HOME APPLIANCE CONTROL FOR USERS WITH MOTOR DISABILITIES USING SMART PHONE

Shruthi.J¹, Ramya.S², Bharathi.R³
Department of Computer Science and Engineering, BMSIT, Bangalore-64

Abstract—In our surroundings, we can see a number of people motor challenged. The motor disabled users won’t be able to access the electronic gadgets of their home without external help. As the technology improves, the way of leading life is becoming automated. This paper proposes the use of this technical advancement for the better life of motor disabled users, i.e., with the use of a touch screen based mobile phone. For implementing this concept in real time, we require a touch screen phone, GSM and a PC. In PC, a virtual environment of home will be created. Any required electronic gadgets can be operated using a smartphone. This concept is useful not only for motor challenged but also for normal people. This implementation results in saving time, money, increasing comfort, self confidence and in-dependability among motor challenged.

Keywords—motor challenged, motor disabled users, touch screen phone, GSM, PC, relay, electronic gadgets.

I. INTRODUCTION

In our day to day life, we come across a number of people who are motor challenged. They always have to depend on their family members or neighbors to do even a simple job. In such cases, it will be a complex job for them to operate the electronic gadgets of their home. This may lead to reducing the level of self-confidence, positiveness and in-dependability and making them weak.

Many a times, these people will be even treated as burdened and kept away from formal gatherings in the society, creating adverse feeling within them. In order to make them feel comfort, increase their self-confidence to certain extent, we present this paper. In this paper, we propose for real-time implementation of controlling the electronic gadgets using a smartphone via GSM.

II. RELATED WORK

There are a number of papers and proposals which depicts concepts related to the automatic control of electronic gadgets by the use of remotes. Some of the papers include microcontroller based home automation and Bluetooth based automation system [1][2]. The Microcontroller based Home Automation proposes for the hardware implementation for control of electronic gadgets. In this, the gadgets are operated automatically depending on surrounding environment conditions, for example when no one are present in home or when it is dark the lights will be made ON with the help of sensors fixed in home. The Bluetooth based implementation proposes the use of Bluetooth technology for controlling the electronic gadgets via PC software. These systems are either costly or inefficient.

This paper presents the implementation of these concepts with the help of GSM which includes microcontroller in it, controlled by a user friendly interface and also says how a touch screen mobile is helpful for motor disabled users. So a touch screen mobile is provided to user as an interface with GSM.

III. OBJECTIVES

The objectives of this paper are as follows:

i. Provide a smart way to control electronic gadgets of home with the help of touch screen mobile phone.
ii. Make them feel comfort to operate the gadgets.
iii. Provide a user friendly medium to control gadgets from inside or outside the home efficiently and effectively.

IV. SCOPE

The proposed system may become more popular in future as it can be used by users with motor disabilities and also by non-disabled users from within or outside the home. This results in less consumption of power, low cost and also allows improving level of independency and comfort among the motor disabled users.

V. ASSUMPTIONS

The End users who use the touch screen mobile are required to satisfy the certain constraints such as they should be sufficiently able to access a touch screen phone without others assistance.

VI. PROPOSED SYSTEM

The proposed system allows a person with motor disabilities to control the home appliances with a single touch on the android mobile phone. This system requires:
i. **Touch Screen based Android Mobile Phone**
The mobile phone should be of touch screen with write permission, so that the application to control the gadgets can be installed on to the phone.

ii. **GSM**
GSM is popularly known as Global System for Mobile communication because of its wide range of deployment in mobile communication. Today, it is the widely used cellular technology that also has ability to roam worldwide.

