, while bearing in mind the smart grid status, renewable energy availabilities and electric vehicle charging scheduling in smart homes [14].   Automation and optimization of water resources for smart homes for better water conservation is another important area of resource management for smart homes.

3.1.2. Security applications

Security is another important service that smart home technology can offer to its inhabitants. Traditional home security systems help secure the home from intruders, while the smart home security systems offer more benefits such as fire detection and smoke, intruder detection, monitoring and home monitoring. [14].

3.1.3. Health-care and elderly-care applications

Older people and some patients want to stay independent at home. Required to ensure their safety at home monitoring and remote care, which can be implemented based on smart home technologies. The detection of falling health monitoring and medication directed are a few examples of health-care services and care for the elderly. This should be the implementation of these services without user inconvenience, and without interference or causing any restrictions on the movement. Several research efforts focus on different types of these services have been made [14].

3.2. Physical Components for Smart-Home

Smart home appliance is an interface between the remote control with its mobile or remote control and a home reliever. For each device, in order to accomplish this interface design process was taken using the 1shiled and Arduino for controlling some application in the home by voice commands and automatically through different sensors.

Each system application will be discussed. The block diagram of complete Smart Home System is shown in (Fig.4). Different types of secondary connectivity between remote or smart phone and micro controller is established through (GSM and Bluetooth) modules. The two previous modules can be connected through Arduino. A specific 1 shield android application has been used such that different home electronic devices can be controlled using a smart phone remotely.

3.2.1. Arduino

Arduino is an instrument used to build a better version of a computer which can control, interact and sense more than a normal desktop computer. It's an open-source physical processing stage focused around a straightforward microcontroller board, and an environment for composing programs for the board.

Arduino can be utilized to create interactive items, taking inputs from a diverse collection of switches or sensors, and controlling an assortment of lights, engines, and other physical outputs. Arduino activities can be remaining solitary, or they can be associated with programs running on your machine .The board can be amassed by hand or bought preassembled as seen in (Fig.1); the open-source IDE can be downloaded free of charge. Focused around the Processing media programming environment, the Arduino programming language is an execution of Wiring, a comparative physical computing platform [16], [17].

Fig. 1. Arduino UNOR3 microcontroller board.

3.2.2. 1 sheeld

Sheeld is a new easily configured shield for Arduino as shown in (Fig.2). It is connected to a mobile app that allows the usage of all of Android Smartphone's' capabilities such as LCD Screen, Gyroscope, Switches, LEDs, Accelerometer, Magnetometer, GSM, Wi-Fi, and GPS …etc. into your Arduino sketch.

On the whole, the first part is a shield that is physically connected to your Arduino board and acts as a wireless middle-man, piping data between Arduino and any Android Smartphone via Bluetooth. The second part is a software platform and app on Android Smartphone's that manages the communication between the shield and the Smartphone and give the opportunity to choose between different available shields. [18].

Fig. 2. 1 sheeld.

3.2.3. GSM

GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band [17], [19].

3.2.4. Bluetooth technology

Bluetooth is a standard utilized part of connections of radio of short extension, bound to substitute connections which use wires between electronic gadgets like personal digital assistants (PDA), cell phones, personal computers (PC), Laptops, and numerous different gadgets. Bluetooth technology can be utilized at homes, offices, schools, hospitals and in cars. Users can get instantaneous connections with several kinds of devices through this technology continuously.

The method for transmission utilized guarantees security against external interference and well-being in sending out data. Between the essential qualities, these must be mentioned; the strength, low cost, small consume of energy low complexity and the ease of use. The Bluetooth is a little microchip that works in a band of accessible recurrence all through the world. Correspondences can acknowledge point to point and point to multipoint [17] [19].

