Smart Home Assistant

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Abstract: In this research paper, the robot called “Smart Home Assistant” built on Arduino platform is discussed. This robot is aimed to help people when people leave children all alone at home without a physical control over them. Also, this robot helps to prevent an apartment from possible bad situations like fire, gas leakage, change of temperature inside of house and so on. Furthermore, this robot not only prevents by signaling an alarm, but also it sends SMS to the owner of apartment and automatically calls to appropriate local services such as Medical service, Fire Station, etc. when it finds out that there is a bad situation occurred.

Key words: Robot • Arduino • Sensor • Xbee • Arduino Uno • Smart Home Assistant

INTRODUCTION

A robot is a mechanical or virtual artificial agent, usually an electro-mechanical machine that is guided by a computer program or electronic circuitry. Robots can be divided as an autonomous, semi-autonomous and remotely-controlled. By mimicking a lifelike appearance or automating movements, a robot may convey a sense of intelligence or thought of its own. The branch of technology that deals with robots is called robotics [1]. Nowadays, robots do a lot of different tasks in many fields and the number of jobs entrusted to robots is growing rapidly. One of efficient ways of dividing the robots is dividing them according to the field of application. There are:

- **Industrial robots** - industrial robots are robots used in an industrial manufacturing environment.
- **Domestic or household robots** - robots used at home.
- **Medical robots** - robots used in medicine and medical institutions.
- **Service robots** - are robots that don’t fall into other types by usage. These could be different data gathering robots, robots made to show off technologies, robots used for research, etc.
- **Military robots** - robots used in military. This type of robots includes bomb disposal robots, different transportation robots, reconnaissance drones.
- **Entertainment robots** - these are robots used for entertainment. It starts with toy robots or the running alarm clock and ends with real heavyweights such as articulated robot arms used as motion simulators.
- **Space robots** - this type would include robots used on the International Space Station, Canadarm that was used in Shuttles, as well as Mars rovers and other robots used in space.
- **School bots** - these types of robots assist teachers in getting children more motivated about learning.
- **Hobby and competition robots** - are robots that you create. Line followers, sumo-bots, robots made just for fun and robots made for competition [2].

Smart Home Assistant [aka SHA] is a type of domestic or household robots as it helps to people inside of apartment. It helps people to protect their house and the most important; it can protect children from fire, gas leak and so on. When it senses trouble situations, it will immediately inform the owner of this apartment via SMS. Moreover, according to the type of situation, it will automatically call to appropriate organization respectively. As an example, suppose that suddenly there is a fire at the apartment and then in this case, SHA will feel that there is a smell increase from normal and it will send SMS to the owner of apartment and call to local fire office. This robot is aimed to serve for busy people or old people and it does not only control apartments, but also it will look after kids. The vision of
authors is to develop interesting and useful robot, which provides efficiency, usability, reliability and the most important is that this robot should be interesting for people to use it. Robot is described in terms of efficiency, usability and reliability.

**Efficiency:** This robot is effective, because it is very easy to use and is suitable not only for specialized workers, but also for the general population, especially for mothers who care about their children all the time. It will effectively protect your home from bad situations by the means of time, which means it will immediately take actions in case of such situations.

**Usability:** Authors think that it is the most useful tool at home. It will inform people by calling and sending message and then people can quickly go home and then prevent from possible dangerous accidents. And it is useful when your children are all alone at home.

**Reliability:** The reliability of this project is also provided, because in this robot, there are sensors, each of which performs its own operation. And, there is a range for temperature, voltage for signaling respectively. Project is the reliable too, because it does not need to be updated and anybody can use it for many years. For the construction of this robot, the Arduino platform was used. Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software [3]. The Arduino project is a fork of the open source Wiring platform and is programmed using an Arduino programming language (Wiring-based (syntax and libraries)), similar to C++ with some slight simplifications and modifications and a Processing-based Integrated Development Environment (IDE) [4]. Furthermore, Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors and other actuators. For this research, sensors like gas, microphone, temperature, flame and motion were used. By using these sensors, the robot is enabled to detect gas smells, fire, sound and any unpredictable motion.

