

HOME AUTOMATION USING ATmega328 MICROCONTROLLER AND ANDROID APPLICATION

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ABSTRACT - Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist them with the muscular requirements of work, automation greatly decreases the need for human sensory and mental requirements as well. Automation plays an increasing important role in the world economy and in daily experience. In this paper, we describe the design and development of a remote household appliance control system using ATmega328 microcontroller and android mobile through GSM technology.

Key Words: Home Automation, GSM, ATmega 328Microcontroller, Short Message Service (SMS), Android.

1. INTRODUCTION

The rapid growth of wireless communication motivated us to use mobile phones to remotely control a household appliance. In this paper we describe a remote appliance control system which can control different household appliances by sending an SMS message from a mobile phone. This controller is extremely handy at places where we have to control the ON and OFF switching of the devices but no wired connection to that place is available. The microcontroller would then control and device based on the information given to it. The proposed solution will need to be easy to use, simple, secure, robust and be useful on most mobile phones. A remote household appliance control has been described

in [1]-[4] using internet. A Bluetooth based home automation control is described in [5]. In [6] a GSM based system for home automation is described which uses voice commands for control. In [7] voice commands for home automation is being described. In this paper we describe a simple remote home appliance control using ATmega328 microcontroller and GSM SMS (Short Messaging Service) via android application.

1.1 NEED OF AUTOMATION

An automated device can replace good amount of human working force, moreover humans are more prone to errors and in intensive conditions the probability of error increases whereas, an automated device can work with diligence, versatility and with almost zero error. Replacing human operators in tasks that involve hard physical or monotonous work. Replacing humans in tasks done in dangerous environments (i.e. fire, space, volcanoes, nuclear facilities, underwater, etc) performing tasks that are beyond human capabilities of size, weight, speed, endurance, economy improvement etc. Automation may improve in economy of enterprises, society or most of humankind. For example, when an enterprise that has invested in automation technology recovers its investment, or when a state or country increases its income due to automation like Germany or Japan in the 20th Century. That's why it looks into construction and implementation of a sys-tem involving hardware to control a variety of electrical and electronics system.

2. SYSTEM DESCRIPTION

The system has two parts, namely; hardware and software. The hardware architecture consists of a stand-alone embedded system that is based on 8-bit microcontroller (ATmega328), a GSM handset with GSM Modem and a android phone. The GSM modem provides the communication media between the homeowner and the system by means of SMS messages via android phone. The SMS message consists of commands to be executed. The format of the message is predefined. The SMS message is sent to the GSM modem via the GSM public networks as a text message with a definite predefined format. Once the GSM modem receives the message, the commands sent will be extracted and executed by the microcontroller. The system will interpret the commands and turn the appliances ON/OFF accordingly via android application. The detail description of individual modules in the system is as shown in Fig 1.

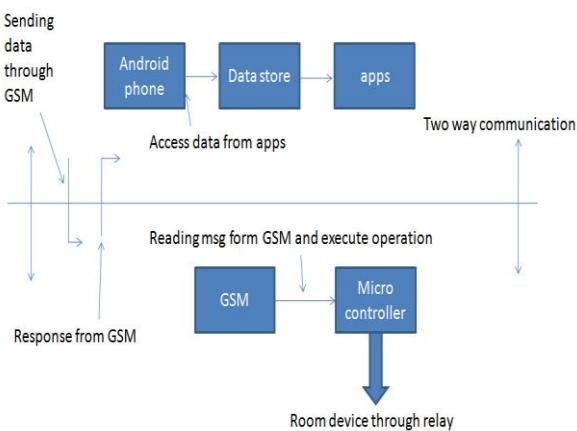


Fig 1: Block Diagram

2.1 User GSM mobile Handset

Cellular phone containing SIM (Subscriber's Identifying Module) card has a specific number through which communication takes place. The mode of communication is wireless and mechanism works on the GSM (Global System for Mobile communication) technology. Here, the user transmits instructions to the system to control the appliance in the form of SMS.

2.2. Receiver GSM Handset

This receiver GSM handset is used to receive the SMS sent by the user and then to transmit an acknowledgement or status to the user's mobile. The receiver handset has to be

equipped with an android operating system and a valid SIM card. In our design we have used a android platform GSM handset model. The handset has a built in AT modem with UART interface and supports most of the AT command instructions. This handset is attached with the microcontroller used to control the appliance through UART. AT Modem is a Modem which supports AT commands, also known as Hayes command. The Hayes command set is a specific command language originally developed for the Hayes Smart modem. The command set consists of a series of short text strings which combine together to produce complete commands for operations such as dialing, hanging up, and changing the parameters of the connection. Most modems follow the specifications of the Hayes command set. AT commands are instructions used to control a modem. AT is the abbreviation of Attention. Every command line starts with "AT" or "at".

2.3. Microcontroller Board

This contains the micro-controller (ATmega328) and a timeout generator circuit. This is the main module of the system. On receipt of the SMS message, text words are checked with predetermined format which includes desired device ON/OFF commands. To read a message the microcontroller sends the appropriate AT command to the Receiver GSM Modem through UART. The Modem then responds with the message and the microcontroller stores the message in the RAM. When the message ends there is no way to know by the microcontroller. The time-out generator circuit performs the vital function of providing the microcontroller board with the ability to detect the end of a message from the receiver GSM mobile. The output of the time-out generator circuit (connected to port1_3 of the microcontroller) is low until the message is being received and becomes high at the end of the message. The microcontroller then processes the command and sends the appropriate controlling signal to the switching module.

