Bluetooth Based Home Appliance Control System with Feedback Voice Response Using Android Application

Md. Ismail Husain[1], Md. Emdadul Haque[2] and Md. Harun. or. Rashid[3]

[1, 2, 3] Department of Information and Communication Engineering, University of Rajshahi, Rajshahi, Motihar-6205, Bangladesh

Email: ismailhusainruice@gmail.com[1], emdad_74@yahoo.com[2], horoshid2@gmail.com[3]

Abstract— With increasing the technology, home automation system is becoming very popular around the world. Home automation system is used to control and monitor electronic security systems, lighting, climate, appliances, audio or video equipment, etc. It is playing important role in human life. We proposed a home automation system that allows the user to control home appliances remotely with a feedback voice response corresponding home appliance. Remote operation is achieved by any smart-phone/Tablet etc., with Android OS (operating system), upon a GUI (Graphical User Interface) based touch screen operation. In this proposed system, Android application act as transmitter, which sends ON/OFF commands to the receiver where loads are connected. Lights, air conditioners, Televisions and fans are among the appliances that can be used in this system. The control signal transmits by Bluetooth wireless network. The android phone transmits the control signal and the relay control device receives this signal. To give the voice response, the recorded voices are store in micro-SD card. So, by the voice response the user can easily understand which household appliance is controlling now. Finally, we evaluate the performance of the designed system by measuring coverage distance and cost analysis.

Keywords— Home Automation System, Android application, Feedback voice response, Bluetooth network, Home appliances.

I. INTRODUCTION

Now a days, the technologically advanced world is getting more and more advance as new technology is penetrating deeper into our personal lives even in our homes as well. Wireless technologies are becoming more popular around the world. Bluetooth technology is one of the most popular wireless technology. Now with the embedded Bluetooth 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 Bluetooth technology. Operating over unlicensed, globally available frequency of 2.4GHz, it can link digital devices within a range of 10m to 100m at the speed of up to 3Mbps depending on the Bluetooth device class [1]. With this capability of Bluetooth; we propose a home automation system based on Bluetooth technology that control the household appliances remotely by using android application. It helps people to reduce house working and household management by its automation.

Generally, in today's modern world human beings are addicted to using modern equipment. Presently, conventional wall switches located in different parts of the house makes it difficult for the user to go near them to operate. Even more it becomes more difficult for the elderly or physically handicapped people to do so. Remote controlled home automation system provides a simpler solution with Android application technology [2].

There are few issues involved when designing a home automation system. The system should be scalable so that new devices can easily be integrated into it. It should provide a user- friendly interface on the host side, so that the devices can be easily setup, monitored and controlled. Moreover, the overall system should be fast enough to realize the true power of wireless technology. Finally, the system should be cost effective in order to justify its application in home automation [3].

The main objective of this proposed system is to develop a home automation system with Android application controlled remotely and gives feedback voice response from receiver.

This paper consists of five sections. Section I discuss the introductory concept of the proposed system. Section II discuss the recent works on wireless home automation system. The proposed system designing procedure is discussed in Section III. Section IV discusses about the implementation and evaluation result. Finally, Section V concludes the works and places some direction of future works.

II. RELATED WORK

There are various types of home automation systems have been studies such as Bluetooth controlled [3-6], internet controlled [7-9], Android based [10-11], RF controlled, IR remote controlled etc. It helps people to reduce house working and household management by its automation.

In [5] proposed and implemented an internet based smart home system that can be controlled remotely upon user authentication. The Android based smart home app communicates with the micro web-server via internet using the REST full based web service. However, this proposed system is complex and not sure in-home automation.

A low cost and user-friendly remote-controlled home automation system is presented using Arduino board, Bluetooth module, smartphone, ultrasonic sensor and moisture sensor. A smartphone application is used in this system which allows the users to control up to 18 devices including home appliances and sensors using Bluetooth technology. An ultrasonic sensor is used for water level detection and soil moisture sensor is use for automatic plant irrigation system [6].

In [8] designed smart phone-based Home Automation System (HAS) is spread across the world as it can be controlled through the Internet. A wide range of sensors are used to capture the readings of temperature, humidity, water level, gas leakage and the flame sensing devices making it an efficient system for security as well as for monitoring. The cost of these designed system is high for the developing country specially for Bangladesh.