3.2.5. Sensors

Sensors are electronic devices that measure a physical quality such as light or temperature and convert it to a voltage. This process of changing one form of energy into another is called transduction. Often, sensors are also referred to as transducers. Sensors can be broadly classified in two categories: digital sensors and analog sensors. A digital sensor's output can only be in one of two possible states. It is either ON (1) often +5V, or OFF (0) - 0V. Most digital sensors work with a threshold. Is the incoming measurement below the threshold, the sensor will output one state, is it above the threshold, the sensor will output the other state. In contrast to a digital sensor, an analog sensor's output can assume any possible value in a given range. Very often the output of an analog sensor is a variable resistance that can be used to control a voltage. Rather than only being able to toggle between two states , the analog sensor can output an almost infinite range of values. In (Fig.3) we will take a look at a couple of digital and analog sensors. It was not feasible to include all possible sensors in this proof-of-concept and for that reason; only sensors that apply to the most common homes and environmental factors were selected. Some of the common factors that a user would most often be concerned with are thermal comfort, light and dark, and the energy usage of their home. Here are some of the Arduino sensors that we used in the smart home system:

1) Flame sensor
2) PIR Motion sensor
3) Laser sensor
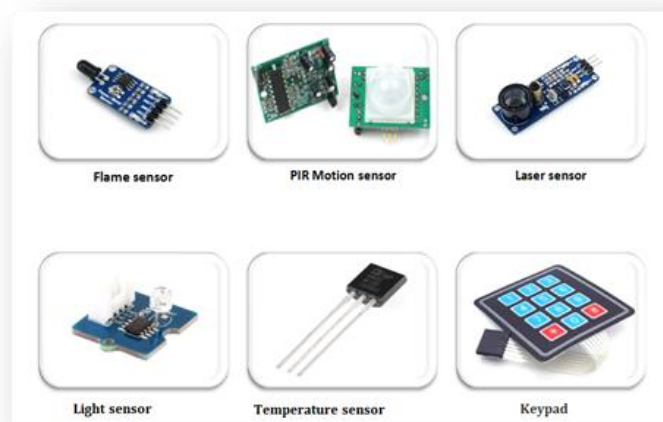4) Light sensor
5) Temperature sensor
6) Keypad

Fig. 3. Arduino sensors.

4. System Description

Home automation system designer is a flexible system which can control and make a subscription between almost all home loading devices. All devices can control indoor also outdoor air from anywhere. Our house can be called a smart home. If one forgets to switch off the lights or other appliances while going out, it allows you to turn off the appliance with your cell phone. By using smart phone, you can get status of your home and also can control your home power devices. This is a simple automation system which contains remote mobile host controller and several home appliances. We have several features in this research. We implement home automation using Bluetooth, Wi-Fi, Temperature Sensor, PIR (passive infrared sensor), Light Sensor, and Gas Sensor. At first, we set up Bluetooth then Wi-Fi. The main features of this system are:

1) Control through android mobiles.
2) The user can control appliances through voice commands.
3) Another feature is detecting humans or intruders by using motion detector or PIR sensor.

