Ardunio and Bluetooth based Smart Home Control System

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ABSTRACT

Internet of Things (IoT) conceptualizes the idea of remotely connecting, monitoring real world and controlling objects (things). Nowadays, many efficient situations for criminal cases are increasing in everywhere and every time. This IoT project focuses on building a smart home control system which sends alerts to the owner. But if there is Automatic Home control System, people can feel safety of their home and also be feeling smart and comfortable of their home. So, home control System is necessary for every home. To demonstrate the feasibility and effectiveness of this system, devices such as light switches, power plug, temperature sensor and current sensor have been integrated with the proposed home control system. This system can communicated with Short Message Service (SMS) on GSM to control home appliances.

Keywords : Smart Home, Home Appliances, Arduino, Bluetooth, Android, Sensor

I. INTRODUCTION

Home automation or Smart Homes can be described as introduction of technology within the home environment to provide convenience, comfort, security and energy efficiency to its occupants. Intelligent home is also known as the smart residential home is moving towards the mobile remote control. Various wireless technologies that can support some form of remote data transfer, sensing and control such as Bluetooth, Wi-Fi, RFID, and cellular networks have been utilized to embed various levels of intelligence in the home. This system is presented Bluetooth based home automation systems using Android Smart phones without the Internet controllability. The devices are physically connected to a Bluetooth sub-controller which is then accessed and controlled by the Smart phone using built-in Bluetooth connectivity [1, 3].

Bluetooth with globally available frequencies of 2400Hz is able to provide connectivity up to 100 meters at speed of up to 3Mbps depending on the Bluetooth device class. The smart home concept in the system improves the standard living at home [1, 3]. The main control system implements wireless Bluetooth technology to provide remote access from smart phone.

The system intended to control electrical appliances and devices in house with relatively low cost design, user-friendly interface and ease of installation. Home automation allows controlling house appliances like door, light, fan, air-condition… etc [5, 8]. It also provides emergency system and home security. It enables the consumer more control of user's home it facilitates many conditions, for example, if the consumer is on user's way to user's home, controlling light turning on, or pre-heating oven when user got home, therefore, many manual actions is replaced by home automation which reduce human efforts and time saving.

The organization of this document is as follows. In Section 2 Components of home control system, GSM SIM 900A, IR Receiver Diode (TSOP38238), Bluetooth HC-05, LDR sensor and Temperature sensor etc. is described. In Section 3, System Architecture and Circuit Diagram are presented. In Section 4, Results and Discussion with the implementation figures is discussed. Finally, conclude the paper in section 5 with advantages and future plan of the system.

II. COMPONENTS OF HOME CONTROL SYSTEM

This section describes the architecture and design of flexible and low-cost home control system. The function of this architecture is divided into three parts: power control via smart phone. The following components are applied in this system:

1. Arduino UNO R3
2. LCD(16x2) Display (for temperature)
3. GSM SIM 900A
4. IR Receiver Diode (TSOP38238)
5. Bluetooth HC-05
6. LDR Sensor (Light Depending Resistor)
7. Temperature Sensor(LM 35)
8. 2-Channel Relay (SRD-05 VDC-S L-C)

A. Arduino UNO R3

Arduino UNO shown in figure is a single board computer. Arduino is an open source physical computing platform based on a simple input/output (I/O) board. The type of the Arduino board used in this paper is ATMega328P Arduino Uno Microcontroller having 2KB static RAM, 32KB flash memory, 8 bit CPU, 6 Analog I/O pins and 14 Digital I/O pins [9]. The language used to program the Arduino microcontroller is C/C++. Programs are created in the Arduino development environment that compiling and linking source code and downloaded to the Arduino board where it starts running. [2,6,7]
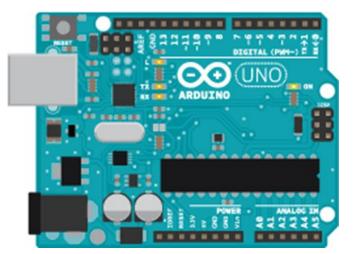

