CONTROLLING HOME AUTOMATION SYSTEM BASED ON WIRELESS SENSOR NETWORK USING CELL PHONE

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Abstract: Artificial Intelligence (AI) systems are used on a day to day basis in our daily life, it is not wrong to say that our lives have also become advanced with the use of this technology. The economy is being shamed by Artificial Intelligent and its effect may be more in future Technology is a never ending process. To be able to design a product using the current technology that will be beneficial to the lives of others is a huge contribution to the society. Hence this paper presents the design and implementation of a low cost, secure cell phone based home automation system. It is to control the home appliance like microwave oven from remote location by using the stand-alone Arduino BT board connected to the input/ output ports. The Arduino BT board and cell phone are communicated without using any cables. This system is to design a device with low cost and scalable, with minimum changes to its core. Only authorized users can access the appliances by applying password protection

1. INTRODUCTION

Two or more device over distance can communicate without the use of wires or cables with the help of wireless technology. The sensors controls, detects and measures some physical effect by providing this information to the control system unit. Now with the embedded technology, digital devices form a network in which the appliances and devices can communicate with each other. Today, home automation is one of the major applications of sensor technology. With this capability of sensor, we propose controlling the home automation system from remote location. There are issues involved while designing a home automation system which should be scalable so that integration of new devices can be done in easily. In order to setup, monitor and control the device, a user friendly interface should be provided on the host side. To track any problem with the system some diagnostic services should be provided. Overall system should be fast enough to analyze the power of wireless technology. The system should also be cost effective to justify its application in home automation.

Neng has presented and architecture for home automation where the system was based on a dedicated network. In this system no hardware issues were considered, the issues were solved only at software level. The pin check algorithm introduced by yavuz and hasan included a telephone and PIC based remote control system. Apart from this it investigated the control of home appliances by a telephone which offers easy usage.

In this paper we present a flexible home automation system with low cost using cell phone. Appliances at home are connected to the Arduino BT board entrenched with sensor. The Arduino BT board and cell phone are communicated without using any cables. Other devices can be integrated into the system with little modifications. The cell phone script is written in Python, so it is portable and can run on any Symbian Operating System platform. **Symbian** is a mobile operating system (OS) and a platform designed for smart phones. Figure 1 shows the block diagram of the BT Board connection.

This paper is includes 1) the system's general architecture and hardware implementations 2) the system's software requirement. 3) our major findings and outline our future work in the paper.

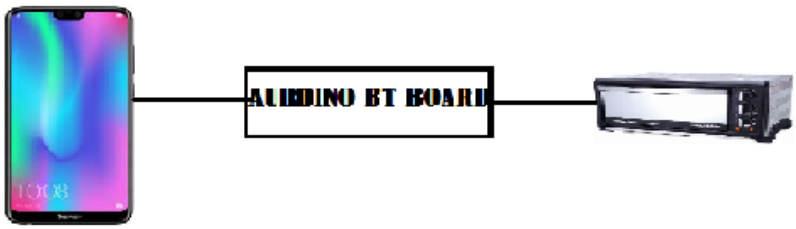

Figure 1. Block diagram of BT Board Connection

2. HARDWARE ARCHITECTURE AND IMPLEMENTATION

This home automation system consists of two main hardware components: the cell phone and the Arduino BT board with sensor. The cell phone script is written in Python which enables the user to access the home appliances and also the control commands for the appliances. This Python script communicates with the Arduino BT board embedded with sensor and sets up an ad-hoc communication protocol between the two devices, which allows controlling the behaviour of the Arduino BT board.

An off-the-shelf ready made Arduino BT is an 8-bit microcontroller board based on the ATmega168 and the Bluegiga WT11 module [11] is used. It supports wireless serial communication over sensor. This board includes 23 digital input and output ports, 10-bit analog to digital converter , 16kB of flash memory, width modulator and extra hardware resources which makes it suitable for the required task. The Arduino BT board can be programmed wirelessly with the help of sensor connection using the microcontroller‟s high-level interactive C language [11].