The development of the features of this system has been completed. The block diagram of the smart home automat ion system is shown in (Fig.4). An Arduino is used to gain values of physical environment through sensors connected to it. These integrated sensors module such as the temperature sensor read the temperature values, the gas sensor device detects smoke and cooking gas to avoid fire outbreaks. The automatic switching on and off of the light of the rooms is controlled by the Light Dependent Resistor which visualize the day light intensity. All this information's from sensors also   sent data to the Arduino for record the switching devices. To incorporate security in our design, a movement detector is integrated using PIR Sensor to identify movements of any objects or human in the home when the security system is turned on.   The relay switches which connected to the relay board is used to send control signals from the   Arduino to the electronic device through the relay used to achieve the power on and off act ions. A authentication gateway is designed required password to check authenticity of the home user for security purpose. It acts as an input device to control the appliances and also acts as an output device to read the value of physical conditions. The mobile application is also utilizing this same procedure to act as an input or output device.
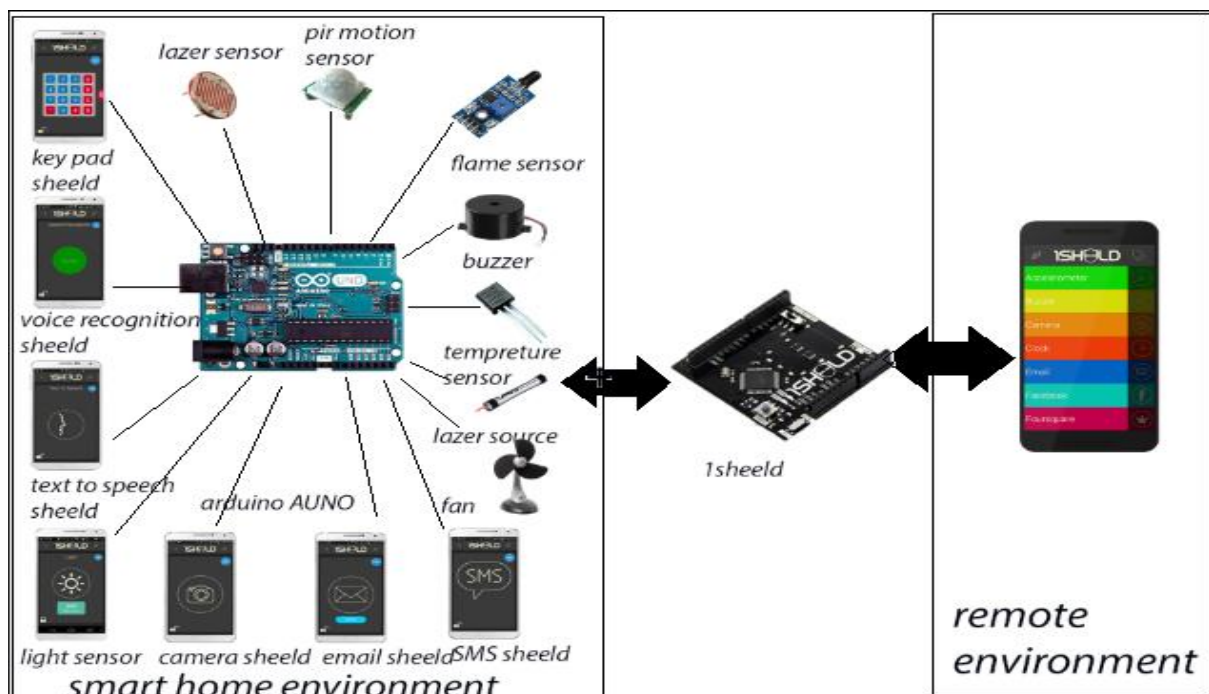

Fig. 4. Block diagram of the smart home system.

4.1. Design and Implementation

Our Design a low cost and efficient smart home system is presented. Here are two main modules in this system:

the interface module of Hardware and the module of software communication. At the heart of this system is the Arduino Uno R3 microcontroller which is also able of operates as a micro web server and for all the hardware module interfaces. All of the communications and controls in this system data pass through the Arduino.   Here we can see in (Fig.5), the smart home system offering characteristic such as environmental control using the temperature, humidity, and gas and smoke sensors. It also offers power switching feature to control lighting, fans/air conditioners, and other home appliances are connected to the relay board. Another feature of this automation system is the intrusion detection of any object or human which it offers using the motion sensors and all these can be controlled from the Android smart phone application.

A model of smart home is prepared using low cost materials having sufficient strength. It consists of various sensors like PIR, 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 Arduino microcontroller. It collects information from the sensors, makes a decision and sends SMS and email to a corresponding number by using a GSM modem. If it finds any interruption in its sensors (for example PIR 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 as shown in (Fig.6). The LDR (Light Dependent Resistor) is used to sense the light in a room and accordingly lights will be turn ON or OFF.