Figure 1. Arduino board

B. Android

Android operating system is primarily designed for smart phones and tablets. Android applications are written in Java programming language using the Android software development kit (SDK) and run in virtual machines []. The ATMega328P Microcontroller is connected by HC-05 Bluetooth Module using wireless technique to the Bluetooth Controller Android application, and the Input/output ports of the embedded system board are connected to home appliances. Android is the base of the application software, which has the largest base of Smartphone [1, 4, 5].
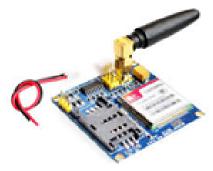

Figure 2. GSM SIM 900A

C. LCD(16x2) Display and 2-Channel Relay (SRD-05 VDC-S L-C)

The liquid-crystal display has the distinct advantage of having low power consumption than the LED. It is typically of the order of microwatts for the display in

comparison to the some order of milli watts for LEDs. Low power consumption requirement has made it compatible with MOS integrated logic circuit. Its other advantages are its low cost, and good contrast. The main drawbacks of LCDs are additional requirement of light source, a limited temperature range of operation (between 0 and 60° C), low reliability, short operating life, and poor visibility in low ambient lighting, slow speed and the need for an AC drive [1,5].

The relay module is an electrically operated switch that allows you to turn on or off a circuit using voltage and/or current much higher than a microcontroller could handle. There is no connection between the low voltage circuit operated by the microcontroller and the high power circuit. The relay protects each circuit from each other.

Figure 3. LCD display screen and 2 Channel Relay

D. IR Receiver Diode (TSOP38238) and Bluetooth HC-05

The standard feature for cellular phones is a Bluetooth technology which can be used in wireless connection for cellular phones and home appliances. Bluetooth technology gives an efficient method for controlling home automation. It is a low cost and a secured technology. The Arduino Bluetooth board is used in the system. The cell phone is used python program to supply the user interface. The band frequency of working is over 2.4 GHz ISM with a range of 10 m and 1 Mbps speed. This module HC-05 shows in figure provides a good wireless transmission & a well receiving serial data; it can be used to

provide a connection between MCU and PC for the data transferring purpose.

The I/O ports of the Bluetooth board and relays are used to connect the devices which be controlled. The Bluetooth simply is password protected. A Bluetooth device has the ability to scan and detect other devices easily. It has the ability of checking whether devices are working properly or not.

The TSOP48.. - series are miniaturized receivers for infrared remote control systems. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter. The demodulated output signal can directly be decoded by a microprocessor. TSOP48.. is the standard IR remote control receiver series, supporting all major transmission codes [1, 4, 5].
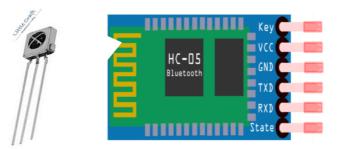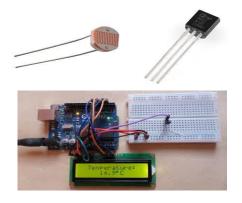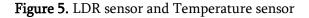

Figure 4. IR Receiver Diode and Bluetooth module HC05 Features

E. LDR sensor and Temperature sensor

It can measure temperature as well as humidity present in a room. Its range is less than 20 meters. It has a negative temperature coefficient (NTC) element and a humidity-sensitive element which is used to measure temperature between 0-50 degree Celsius [1,5].

Two cadmium sulphide (cds) photoconductive cells with spectral responses similar to that of the human eye. The cell resistance falls with increasing light intensity. Applications include smoke detection,

automatic lighting control, batch counting and burglar alarm systems. The sensitivity of a photodetector is the relationship between the light falling on the device and the resulting output signal. In the case of a photocell, one is dealing with the relationship between the incident light and the corresponding resistance of the cell.

Figure 5. LDR sensor and Temperature sensor

III. SYSTEM ARCHITECTURE AND CIRCUIT DIAGRAM

Hardware interface modules are directly interfaced with sensors and actuators through wires. It has the capabilities to control energy management systems like lightings and power plugs. For monitoring Home Environment the system supports sensors such as temperature, humidity and current.

