Bluetooth-Based Remote Control System for Electrical Appliances

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ABSTRACT

There is increasing interest in home automation and remote control systems. This paper examines the trend based on existing technologies and presented a Bluetooth-based Remote Control (BRC) system for controlling small electrical appliances. The system design and implementation is guided by the rational unified process approach. A graphical user interface was developed for an Android smart phone from which control signals are sent via a Bluetooth connection to a Bluetooth receiver module mounted on a microcomputer system to which an electrical appliance attaches. Upon receiving a control signal, a microcontroller translates the signal into the desired ON/OFF signal for light bulbs or SPEED for ceiling fan regulation. Android Studios was used to developed the smart phone application while Embedded C was used to programmed the microcontroller and LED display output. PCB Wizard and Mikro C served as additional development tools.

Keywords: *Assistive tools, Home Automation, Smart Home, Reduce, Android remote control.*

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1. BACKGROUND TO THE STUDY

The growing interest in home automation systems can largely be attributed to the need to control and monitor domestic electrical appliances from a single hand-held device. This growing interest has led to the concept of Home Automated System. This over the years has received various names from different Authors of papers and Co-Authors in the scientific world. Home Automated System has to do with establishing communication between appliances and devices in a home. The name Home Automated System can be attributed to the work of these researchers (Al-Ali and Al-Rousan, 2004; Piyare and Tazil, 2011; Ramlee et al., 2013 and Viji et al., 2016). Another term that is often used is *Smart Home System* (Mohd-Helmy et al., 2010 and Mohamed et al., 2014). Other researchers have referred to the concept of Home Automated System using slightly different, but related terms (Yavuz et al 2007; Faisal et al., 2012 and Mughele and Kazeem 2013). A Home Automated System can benefit users in two major ways. First, it can serve as an assistive tool to enable users with reduced mobility live an independent life. Second, it can help users power on/off devices on a need basis, thereby cutting down their electricity consumption.

Home automation systems are implemented with the use of suitable sensors and actuators to create a host controller that interfaces with domestic electrical appliances. Also, a suitable means of communication has to be set up between the hand-held (remote control/monitoring) device and the host controller. Home automation systems have been implemented using a variety of wireless communication technologies including Wi-Fi, GSM and Bluetooth. In this paper, Bluetooth is preferred because it eliminates GSM network usage charges. Bluetooth modules come as a standard feature in smart phones and modern laptops due to their low cost, low power requirement and small size. Bluetooth operates over the unlicensed, globally available frequency of 2.4GHz. It is capable of linking digital devices within a range of 10 meters to 100 meters at a speed of up to 3Mbps, depending on the Bluetooth class. It is therefore a good choice for point-to-point or point-to-multipoint short distance communication.

Most of the existing technologies stop at light controllers and powering on/off appliances. This paper presents a design that has the advantage of also controlling the speed of electric fans.

1.1 Statement of Problem

Home automation systems provide a more convenient means for users to remotely control electrical appliances, to utilise power supply efficiently and to have an improved quality of living. In a bid to keep the cost of deployment as low as possible, this study pursues a solution that utilises an Android smart phone with Bluetooth connectivity as the handheld device. The study focuses on remotely controlling small electrical appliances, such as light bulbs and ceiling fans, which are predominant in many residential properties in Sub-Saharan Africa.

1.2 Objective

The main objective of this study is to design a system comprising of an Android application that sends control signals to a microcontroller for the switching ON/OFF of light bulbs and other small electrical appliances, as well as regulating the SPEED of electric fans (see Figure.1).