We proposed a low cost, user friendly home automation system that control household appliances remotely using GUI based android application and gives feedback voice response of that appliances from the receiver circuit.

III. SYSTEM DESIGN AND WORKING PRINCIPLE

A. Proposed Home Automation System

The overall proposed system divided into two sections.
1. Transmitter section.
2. Receiver or Relay control section.

The transmitter or remote section consists by android app. The android app consists by GUI based several buttons to control the household appliances. The receiver section consists by one Arduino Uno, one HC-05 Bluetooth module, 4-channel relay module, micro-SD card reader module and speaker etc. Fig. 1 shows block diagram of proposed home automation system.
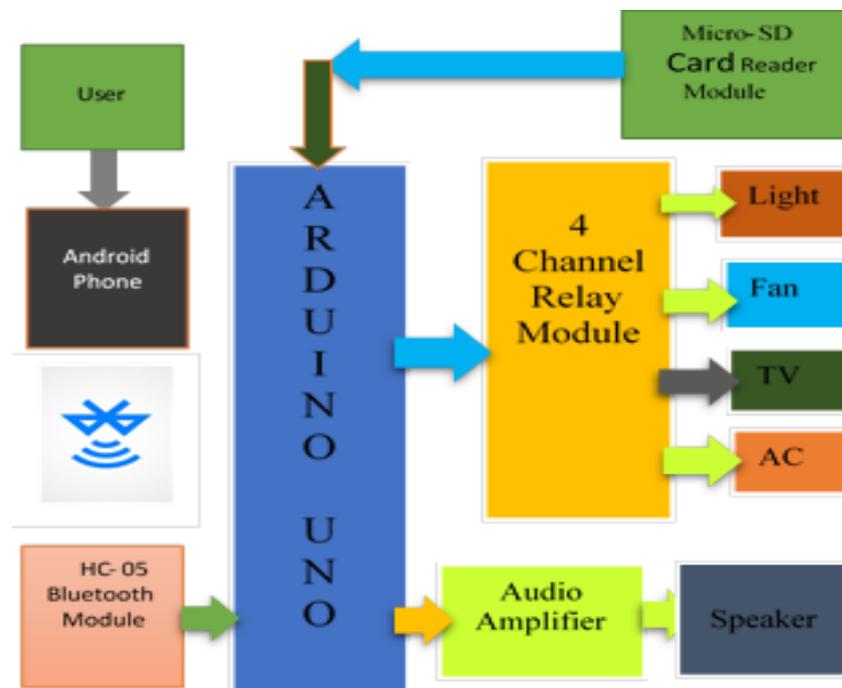

Fig. 1 Block diagram of proposed system.

B. Hardware Components

The following components required to design the overall system.
- Arduino Uno

- HC-05 Bluetooth module
- 4-channel relay module
- Micro-SD reader module
- Micro-SD card
- Speaker
- LM 386 audio amplifier.
- Power source and DC adapter

C. Design of LM386 Audio Amplifier Circuit

In this system, we designed a LM386 audio amplifier circuit. It is a very low-cost audio amplifier. The integrated chip LM386 is a low power audio frequency amplifier requiring a low-level power supply (most often batteries). The IC is designed to deliver a voltage amplification of 20 without external add-on parts. But this voltage gain can be raised up to 200 (Vu = 200) by adding external parts. The Circuit diagram of LM386 audio amplifier shows in the Fig. 2.

