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DOOR-AUTOMATION SYSTEM USING BLUETOOTH-BASED ANDROID FOR MOBILE PHONE

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ABSTRACT

Smart Home is the term commonly used to define a residence that uses a home controller to integrate the residence's various home automation systems. The most popular home controllers are those that are connected to a Windows based PC. In our research we presented a part of smart home technology which using Bluetooth in a mobile device, so it will more easy and efficient to use. It also based on Android and Arduino platform both of which are free open source software. In this paper, a system called door locks automation system using Bluetooth-based Android Smartphone is proposed and prototyped. First the hardware design and software development are described, then the design of a Bluetooth-based Smartphone application for lock/unlock the door are presented. The hardware design for door-lock system is the combination of android smart phone as the task master, Bluetooth module as command agent, Arduino microcontroller as controller center / data processing center, and solenoid as door lock output. All of the tests indicate that all goes according to the initial design of this research.

Keywords: android, arduino uno, door automation, bluetooth, smart phone.

INTRODUCTION

Today, most mobile phones are a 'smart phone', which offers more advanced capabilities in connectivity issues than regular cell phones. According to an investigate by ABI Research, at the end of 2013, 1.4 billion smart phones has been in use: 798 million of them run Android, 294 million run Apple's iOS, and 45 million run Windows Phone [1]. Smart phone usually support one or more short range wireless technologies such as Bluetooth and infrared, making it possible to transfer data via these wireless connections. Smart phone can provide computer mobility, ubiquitous data access, and pervasive intelligence for almost every aspect of business processes and people's daily lives [2].

One of the smart phone applications that have been developed is smart homes technology [3]. Smart home technology is the technologies that are used in homes with various apparatus converse over a local network. According to the Smart Homes Association the best definition of smart home technology is: the combination of technology and services through home networking for a better value of living. This technology can be used to monitor, alert and execute, according to the desired functions. Smart homes technology makes automatic connection with environment via Internet, telephone or regular fixed phones. Smart homes actually have the ability to make life easier and more proper. Home networking can also offer peace of mind. Whether you're at job or on holiday, the smart home will aware you to what's going on, and security system can be built to offer some help in emergency situations. For example, not only would a house owner be woken with warning of a fire alarm, the smart home would also release doors, call the fire department and light the pathway to safety [4].

The use of Bluetooth technology in a smart phone today is not just for the transfer of data and files only. In recent years, smart home automation is one of the applications of Bluetooth technology. Bluetooth technology operate over unlicensed, its available at 2.4GHz frequency, it also can link digital devices within a range of 10m to 100m at the speed of up to 3Mbps but it depending on the Bluetooth device class [5]. With these qualifications of Bluetooth; we offer a door automation system based on Bluetooth technology, especially in door automation system.

BACKGROUND AND RELATED WORK

There are some factors that must to be considered when designing a smart home system. The system is invented to be low-priced, scalable so that new devices can be simply integrated into the system, and it should be user friendly. A variety of smart systems have been considered where the control is via Bluetooth, internet, short message service (SMS), smart card based, wifi etc

Shiu Kumar proposed smart home design application that allows owner to manage their home through internet. Its need a PC tend the information to the internet, so a PC is used as a server that increases the price and power consumption while others need web page hosting that need extra cost also.In his paper, said that the use of PC can require considerable cost and can be reduced by using a microcontroller [6].

Deepali recommends the use of the android platform version 2.3.4 Gingerbread and 3.1 Honeycomb using the Java programming language for smart home security system for the disabled and senior citizens [7]. In his research , the connection between android platform and the home device using wired conection, so It will be more efficient to support various wired as well as wireless technologies such as Bluetooth, Zigbee, Wi-Fi, World Wide Web. The implementation of Bluetooth for home security systems using the ARM9 processor were introduced by Naresh [8]. Hao Shi, in his research on home lighting settings implemented an open-source

Android Development Tools (ADT), the Android SDK (Software Development Kit) and Java Development Kit (JDK) [9]. Manasee Patil had examined home automation system using RFID, Wireless Sensor Network (ZigBee) technology and GSM. ZigBee is low power wireless technology used for monitoring and controlling various devices [10]. R. Piyare [11] has introduced design and implementation of a low cost, flexible and wireless solution for home automation, especially or on/off the lamp and to on/off the television automatically. However, this is a basic system without advanced features like integration of RTOS, and also not has light sensors that are used to intelligently control the home appliances without human intervention.

All research that mention above, inspired our research to make a research about the device that providing a safe and efficient solution for controlling home automation. The first step to build a smart home is about the security and the door is the mayor device for security system.

The device is a system to lock and unlock the door. Rather than using a key, it uses a command that is delivered digitally via Bluetooth on Smartphone and other mobile devices. The use of electronic lock using Bluetooth on Android smart phones in addition to providing ease of use, also provide better security than conventional key.

The system designed to simulate an electronic key, which is controlled through a Bluetooth-enabled smart phone. Controlling conducted by sending a command via Bluetooth to the Arduino circuit that acts as a connection between Android smart phone and solenoid.