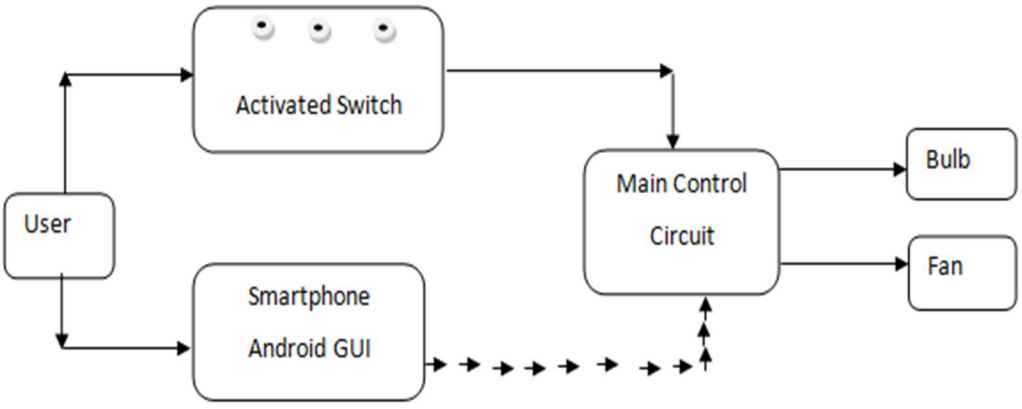

Fig 1: BRC System Functional Block

2. METHODOLOGY

2.1 Rational Unified Process (RUP) Approach

This paper adopts the Rational Unified Process (RUP) approach to guide the design and implementation of the system. RUP provides guidelines, i.e., templates for all aspects and stages of program development. It entails building and designing a system in phases which include Inception, Elaboration, Construction and Transition. These four phases can further be Broken into: Planning and Evaluation, Requirements, Analysis and Design, Implementation, and finally Testing. Depending on the outcome of the testing, the program development may return to the Planning and Evaluation phase or shoot off to the Deployment phases. It is architecture-centric, where the architecture is a function of user needs (Ashraf, (2014)).

The following steps detail how the Rational Unified Process guided the design and implementation of the Bluetooth-based Remote Control (BRC) system.

Existing systems were reviewed.

- A gap was identified on the need for FAN REGULATION.
- An Android application was created using Android Studios.
- A microcontroller alongside switches and relays were put together on a printed circuit board.
- Embedded C was used to program the microcontroller.
- The finished system was tested and modified as required.

2.2 The Research Design

This paper consists of two design components; The Hardware and The Software design.

2.2.1 Physical Framework (Hardware Design)

BRC system hardware Design consists of two main components: The Smartphone and The Main Control Board. The Smartphone hosts the Androids application which allows the users to establish the control of the home appliances. Androids application communicates with the Main Control circuit by establishing an ad-hoc communication protocol between the Smartphone and The Main Control Board via a Bluetooth technology. Bluetooth module is chosen to establish the Bluetooth connection between BRC System main control board and the Smartphone Android Application. Fig 2 illustrates the hardware block control function of the system.

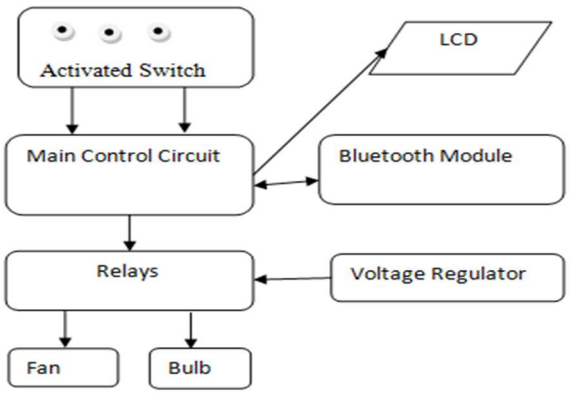

Figure 2 BRC System Hardware Block

The main Control Circuit components is known as the Brain of the BRC System because it coordinates the commands send from the Smartphone Android application to the microcontroller for processing and thereafter send the processed command to the Relay to activate the applicable electrical appliance either to switch ON/OFF (illustrated in Figure 3 BRC System Design). PIC16F677A Microcontroller is adopted in this System due to its large programming memory, capability to perform many tasks, easy to see and For the Bluetooth module, low cost Cytron Bluebee is chosen to establish the Bluetooth connection between main control board and the GUIs because it comes with onboard antenna and provides a serial port profile,