4.1.1.   Hardware module

Arduino can feel the community by receiving input signal from array of sensors and can alter its environment along actuators. An analog heat sensor is a chip that tells you what the surroundings heat is. It uses a capacitive human movement sensor and a thermostat to measurement the surrounding air, and brand out a analog signal on the pin of data. It is categorically easy to use, but prescribes safe timing to grab data. The only actual downside of this sensor is that you can only get newest data from it once each 2 seconds, so when manage our library; sensor indication can be more than 2 seconds old.
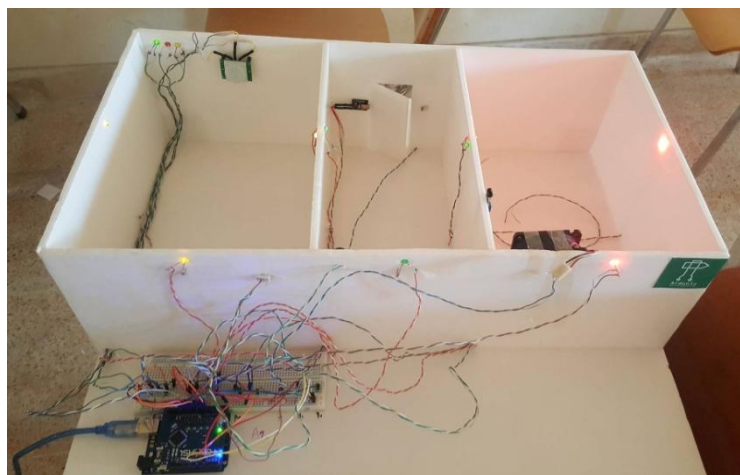

Fig. 5. Model of smart home.

The home automation system consists of two main hardware components: the 1sheeld application(on the mobile) which runs the shields', and the Arduino Uno   microcontroller board which is flexible, inexpensive, offers a variety of digital and analog inputs, serial interface and PWM outputs. A 1sheeld application hosts the Arduino platform management and Arduino Uno controls the home appliances and also enables the user to access them through voice commands. The computer communicates with the Arduino Uno microcontroller board through USB data transfer cable. A number of appliances and sensors are connected to ports of the microcontroller board. The home Appliances can be monitored and accessed by the mobile. Our home automation system can be divided to the following:

Monitoring sensor reading

Arduino enables users to monitor various kinds of sensors such as temperature sensor, PIR motion, light sensor and laser sensor in real time. The analog and digital pins on the Arduino board can serve as general purpose input and output pins (GPIO). The ATmega328 microcontroller embedded on the Arduino board contains the analog-to-digital converter (ADC), which converts the analog input signal to a number between 0 and 1023.

The integer number is proportional to the amount of the voltage being applied to the analog input. Any sensor operating on 5 volts can be directly connected to the Arduino board. As a prototype for monitoring sensor readings with Arduino, we have implemented a simple setup to connect the analog sensor to the Arduino board.

Controlling actuators

The Arduino gateway can trigger actions (e.g., pushing notifications and turning on or off switches) while monitoring sensors in real-time. While reading the sensor data in real-time the Arduino takes required actions like controlling the fan, switching the LED, and turning ON/OFF the alarm accordingly.

In this system, two operating modes are designed. The first one is a manually– automated mode in which the appliance (lights) is monitored and accessed by voice command. The selected appliances can be switched ON/OFF according to the suitable decision. The other mode is a self-automated mode. In this case the microcontroller accesses the appliance automatically without returning back to the user decision. The user can monitor the action only.The security panel is designed with Arduino platform. The designed arduino_UNO platform can control the whole system and turns ON/OFF the system accordingly and also sends required information to the user.

Temperature Sensing System

At this section we will control the home temperature automatically by using a special temperature sensor LM35. It is a precision integrated-circuit temperature sensing device with an output voltage linearly proportional to centigrade temperature. LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from output to obtain convenient centigrade scaling It has an output voltage that is proportional to the Celsius temperature. It has low self-heating capability, suitable for remote applications, low cost due to wafer level trimming, operates from 4 to 30v, low impedance output in this case. In this project we used this to sense the room temperature, the Arduino classifies the measured temperature as hot, normal or cold and then controls the fan accordingly by turn it on (if the temperature is high) or turn it off(if the temperature is low). So if room temperature goes very high or low it can be automatically adjust the fan as per the temperature.