Solenoid door lock is the electronic device that made for door lock and often use for automatic door locks. Solenoid will operate if the system has a voltage. The average of the solenoid door lock is 12 volt. In normal condition, the lever will be Normally Closed. If there is any voltage through the solenoid, it will unlock the door. Usually the solenoids combine with electric key lock system with RFID and password. In our research we combine solenoid door lock with Bluetooth-based smart phone.

HARDWARE ARCHITECTURE AND IMPLEMENTATION

There are several step in hardware design, i.e.

- The design of Arduino Uno circuit
- The design of Bluetooth circuit
- The design of Solenoid door lock circuit
- The design of LED circuit
- The design of power supply circuit
- The design of driver relay circuit

Arduino microcontroller serves as the brain of the whole series. [12] The microcontroller can be linked with other circuits to perform certain functions. The Arduino microcontroller using IC ATMega328P-PU and works by entering the program that has been created and ready for instantly use. Bluetooth module used in this circuit is the type of HC-05, which requires a 3.3 V DC power drawn from the Arduino microcontroller circuit (pin 3.3 V), Pin (TX 1) is a pathway transmit / send data on the Bluetooth module HC-05 with microcontroller and Pin (Rx 0) as the receive path / receiver data on the HC-05 Bluetooth module with microcontroller while the path GND (Ground) is a path connecting the data between HC-05 Bluetooth module with microcontroller circuit.

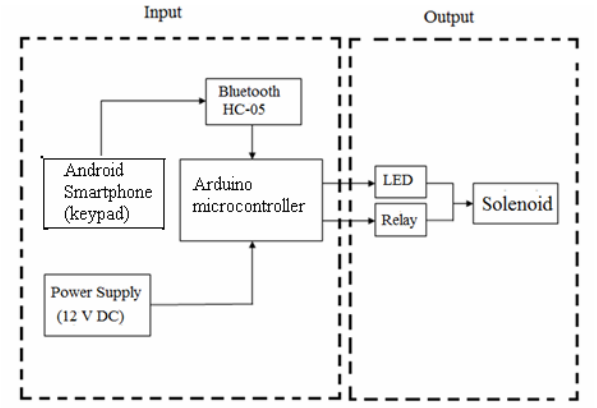

Figure-1. Block diagram of door automation system using android.

The block diagram in Figure-1 describes the system overall. This system has input from android Smartphone using Andruino software (v0.11), the overall system is controlled automatically and the output is a solenoid that connected to the Arduino microcontroller circuit. The function of each block can be seen in Table-1.

Table-1. The function of each System Block.

No	System Block	Function
1	Arduino Microcontroller	As data processing center
2	Android Smartphone (Andruino v0.11)	As data input
3	Bluetooth Module Hc-05	As data receiver
4	Battery and Adaptor (12V)	As the power supply
5	Driver Relay	As switch
6	LED	As indicator
7	Solenoid	As system output

The system required a program that must be implemented to the microcontroller. Programming language for the Arduino microcontroller is C language. To run the the program and incorporate the program to the microcontroller needed software i.e. Arduino.

The mechanism of device is to input a digital keypad on the software on android Smartphone first, if there is a command that is controlled by the user, the data will be instantly sent via a Bluetooth network then the input received by the Hc-05 Bluetooth module that connected to Arduino microcontroller. Arduino

microcontroller circuit serves as a data processor that controls the solenoid that previously connected to a relay that functions as an on / off switch.

Microcontroller is the central data in processing system. Microcontroller Arduino has been equipped with an internal EEPROM, Flash memory, etc. This section will examine the input password, and give orders to the LED and relay, to fill out his program with the principle of ISP (In System Programming) so that the program can be done without removing control.

Power supply circuit is used to supply power throughout the series; the power needed for the whole series is equal to 12 Volts DC. There are several components in the power supply circuit, such as transformers that serve for lowering the voltage. Capacitors are used as filters. And the last is the type LM7812 regulator IC that functions as a regulator of the power output by 12 Volt

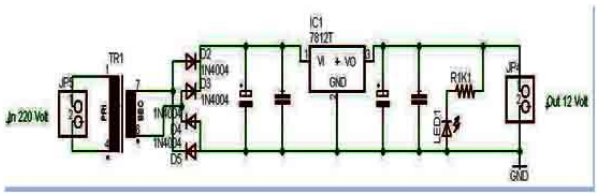

Figure-2. Power supply circuit.

Relay has a function as an electronic switch. Relay will be active when given input from the microcontroller, and serves as a switch for the solenoid system. In this research, we use the electro mechanical solenoid 12 V with supply voltage to 12V from Adaptor. Solenoid connected to the Relay, Relay connected to the 5V pin of the Arduino Uno for supplying coil voltage and ground Relay to ground Arduino Uno pin.

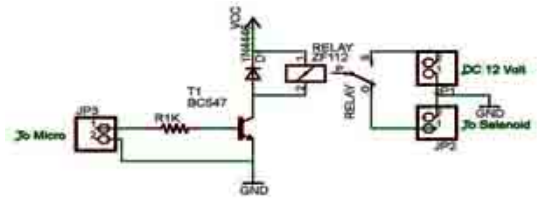

Figure-3. Relay driver circuit with solenoid

LED circuit serves as indicator for electric current. LED will turn on when current is passed from 12V DC solenoid in open-door condition, so the LED will be off when the system / solenoid current is not passed in the locked state.