The Sensor in our module picks up the packets sent from the cell phone. These packets containing the appliance status commands are pipelined through a microcontroller and the designed analogue circuitry according to the definition of each output. Various home appliances are connected to the digital output ports of the Arduino BT board via relays to provide suitable high currents and voltage. Figure 2 shows the Aurduino BT Board overview.

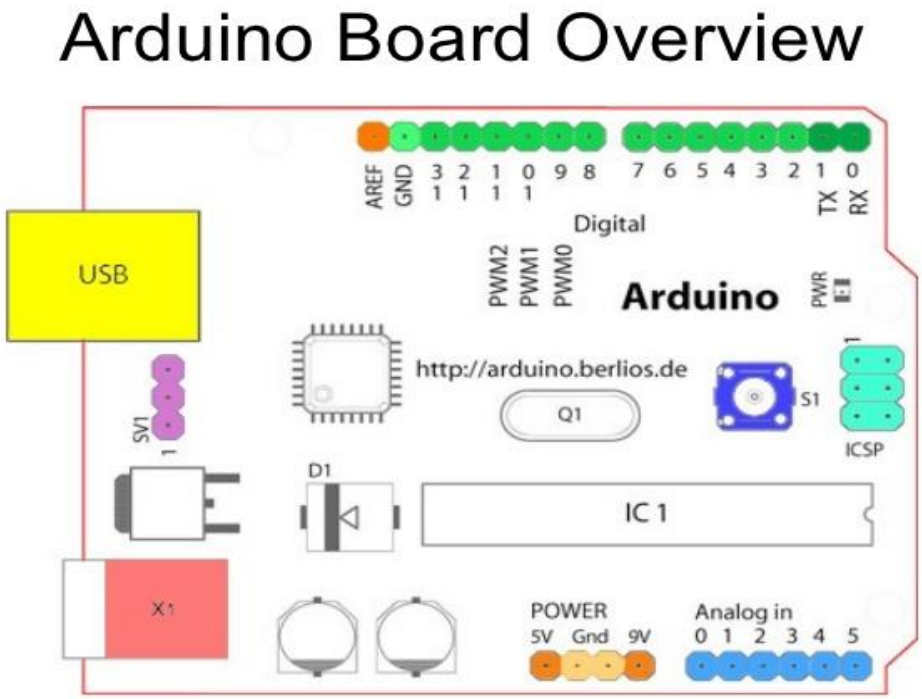

Figure 2. Arduino BT Board

3. SOFTWARE DEVELOPMENT

Bluetooth-compatible devices perform “inquiries‟ to detect and find other Bluetooth enabled devices within the area. Sending commands from software to turn ON/OFF a device may not guarantee the successful operation of the device as the device may be defective. To solve this problem, a feedback circuit has been designed and implemented to indicate the device‟s actual status after it receives the command (ON/OFF) from the cell phone. Once the command has been sent to turn ON a device, the feedback circuit senses the current and gives an output signal by turning ON a respective led on the switching circuitry indicating that the device is ON. Otherwise, the device is malfunctioning indicating that the command was not executed successfully.

3.1 The Program Flow chart

Upon the execution of the program, it first checks if device is already enabled on the phone. If enabled, the device and service discovery process will run. The software will check if any predefined devices are stored in the phone’s memory. If so, they will be listed down for the user to select. The program checks whether the selected device is within the range. If so it will verify the device is a Bluetooth transceiver (Arduino BT board) enabled or not. Once found, these devices will be displayed on the screen and also stored in memory.

Once it is established that the device is indeed a transceiver, the software will store the unique addresses of all the controller modules connected to it, in this case Arduino BT. If the address of a controller module has not been saved, then it will be labelled a number i.e. „OVEN1‟. Otherwise, it will be given its saved name and will allow the user to enter the pairing password for the BT board. Upon giving the correct password, the program stores all connected controller modules names inside the phones memory, then only the Main Menu user interface will be displayed.