Lighting Control Systems

In this section user will be able to control the light by LDR sensor automatically. In automatic light control system, Light Dependent Resistor (LDR) sensor is used to detect bright/medium/dim/dark conditions. It is a special type of resistor that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits. The number of LED lit is controlled by the Arduino and depends on the lighting condition of the room and is inversely proportional with the brightness of the room. This application is important for saving the energy.

Flame Detecting System

The sensor we used is the flame sensor. This is a cheap sensor that is sensitive to flames. This flame sensor module is useful for fire emission detection in home and industry. When used in applications such as industrial furnaces, their role is to provide confirmation that the furnace is properly li. Based on its fast response time measurements can be taken as soon as possible. Also the sensitivity can be adjusted by the potentiometer. When the target combustible flame exist, the sensor's conductivity is higher along with the flame concentration rising. The flame sensor reports flame by the voltage level as output.

A flame detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the flame.

Security Systems

The security system is designed using the Arduino platform. A security system consists of a portable panel

consisting of keypad, a laser sensor and a camera. On start up the system requires a 4 digit password which was previously set up by the user. If the entered password matches the previously set up password then Arduino sends an affirmative message to the mobile via 1sheeld application so the door opens and the entire smart home system turns ON. If the password does not match, then the camera captures an image of the intruder and saves the image in the system and also e-mails the image to the user and the door remains locked as shown in (Fig.6).

Voice Control

At the end of our work we have introduced special features for our smart home system which will be highly beneficial for elderly person. The user will be able to turn on and control the lights (led), fan, light sensor, and get acknowledge about the home status by giving voice commands. A program is written in Arduino to accomplish this action. Using this program, the system recognizes the voice command and sends a predefined message according to the command, to the Arduino. The Arduino will provide the required action according to the voice commands.

Security System using Camera

The security system uses the camera of mobile software to interface the camera. The camera takes snapshots and save it in the memory and then sent it via the email to the user. Snapshots can be uploaded to the email using your own mobile as a server. A mail can be sent by this software to the owner along with the images. The sensitivity and tolerance of images can be adjusted.

The advantage of this software is that it is very easy to use and it requires only the email and mobile camera. However, the mobile to which the camera is attached should be continuously ON for 24 hours. Instead of mobile camera, web camera can be used. The smart home system was fully functional for the switching applications and as the appliances are switched on the user interface is updated to reflect the current status. The smart home system was also tested for intrusion and fire detection whereby it successfully detected the respective events generating an email to the user and turning on the siren. Figure .6 shows the email generated and received by the user on the mobile device or the desktop PC.
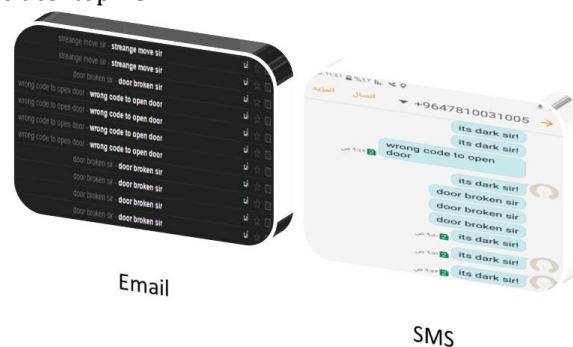

Fig. 6. Alert notifications generated via email and SMS.

The proposed system has approved feature with respect to the researches mentioned in Section 2. On the other hand, it also has security features such as user authentication for accessing the smart home system, and intrusion and fire detection with alert notification. The system does not require a dedicated PC or voice processing module for the voice activation feature making it low cost and affordable.