**Implementation:** Implementation is divided into two parts: Hardware and Software parts. Hardware part is a physical implementation of project. Software is a soul of project.

**Hardware Part:** This part is started by connecting Arduino to the PC via USB cable A-B for Arduino. Because Arduino is a main part of every robot, it is a brain of machine which shown in Figure 1.

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low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones [5].

Third one is gas sensor MQ4. It is used in gas leakage detecting equipment in consumer and industry markets, this sensor is suitable for detecting CH4, Natural gas, LNG, avoid exposure to alcohol, cooking fumes and cigarette smoke. The sensitivity can be adjusted by the potentiometer [5].

Fourth is sound sensor. This small breakout board couples a small electret microphone with a 100x opamp to amplify the sounds of voice, door knocks, etc loud enough to be picked up by a microcontroller [5].

In each sensor there are 3 pins: VCC (3 to 5V power), data out and ground. We connect these pins with appropriate pins in Arduino Uno:

Next is connecting a GSM Siemens TC35 module to Arduino Uno. Siemens TC35 module one of the famous of GPRS/GSM shields. This TC35i GSM engine (shown in Figure 15) operating in the GSM 900 MHz and GSM 1800 MHz frequency band is an extremely compact and super slim communication module especially designed for telemetry, telematic and telephony such as: metering, fleet management, security systems, POS terminals or vending machines. It is compatible with the predecessor engine TC35 and offers additional features such as SIM application tool kit and extended AT commands for the industrial environment [6]. In Figure 8 there is shown wiring scheme of connecting gsm module to Arduino. So using this scheme it is easy to do it. So as shown here we connect digital 2 and 3 pins of Arduino with rx and tx of gsm respectively. Also connect ground to ground and 3,3V to 3,3V.

And on the reverse side of this GSM, there is a place where we can insert sim card. Using this GSM module which shown in Figure 9 and sim card it is easy to send messages and to make calls.
So the last step is to connect all devices such as led, buzzer, sensors and GSM module with Arduino Uno using breadboard via jumper wires. The final version looks like this:

**Software Part:** Firstly, we include library and declare static, public variables:

- \#include <SoftwareSerial.h>
- \#define DHT11_PIN 1
- SoftwareSerial gsmSerial(2,3);
- byte dht11_dat[5];
- int tempc = 0;
- const int analogInPinFlame = A0;
- const int analogInPinGas = A2;
- const int analogInPinSound = A3;
- const int ledPin = 13;
- int sensorValue = 0;
- int sensorValue2 = 0;
- int sensorValue3 = 0;

One of the main functions is a *setup()* function. This function is called when a sketch starts. It will only run once, after each powerup or reset of the Arduino board. In this function we set analog port 0, digital ports 9 and 13 as an output and analog ports’ initial value is equal to 1. Also here we call *beep()* 3 times.

```c
void setup()
{
    DDRC |= _BV(DHT11_PIN); //let analog port 0 be output port
    PORTC |= _BV(DHT11_PIN); //let the initial value of this port be '1'
    Serial.begin(9600);
    beep(50);
    beep(50);
    beep(50);
}
```

Other main function is *loop()* . It loops consecutively, allowing our program to change and respond.