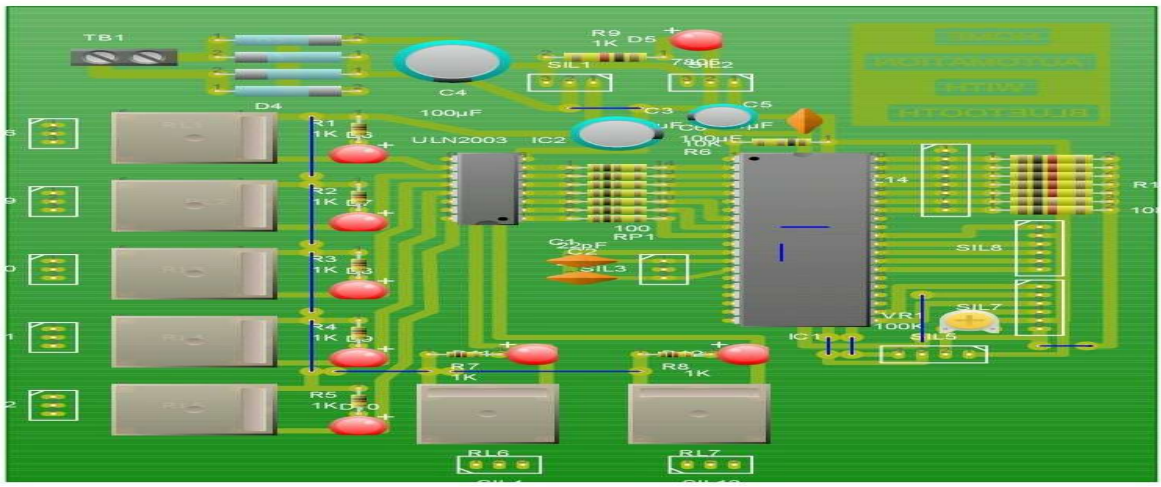

Figure 3: BRC System Design

2.2 Software Design

The software design for this system focuses on two aspects; The Smartphone application (GUI) and the Microcontroller. The Smartphone application (GUI) is developed using Android Studio for sending commands to the main control circuit of the BRC System. This application is used to control the appliances according to the user command to the main control circuit. This is possible after the send command had been processed by the microcontroller then the electrical appliance is controlled through a relay. The Microcontroller is programmed with C programming Language to be able to processed and understand the user send command.