4.1.2. Software module

For software analysis, both programming for keychain and safety pad are made using C programming written in Arduino IDE software as seen in (Fig .7). The system has incorporated with a 1Sheeld system which comprise of a shield that is physically attached to Arduino board. 1Sheeld handling data and it serves as wireless medium between Arduino and any Android Smartphone via Bluetooth as shown in (Fig. 8).
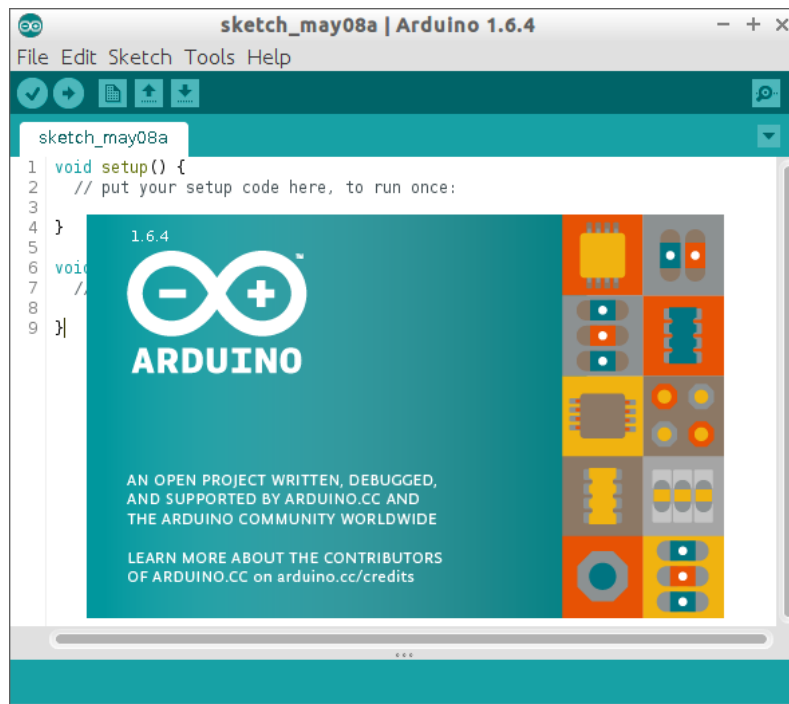
Fig. 7. Arduino IDE software.

Fig . 8. 1 sheeld's notification apps and 1 sheeld hardware that connected to Arduino.

The software platform on 1Sheeld helps connect the Arduino to 1Sheeld's own apps on Android Smartphone where it manages the communication between the any sensors from Arduino to the Smartphone itself. For this system, 'Notification Shield' is used as the load sensor detects any weight on the safety pad. This notification feature will keeps giving alert for every few minutes as long as it detect any weight on the safety pad.

4.1.3. Algorithm and pseudo code

Here we have implemented simple search and take decision algorithm as explained in (Fig.9). The algorithm which we have implemented the pseudo code is following:

1) Flame detection code: If flame sensor detects abnormal flame, then alarm system activates (light change, sound alarm, send   SMS, auto email),
2) door detection code: If laser sensor detects any low values, the   alarm system will activate (sound, light will change, send SMS, auto email,   ),
3) Motion detection code: If motion sensor activates and detect any kind motion, alarm system activate (light change, sound alarm, auto email, send SMS).

4.2. Results and Discussions

All the implemented features of this research are functionally working. This research includes Arduino based control and sensors based detection of home intrusion that is actually the main part of security and privacy mechanisms.

Bluetooth system, Wi-Fi auto synchronize system that are also helpful for security and privacy. Which are successfully done with our proposed hardware devices implementation of the research. All features are working as expected.

The proposed system is tested on the model of smart home (which is shown in Figure 5).The 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.

The developed GSM based security system gives good response to the sensor and sends SMS when it detects the fire is increased above desired level or laser reading is decreased lower than the required level or if there is a strange movement in the home.