The sensors that connected to the main control board measure room temperature and humidity level in the house. The indication from the sensor is able to remind the user to switch on/off the heater, fan or air-condition in the house. The home appliance on/off status and temperature or humidity reading are synchronized to the two smart phones. The switches status and sensor reading are in real-time monitoring by the main control board.
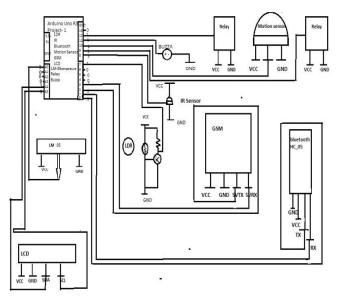

Figure 6. Circuit Diagram for Motion, Temperature and GSM

F. Software Description

Software of the proposed home automation system is divided into two parts: server application software and microcontroller firmware. The server application software is a library implementation of a micro Web-server running on Arduino Uno using the Ethernet shield. This Ethernet shield has the capability to be used both, as a client or a server. To successfully communicate between remote user and the Home Gateway, configuration stage and sensor/actuator control stage layers have been implemented on the Arduino Uno. The Arduino Uno and Ethernet shield were used to implement the micro Web-server for the Home gateway.

The software used here is Arduino IDE. The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open source software. The Arduino Integrated Development Environment – or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and

communicate with them. This software can be used with any Arduino board.

IV. RESULTS AND DISCUSSION

The system consists of a micro Web - server based on Arduino Ethernet, hardware interface modules and the Android compatible Smart phone app. This system allows authorized home owners to remotely control and monitor connected devices at home using any Wi-Fi or 3G/4G enabled Smart phone which supports Java. The smart phone app provides a graphical user interface (GUI) for accessing and controlling the devices at home through server real IP. This system can communicated with Short Message Service (SMS) on GSM to control home appliances that is light is on off by using mobile. IR sensor and Bluetooth device are used to Switch ON/OFF from smart phone and remote control. Automatic light system can also be including by using LDR sensor for power saving. This system can also read temperature by using temperature sensor and LCD display.

Remote users represent authorized users who can access the system on their Smart phone app using the Internet via Wi-Fi or 3G/4G network. Home Environment consists of Home Gateway and a hardware interface module. The primary function of the Home Gateway for the proposed architecture is to provide data translation services between the Internets. The main component of the Home Gateway is a micro Web - server based on Arduino Ethernet. The main task of the server is to manage, control and monitor system components, that enables hardware interface modules to successfully execute their assigned task using actuators and to report server with triggered events via sensors.

The automatic switching on and off of the light is controlled by the Light Dependent Resistor (LDR). Implementation of wireless Bluetooth connection in control board allows the system install in more simple way. The control board is directly installed beside the

electrical switches whereby the switching connection is controlled by relay.

Figure 7. Implementation of Home design and Circuit development in Home control

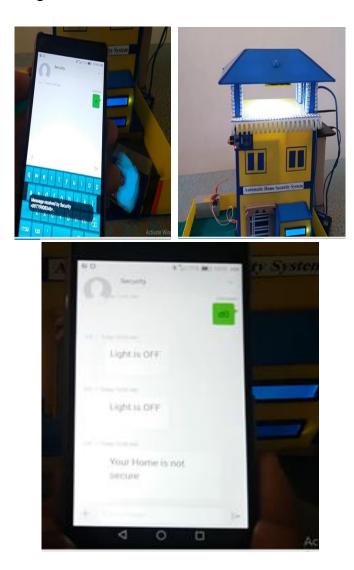**Figure 8.** Home control with Bluetooth in Android

Figure 9. Home control using message for switch on/off

V. CONCLUSION

Remote users represent authorized users who can access the system on their Smart phone app using the Internet via Wi-Fi or 3G/4G network. Two authorized users can access in this system. Home Environment consists of Home Gateway and a hardware interface module. Home control system is useful for everybody and necessary for every home. Since automatic light system can be used at day and night, this system can reduce the power consumption. This system can be provided for human being life.

A. Advantages of the System

This low cost system with minimum requirements takes care of both home security as well as home automation. To operate home control system the user need not have data connection enabled in his phone. The building and home that apply this kind of system can improve daily life and reduce power consumption.

B. Future Plan

If RFID card and password are known by someone, we can change the password. Fire alarm system can be extended. We can extend the controlling the air conditioner automatically when room temperature is high by using temperature sensor. Future works will focus on creating a wireless network between the home server and the home devices using Zigbee and implementation of voice commands for controlling the application via voice.

VI. REFERENCES

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