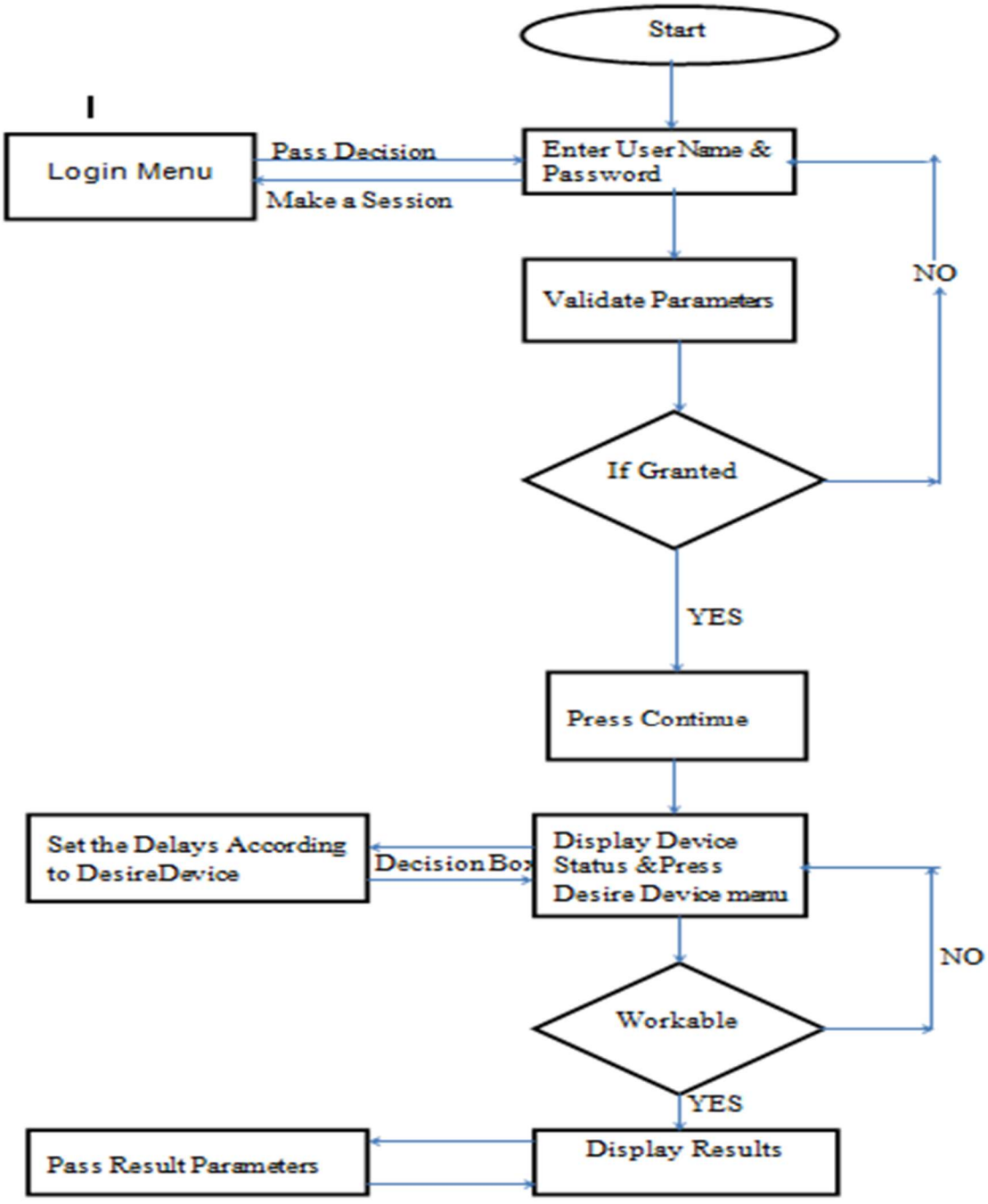

Figure 4: BRC System Software Design

3. DISCUSSION OF RESULTS

The results of this System led to remote control home appliances by touching the Smartphone screen to send a signal to the Microcontroller for signal processing in order to activate the corresponding appliances to either switch on or off.

Fig 5: BRC System Login Menu

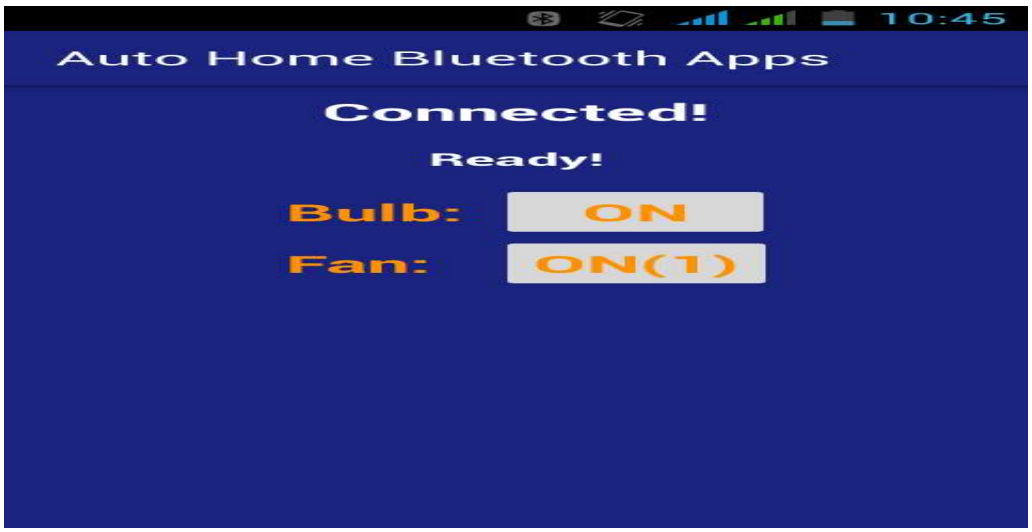

Fig 6: BRC System Control Menu

Fig 7: BRC System Powered Bulb and Fans

4. CONCLUDING REMARKS

In conclusion, BRC System provides a low cost system to be use at homes. The remote control function by Smartphone is very useful for everybody especially to physically disabled persons. The system is secure from access from any intruder. The users are expected to acquire password and username before controlling the home appliances. This design transforms a Smartphone into a hand-held controller for controlling home appliances. With the Bluetooth enabled Smartphone along with Bluetooth technology, the complication of wiring is eliminated and also provides convenience for the user by eliminating the need to often getting up and down to switch on/off home electrical appliances. Bluetooth technology is low cost when compared to other wireless technology. On the other hand with the addition of Fan Speed Regulator to be able to regulate the Fan speed to one choice. The system is designed in a user-friendly interface. For future work, the Android Graphical User Interface will be implemented with Speech recognition control and the low voltage activated switch will be replaced by clap switches.

5. CONTRIBUTION TO KNOWLEDGE

In light of the literature review and Research evidence; this paper has contributed in the area of Computer Embedded System by introducing Fan Speed Regulation.

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