The Menu shows the following options: “Options”, “OVEN”, and Other device ”and“ Exit as shown in the fig 3 These states are either ON or OFF. There are certain options to choose from in the “oven” interface: they are .pre-heat, baking, grill. When the certain option is been chosen, the software will send data to the Arduino BT transceiver, which in turn will send the data to the controller modules. The Exit option will let the user end the program

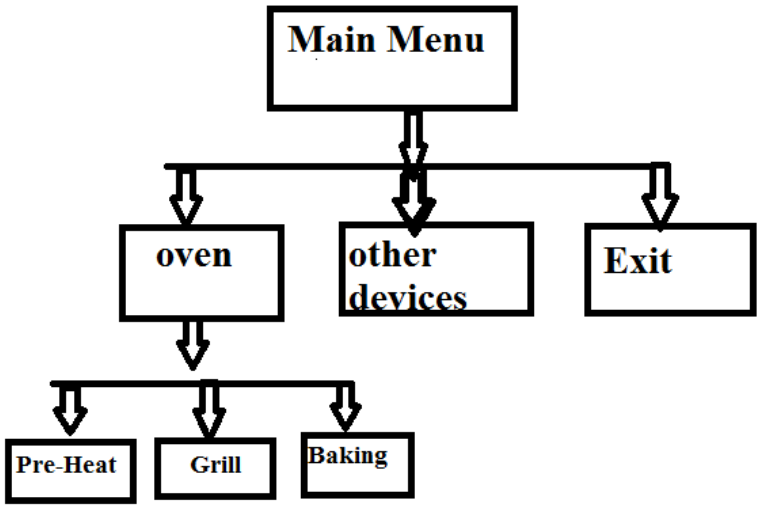

Figure 3 Program Flowchart for Main Menu Window of the GUI.

3.2 Simple Device Discovery

Signals consumes a lot of power while sending inquiry, so it is better to interact with the local device (cell phone) first to retrieve the information of the pre-known and the cached Bluetooth devices. Pre-known devices are the devices that communicate regularly with, while cached devices are the devices that have been found via previous inquiries. As stated, this reduces the power consumption and hence saves battery.

3.3 Communication Module

The Serial Port Profile (SPP) is the Bluetooth profile that realizes the RFCOMM connection between two devices. The RFCOMM protocol is an emulation of the RS-232 serial port connection of two devices over a wireless link. Here we have established an RFCOMM connection between the mobile phone and the BT board. Once the RFCOMM connection has been made, the client can start sending the binary streams or the appliance status commands. ASCII commands are sent from the cell phone to Arduino BT, these commands are automatically converted to binary by Arduino board. Now Arduino BT reads in the ASCII values through serial port and compares with the binary equivalent of these values. Then it turns ON/OFF the respective device according to the commands received. Sample code for reading commands sent from the cell to Arduino BT is given below.

```
void loop ()
{
value = Serial.read();// read the serial port
if (value  == 97 ) //reads the value from the mobile phone
{
//if the value is 97(which is 'a' in ASCII) turn the
OVEN ON

  digitalWrite(pre-heat, MID);//sets the oven  to the pre heat mode;
  else if(value==98)
  {
  OVEN ON
  digitalWrite(grill, HIGH);//sets the oven to the grill mode;
  }
  else
  if(value==”65”)
  {
  TV ON
  digitalWrite(TV,CHANNEL MTV);// Set MTV channel
```

-

```
}
```

3.4 Graphical User Interface (GUI) Module

The key feature of our application is to hide several processes from the user while allowing some degree of interaction with the application. By using the GUI package, we were able to customize the application with a variety of user interface elements such as text boxes, choice groups, alert messages, lists and command buttons.

4. CONCLUSION

In this paper we have introduced the concept of designing and implementation of a low cost, flexible and wireless solution to the home automation. System is secured from unauthorized user as users are expected to acquire pairing password for the Arduino BT and the cell phone to access the home appliances. This way we can protect from unauthorized users.

References:

Fig. 1. Neng- Shiang Liang; Li-Chen Fu; Chao-Lin Wu. "An integrated, flexible, and Internet-based control architecture for home automation system in the internet era".

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Fig. 2. E. Yavuz, B. Hasan, I. Serkan and K. Duygu. "Safe and

Secure PIC Based Remote Control Application for Intelligent Home". *International Journal of Computer Science and Network Security*, Vol. 7, No. 5, May 2007.

Official Arduino BT website:

Fig. 3. http://www.arduino.cc/en/Guide/ArduinoBT

Fig. 4. Official Nokia forum website: http://library.forum.nokia.com