A simple but efficient audio amplifier is designed using LM386 audio amplifier IC. The working of the circuit is very straight forward as all the work is done by the LM386 IC itself. When the system is powered on and proper audio input is given at the input, the LM386 amplifier the input signal by a factor of 200 and drives the output speaker. One of the main problems with audio amplifiers like LM386 is the noise. Our designed audio amplifier circuit, there was very less noise from the speaker.
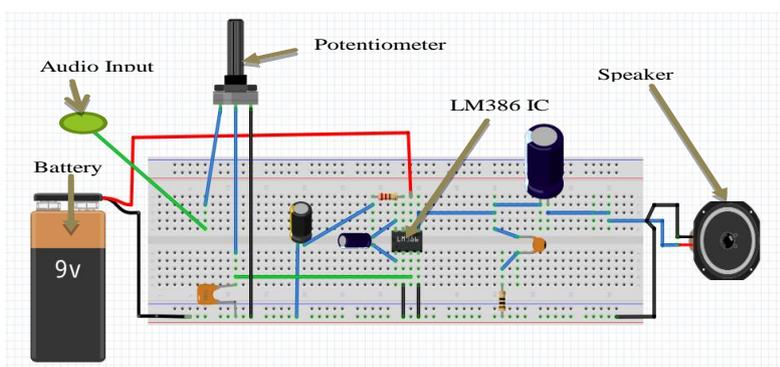

Fig. 2 LM386 audio amplifier circuit.

D. Design of Receiver or Relay Control Circuit

Circuit diagram of the receiver or relay control device shows in Fig. 3. In the receiver H-05 BT module work as slave, so it receives the transmitted signal. According to the transmitted signal the channel is on or off of the 4-channel relay module. The household appliances are connected to the relay channel. The voice response section is one of the parts of receiver circuit. It consists by LM386 audio amplifier, Micro-SD card reader and speaker. Communication interface of micro SD card reader module is a standard Serial Peripheral Interface (SPI). SPI mode has three lines common to all devices, which are Master In Slave Out (MISO), Master Out Slave In (MOSI) and Serial Clock (SCK). Another one line specific for every device slave select (SS)- the pin on each device that the master can use to enable and disable specific devices
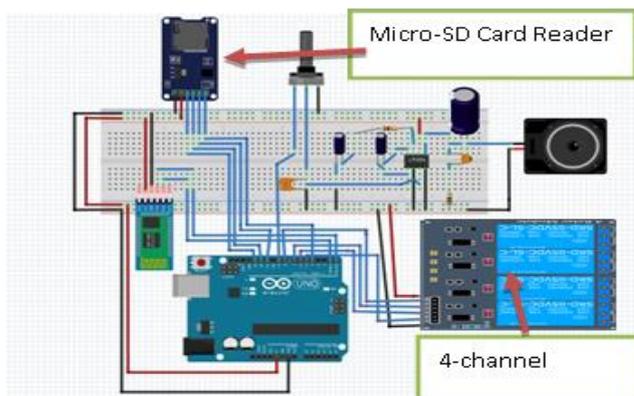

Fig. 3 Receiver or Relay control circuit.

E. Design Home Automation App

The most important feature of our designed 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 to include a variety of user interface elements such as text boxes, menu bars, lists and command buttons. In Fig. 4(a) illustrates design for the Bluetooth connection graphical user interface.

By pressing the "SHOW-PAIRED_DEVICES" the user can see the previous paired devices name in bottom of Fig.4(a). By pressing the device name, then connect the corresponding device with android phone. This shows in Fig. 4(b).
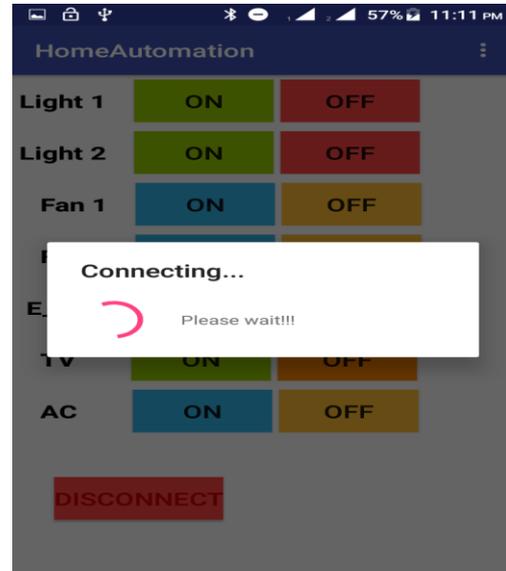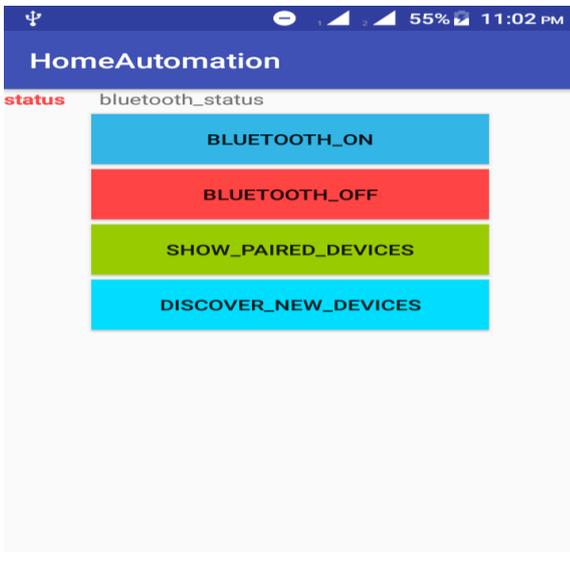