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.
2) Mobile networks are used for transmission.
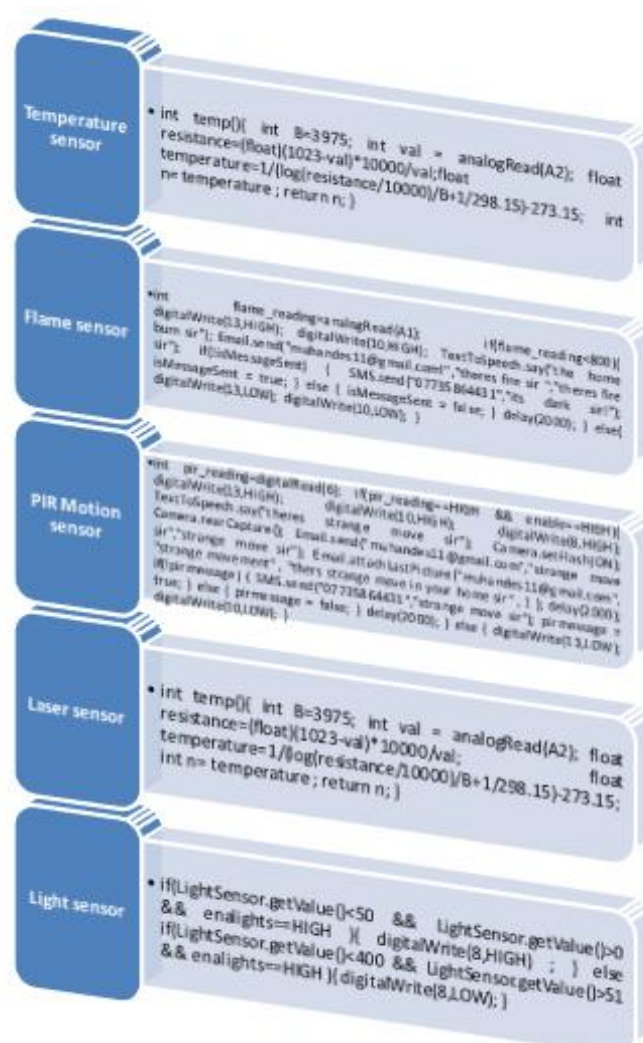3) It is very cost effective, as day by day the cost of SMS is reducing.

Fig . 9.   Sensors search and take decision algorithm code.

5. Conclusion and Future Work

The existence and rise of smart homes has increased the need of applying intelligence in learning the activities of inhabitants and predicting their future demands in applications like resource management, energy efficient automation, security, and health monitoring. For this purpose, to provide a standard and easy to understand framework for developing and using electronic devices in our homes in such a way that energy is not wasted.

Our research goal was to implement a smart home system by controlling the electronic devices at home remotely with a mobile phone and to receive alerts on intrusion and movement around restricted place. The goal was achieved successfully. The devices were controlled by sending instructions as voice commands; as the alerts were received as an SMS and Email. A passive infrared sensor was used as detectors to detect the intrusion and movement around the restricted premises respectively. A temperature sensor was used as a heat detector and a led light was used to show the demonstration of an electronic device management. The GSM module was used for communication between the microcontroller unit and the mobile station. The developed GSM based security system gives good response to the sensor and sends SMS and Email when it detects the fire or temperature is increased above desired level. As well, it can send a message to the user for action when the owner is out of station and the home is locked which helps us to keep more secure of our home.

Moreover, owner can control loads (on/off) automatically; Flexibility with the technical customization and economy are the main advantages of the design .This research will have a large effect to the living standard of human being. In the system, a lot of other features can be added to the user's requirement depending upon the situation

The research has been able to provide a standard and easy to understand framework for developing and using electronic devices in our homes in such a way that energy is not wasted. The system also presents another dimension of developing a control agent of our environment. The mobile phone as the control agent has satisfactorily contributed in the achievement of the goals of comfort and efficiency desired in smart living.

It is always hard to do predictions about the future, but we would like to extend the system to be more robust and efficient. In the future, some modification can be made like adding motion sensors for automatic turning ON/OFF of lights, fans depending upon the position of user, wireless connectivity can be added to system, and schedulers can be added for controlling home appliances. The whole system can be fabricated as economic commercial hardware package. The concept of this home automation can also be used for grid automation in smart grids in power systems.

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