SOFTWARE DEVELOPMENT

We use C language as programming language for Arduino (1.0.5) to run Arduino microcontroller. Relay as a switch to move the solenoid is set in pin 6 in Arduino microcontroller. Output pin 6 in relay will be in high condition and 1 s delay after user gives an order. [13]

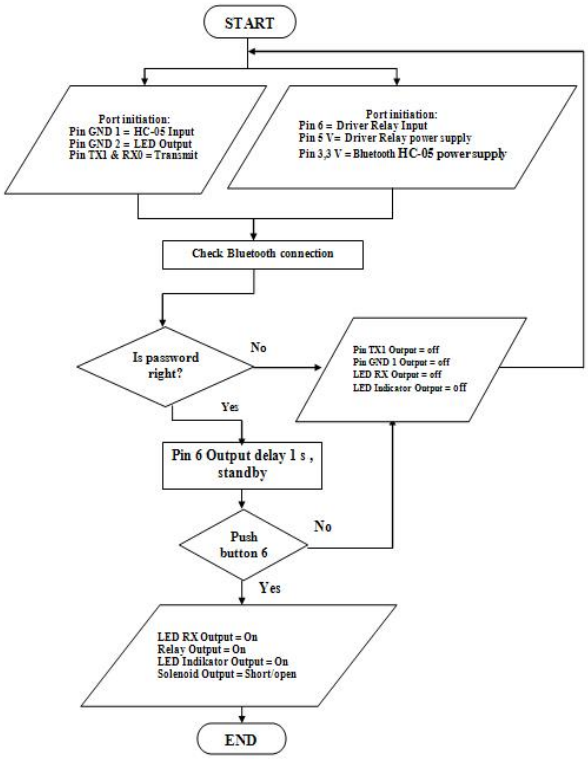

Figure-4. Flowchart for solenoid door lock programming.

EXPERIMENTAL RESULTS

After the implementation phase, the testing process performed. The results of the test series shows the minimum system of the Arduino microcontroller circuit system has a minimum value 9600 Bits per second, with 8 data bits and 1 Stop Bits. The whole series in this study operate the power of 12 volts. The power drawn from an adapter with a 7812 regulator IC. A function of this IC is to make the input voltage 220 volts of electricity into the main 12 volt DC, so it is safe and does not damage the circuit. Testing is done by ensuring the circuit has been installed correctly. With LED indicator that turn on in the microcontroller circuit and make sure there is no damaged component.

Relay and solenoid used to open and lock the output. The relay driver receives input data from Pin 6 on the microcontroller. Pin 6 on the microcontroller has function as input keypad on smart phone. Voltage measurements performed on output of the microcontroller Pin 6 using Volt-Ohm meter. Testing was conducted to determine the changes or differences in voltage solenoid.

Further testing is to examine the connectivity between Bluetooth on android Smartphone with Bluetooth module series HC-05 and the connection between keypad with Microcontroller. All of these tests show that all goes according to design connections. Final testing is testing the connection System to lock/unlock the door automatically. The test is performed to test the Arduino output in giving output on the LED and Relay for opening and closing the systems. Positive cable from the 12V supply adapter

connected to a COM port on the relay, and the other connected to a port on the relay NO. This condition make the voltage supply of the adapter can not flow because normally Open positions in the state. When the relay is active, the relay was originally connected to the COM port and port NC will be connected to the COM port and port NO. These conditions make voltage supply passed the solenoid adapter and make solenoid open the door system.

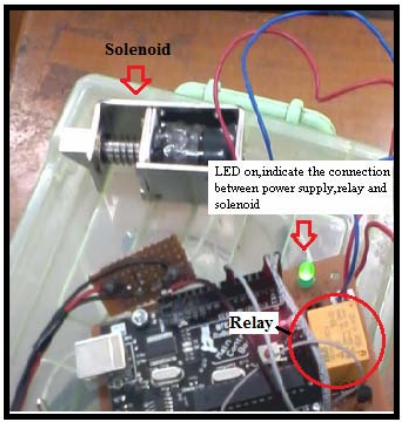

Figure-5. LED on indicate the connection between power supply, relay and solenoid.

CONCLUSIONS

This is a ongoing project. This paper gives basic idea of how to control home security for smart home, especially for door key locks. We use solenoid door lock system as a prototype for indoor and outdoor key lock system. It also provide a security and easy for Android phone/tab users. This project based on Android and Arduino platform both of which are Free Open Source Software. So the implementation rate is inexpensive and it is reasonable by a common person. Accomplishment of wireless Bluetooth connection in microcontroller permits the system installation in more easy way. The system has been successfully designed and prototyped to control the door condition using an Android Bluetooth-enabled phone and Bluetooth modules via Bluetooth HC-05. We have discussed a simple prototype in this paper but in future it can be extended to many other regions.

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