Fig. 4: (a) GUI activity for Bluetooth operation.   (b) Connection establishment with receiver device.
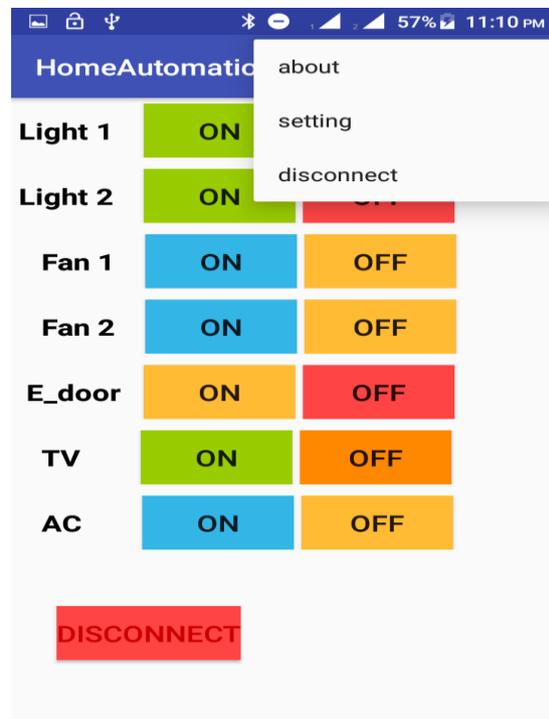

Fig. 5: (a) GUI for controlling the home appliances (b) GUI with menu bar for controlling the home appliances.

In Fig. 5 illustrates designs for graphical user interface to control household appliances.

IV. IMPLEMENTATION AND RESULTS

A. Experimental Setup

The receiver or relay control device shown in the Fig. 6. We used four appliances (light, fan, TV and AC) but shows by three lights and one fan for primary implementation. In the relay control device, the pre-recorded voice response gives via speaker. For example, when user press the light 1 "ON" button, then voice response gives as "Thank you, you on the light" two time repeated. Similarly, for fan, TV and AC etc, when press buttons for on operation. When press the light 1 "OFF" button, then voice response gives as "Thank you, you off the light" two time repeated. Similarly, for fan, TV and AC etc, when press buttons for off operation.

Fig. 6 Receiver or Relay control device.

B. Cost Analysis

It is seen from Table I that the designed home automation system is cost effective and economical. The cost of this system depends on the setup environment.

TABLE I.   COST OF EQUIPMENTS

Name of Equipment	Cost (BDT)
Microcontroller	150
HC-05 Bluetooth module	250
SD card reader module	240
4-Channel relay module	300
Speaker	50
AC to DC adapter	75
Switch and other parts	350
Total amount	1765

V. CONCLUSIONS AND FUTURE WORK

In this paper, we have introduced design and implementation of a low cost and user-friendly system, to control the home appliances remotely. In this designed system, we shown for only four household appliances such light, fan, TV and AC. This system is better useful for on-off switching applications remotely without any internet connection. The use of android phone is increasing day by day in Bangladesh. So, this system can easily implementation in our country. This system is easy to operate by any user. Future works will be focused on enhancing the performance of the system. Several improvements can be made on the proposed system. Bluetooth wireless communication system can be replaced with another wireless communication system for cover large areas.

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