![GSM Network Diagram](image)

The GSM network consists of following components:

i. **Mobile Station (MS)**
   - ME (Mobile Equipment): It is a terminal device, which is uniquely identified by IMEI (International Mobile Equipment Identity).
   - SIM (Subscriber Identity Module): It is a smart card that is inserted into the mobile equipment inorder to have access to the subscribed services such as make and receive calls. IMSI uniquely identifies the subscriber present on the SIM.

ii. **Base Station Subsystem (BSS)**
   - BTS (Base Transceiver Station): This includes radio transceivers capable of transmitting signals.
   - BSC (Base Station Controller): This is responsible for controller one or more BTS. It connects MS and MSC.

iii. **Network Switching Subsystem (NSS)**
   - HLR (Home Location Register): Contains each subscriber’s administration information along with current location of mobile registered in a GSM network.
   - VLR (Visitor Location Register): Contains selected details necessary for subscribed services from HLR for each mobile that has migrated from home location to other location.
   - MSC (Mobile service Switching Centre): Is the central component of NS that handles registration, authentication, call routing to a roaming subscriber.
   - EIR (Equipment Identity Register): Is similar to database that contains list of IMEIs of all valid mobiles. AuC (Authentication Centre): Isa protected database that contains IMSI of each subscriber’s SIM card.

iv. **PSTN /ISDN**
   - Are the fixed networks which are connected via MSC with GSM network i.e., BSC.
   - In this system, we use GSM MODEM (SIM 300). The below one is the snap of SIM 300 GSM.

![SIM 300 GSM Mode](image)

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**Figure 1. General Architecture of GSM network**

**Figure 2. GSM MODEM (SIM 300)**
iii. 8051 Microcontroller Development Kit
   - 8051 Pin configuration

8051 is a 40 pin chip with pin 20 and 40 being GND and VCC respectively. Pins 1 to 8 as port 1, 21 to 28 as port 2, pins 39 to 32 as port 0 and pins 10 to 17 as port 3. Port 0, 1, 2 are used as input or output and port 3 pins are dual function pins [5][12].
   - 8051 Development Kit:

![8051 Pin configuration](image)

Figure 3. 8051 Microcontroller Pin configuration

The Kit includes a 40 pin socket into which 8051 microcontroller will be placed, 9-pin socket to connect to other kits such as GSM via 9-pin male connector. The power to the kit is provided using a 12V Adapter [5][12].

iv. Relay

![Relay](image)

Figure 5. Relay

Relay is an electrical circuit that is activated by a signal or current in one circuit to open or close another circuit. It is used for performing the switching operation mechanically. Normally a relay consists of 5 terminals among which 2 terminals to give input DC voltage, remaining terminals to connect to high AC voltage.

v. Electronic gadgets

Electronic gadgets can include the electronic appliances such as bulb, fan, air cooler, and television and so on.

VII. DESIGN

i. System Architecture
The system architecture shows the interaction between an android touch screen mobile phone, PC (Virtual home), 8051 Microcontroller Kit, GSM, relay and electronic appliances. In Figure 6, PC and mobile phone interact via wireless connection, in turn connected to GSM, Microcontroller, relays and then gadget is through cables.

The Virtual home gives an illusion of electronic appliances in a typical home in the form of buttons which changes its state upon touch on the icons present in the application installed on the mobile.

![System Architecture Diagram](image)

**Figure 6. System Architecture**

The application containing the GUI for interaction with PC and GSM will be designed and installed on the touch screen mobile. Depending on the icon touched on the mobile screen, corresponding appliance is either switched ON/OFF through GSM.

GSM sends signals to the 8051 microcontroller according to which appropriate gadgets are operated. The relay circuit is necessary to control high voltage operating gadgets, since a relay is capable to drive high voltage devices with low voltage power supply.

**ii. Data flow diagrams**

- **User view**: Depicts an abstract view of flow of request from user on touch screen and response from mobile to user in the form of ON/OFF of gadgets.