2.4. Android

Android is a mobile operating system that is based on a modified version of Linux. It was originally developed by a start-up of the same name, Android, Inc. In 2005, as part of its strategy to enter the mobile space, Google purchased Android and took over its development work as well as its development team). Google wanted Android to be open and free; hence, most of the Android code was released under the open source Apache License, which means that anyone

who wants to use Android can do so by downloading the full Android source code.

2.5. Android Application

Android is a software stack for mobile devices that include an operating system, middleware and key applications. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language. By providing an open development framework, Android offers developers the ability to build extremely rich and innovative applications. Developers have full access to the same framework APIs used by the core applications. Android includes a set of C/C++ libraries used by various components of the Android system. They include System C library, Media library, Surface Manager, LibWebCore, SGL, SQLite, FreeType and 3D libraries. Android applications are written in Java programming language. The Android SDK compiles the code along with any data and resource files into an Android package, an archive file with an .apk file extension. All the code in a single .apk file is considered to be one application and is the file that Android powered devices use to install the application. Once installed on a device, each Android application lives in its own security sandbox. Some important application fundamentals are: The Android operating system is a multi-user Linux system where each application is a different user. By default, the system assigns each application a unique user ID. The system sets permission for all the files in an application so that only the user ID assigned to that application can access them. Each process has its own virtual machine, so an application's code runs in isolation from other application. Every application runs its own Linux process. Fig 2 shows android application created in mobile.

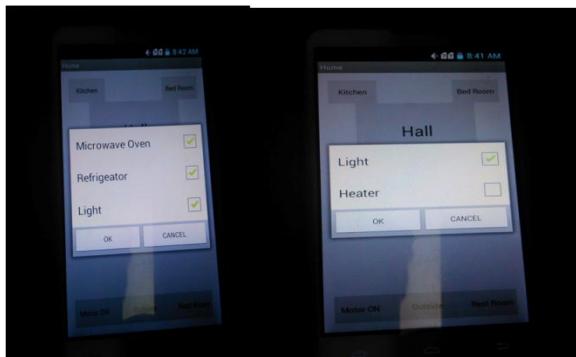


Fig 2: Android application

3. ALGORITHM

The system operates as per the algorithm shown in Fig 3. Upon power up the microcontroller initializes the AT Modem. During initialization the microcontroller configures the Modem's UART speed, message format etc. to be used. After the initialization is complete the microcontroller continuously checks the Modem for any new message. Upon receipt of a message the microcontroller reads the message and extracts the command and authentication information. The authentication information may be the remote user's mobile phone number or a text string sent along with the message for command.

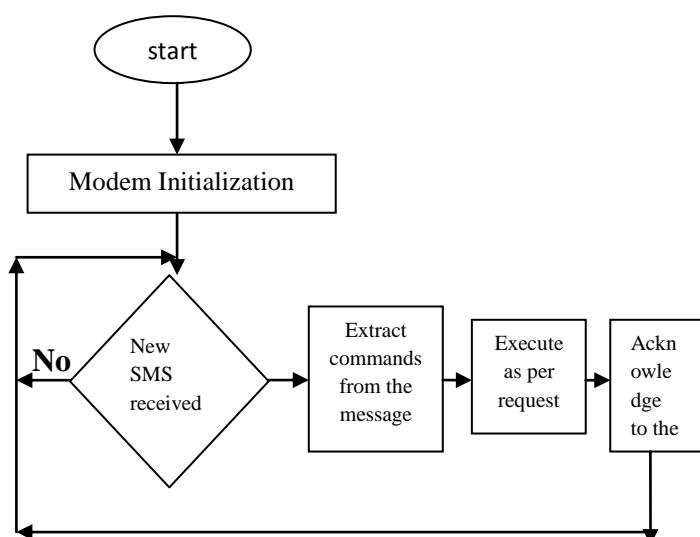


Fig 3: Flowchart of Microcontroller

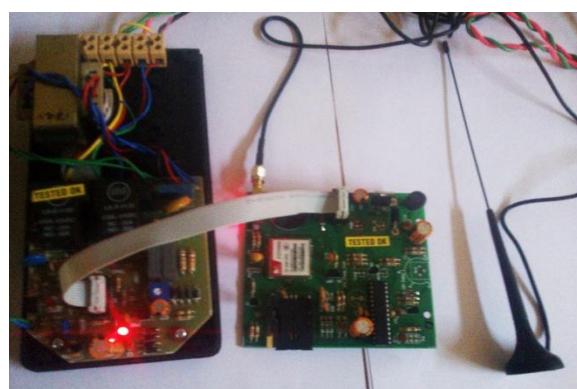


Fig 4: Photo of complete system

After the authentication is verified the microcontroller then sends the appropriate control signal to the switching module to control the appliance. The command is executed and the devices are switched ON or OFF according to the command by android application. The microcontroller then sends an SMS to the user through the AT modem stating the Status of the appliance as an acknowledgement. Fig 4 shows complete setup of the system.

4. CONCLUSION

In the paper low cost, secure, ubiquitously accessible, auto configurable, remotely controlled solution for automation of homes has been introduced. The approach discussed in the paper has achieved the target to control home appliances remotely using the SMS-based system satisfying user needs and requirements. The extensive capabilities of this system are what make it so interesting. From the convenience of a simple android mobile, a user is able to control and monitor virtually any electrical device in a household. By connecting all the appliances with the system through power line communication or wireless to the system, all electrical household appliances can be controlled by sending a message from a android mobile.

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[8] Official Android developer website:
<http://www.developer.android.com>