In this fragment of code we read our sensors from Arduino board:

```c
void setup()
{
    DDRC |= _BV(DHT11_PIN); //let analog port 0 be output port
    PORTC |= _BV(DHT11_PIN); //let the initial value of this port be '1'
    Serial.begin(9600);
    beep(50);
    beep(50);
    beep(50);
}
```

```c
void loop()
{
    sensorValue = analogRead(analogInPinFlame);
    sensorValue2 = analogRead(analogInPinGas);
    sensorValue3 = analogRead(analogInPinSound);

    if (sensorValue >= 550)
    {
        digitalWrite(ledPin, HIGH);
        beep(1000);
        sendTextMessage(1);
        delay(3000);
        call(1);
        delay(5000);
    }
    else
    {
        digitalWrite(ledPin, LOW);
    }
}
```

And if all right led turns off and do not beeping, sending or calling.

```c
else { digitalWrite(ledPin, LOW);} }
```

Next the function which has not lower importance is the function *send Text Message()* . Here according the value which we get from sensors, it sends message to owner about appropriate situation:

```c
void sendTextMessage(int value) {
    if (value==1){
        gsmSerial.print("AT+CMGF=1\r");
        delay(100);
        gsmSerial.println("AT+CMGS="+77012139930\r");
        delay(100);
        gsmSerial.println("Flame sensor: ");
        gsmSerial.println((char)26);}
```
Following is a `beep()` function. It used to beeping signal and to control volume of signal:

```c
void beep(unsigned char delayms)
{
    analogWrite(9, 200); // between 0 and 255
    // for louder sound bigger value
    delay(delayms);
    analogWrite(9, 0); // 0 turns it off
    delay(delayms);
}
```

Also one of the important function is a `call()` function. By getting value of sensor we call to appropriate phone number:

```c
void call(int num)
{
    if (num==1)
    {
        gsmSerial.print("AT\r");
        delay(100);
        gsmSerial.write("ATD87016887070;\r");
        delay(100);
    }
}
```

So writing like this fragments of code for each sensor we finished doing our robot.

**Analysis and Results:** Acceptance of robot companions: Responses for acceptance of computers and computer related technology in the home were more positive compared to responses for the likeability of having a robot companion in the home. 82% of subjects liked or liked very much the concept of computing technology in the home compared to just fewer than 40% for a robot companion (Figure 11 for likeability of a robot companion in the home). No significant differences were found for gender, age or level of expertise with technology [7].

The potential role of a robot companion: When asked what role they thought a future ‘robot companion in the home should have’, the majority of participants wanted the robot as an assistant (79%), a machine/appliance (71%) followed by a servant (46%) (Figure 12). Fewer people wanted the robot companion as a ‘friend’ or a ‘mate’. Younger subjects suggested that they would like to have a future robot companion in the home as a friend, compared to none of the older subjects (t (26) = 2.69, p =.01). No significant differences were found for gender, or level of expertise with technology.

Task performance for a robot companion: When they were asked what tasks they would like this future robot to be able to carry out, the majority of the subjects wanted the robot to be able to do household (vacuuming) jobs (96.4%) [7].

Guarding the house, entertainment and gardening were also popular choices for robot roles around the home (Figure 13). No significant differences were found for gender, age or level of expertise with technology related disciplines [7].
CONCLUSION

At the end, after finishing this research, we came up to the following conclusion:

- It can be said that this device is very useful, especially for busy people;
- This device is trustable, which means that no matter where we are physically, we are informed with all changes at our apartment;
- If the volume of beep is increased enough, then neighbors will be able to hear this beep and make necessary steps to help kids in case of accidents;
- Furthermore, this device is able to send SMS or make a cell phone call to appropriate offices like medical help, gas-service, etc. and by making these calls; they will be informed as well.

It can be concluded that this device can be sold in a market. If start selling this device, then it needs to be designed creatively so that people will be attracted by this device.

Our aim was to not only control apartments, but also kids from trouble situations. Of course, during the implementation of this project, some problems appeared, but every problem has its own solution. By using GSM platform it sends message to the owner of house about troubles like fire, gas smells, room temperature changes, loud sounds and calls to appropriate offices.

ACKNOWLEDGEMENTS

Special thanks are given to Suleyman Demirel University, Kaskelen, Almaty, Kazakhstan for providing us with all necessary equipment and for their patience.
Last but not least thanks are given to the research department of the University of Technology (em. Niyazi Ari, Prof. Dr. sch. Techn. ETH) Zurich, Switzerland.

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