![User level data flow](image)

**Figure 6. User level data flow**

- **Inner view**: Depicts the complete interaction within the system. The interaction is as follows:
  1. When application is initiated, user will operate the touch screen based mobile. Once we select Room, it will display the available gadgets on screen.
  2. On touching any icon on Touch Screen, request is sent to PC and GSM. PC will take the request and responds to the user. Similarly GSM also responds to the user, by making gadgets on/off.

  a. Once request comes from user to GSM via application, GSM sends signal to Microcontroller.
  b. Then the microcontroller processes the request and controls the operation of electronic gadgets like Bulb, Fan etc according to the request received.
Figure 7. Inner level data flow

iii. Operational view

Figure 8. Operational level dataflow

iv. Relay

i. Block diagram

Figure 9. Block diagram of relay connection

The block diagram of connection of relay with the appliance is as shown above. The coil in relay is connected to the switch and 12V adapter. The other 2 pins of the relay is connected to bulb and 240V AC power supply.

ii. Circuit diagram:

A relay circuit has to be constructed to operate real time appliances that takes input supply of 5V and produces an output voltage of 230V.
This makes it possible to operate any appliance that requires 230V for their operation. One relay circuit is required to control one.

VIII. IMPLEMENTATION

The implementation part includes both software and hardware implementation. The software includes the development of application that consists of GUI of home appliances and hardware includes the fixing of GSM, microcontroller kit, relay circuit and junction box.

i. Software Implementation

The software that are used for the implementation of the proposed system are Eclipse Juno for android application development, Eclipse Helios for designing virtual home, Apache tomcat for interacting application with virtual home (Simulator), Keil software for writing embedded C code necessary for driving the electronic gadgets and this code is embedded into the 8051 IC using Flash Magic software.

- Android application:
  This is the application of proposed project that will be installed on the touch screen based android mobile phone. Through this mobile application the motor disabled user can easily and safely control the operation of electrical appliances [3]. The application looks as shown below.

The above screen on the mobile is the Home Page of the application installed. As we can see, the application contains buttons representing Open Simulator, Hall, Kitchen and Bed room which upon clicking navigates to its corresponding screens i.e., Simulator (Virtual home) screen, Hall screen, Kitchen screen and Bed room screen. The Hall screen of the application is designed as shown in Figure12. As we can see, the Hall screen contains a text field to enter recipient number, two image views (air cooler and television) representing gadgets and a button to either switch ON/ OFF both gadgets at once.

Similar to Hall screen, the Kitchen and Bed room screens are designed with gadgets like bulb, fan etc. The application is designed such that, when an icon is touched on the mobile after the recipient number is entered, a signal will be sent to GSM to toggle the status of artifacts [7][8]. The GSM sends control corresponding to that gadget to the microcontroller that controls the operation of gadgets.
Virtual Home (Simulator):
This is a frame on desktop containing electronic appliances such as bulb, fan, television, air purifier, computer and so on that are present in a home. This is coded in Eclipse Helios, and is executed on apache tomcat server. The frame looks like as below.

When an icon on mobile screen is touched, a signal will be sent to simulator to change its status, where the button on the Simulator and image on the mobile changes.

ii. Hardware Implementation

Hardware implementation can be done by following the steps mentioned below:

- Connecting the GSM with 8051 Microcontroller Development Kit using wires.
- Building the relay circuit as shown in Fig.10 on a PCB.
- Preparing the junction box consisting of 3 pin sockets that are connected with 2 pin plugs. Connect the cables of sockets with the relay.
- Use port 2 pins for visualizing the output i.e., operation of appliances.
- Connect input pin (power supply) with 5V pin on kit.
- Provide 12V power supply to GSM
- Ground the GSM, 8051 Kit and relay board.
- Provide power supply to the system via 12V Adapter. The board after implementing the hardware is shown below.
IX. CONCLUSION AND FUTURE WORK

The system proposed in this paper provides a user friendly interface i.e., a Touch screen phone. By a single touch of either motor challenged or normal people on the screen, the electronic gadgets can be operated. This saves power consumption, time and money, increases convenience, contributes to economy and also can be operated from out of station. The future work includes addition of security system, automatic door locks, temperature system, so that they can be controlled by a handheld mobile device.

REFERENCES