

# Design And Implementation Of Smart Living Room Wireless Control For Safety Purpose

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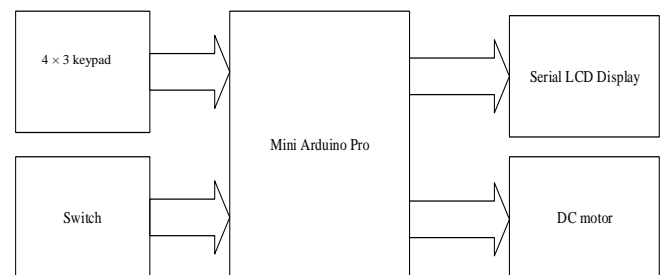
**Abstract:** This research presents the microcontroller controlled smart living room system using Bluetooth wireless technology from mobile phone. An android apk is created in mobile for controlling the living room system. A 16F877A microcontroller is interfaced serially to a bluetooth module transceiver. It is used for controlling fan speed control, dim light control, lighting ON/OFF and window angle control. An arduino controller is used for keypad control door security. It is connected to DC motor control circuit and switching circuit for opening and closing of the door, keypad for entering password and serial LCD for displaying the update status of the door. User can control the home appliances by using bluetooth connection from mobile phone in its range. User can adjust the dim light, fan speed, window angle and light bulbs from android apk. An internal EEPROM is built in 16F877A microcontroller and it stores the last requested data of the appliances. If user wants to recover the former conditions of the appliances, he can recall them from android apk.

**Keywords:** Arduino, 16F877A Microcontroller, Bluetooth, Android apk

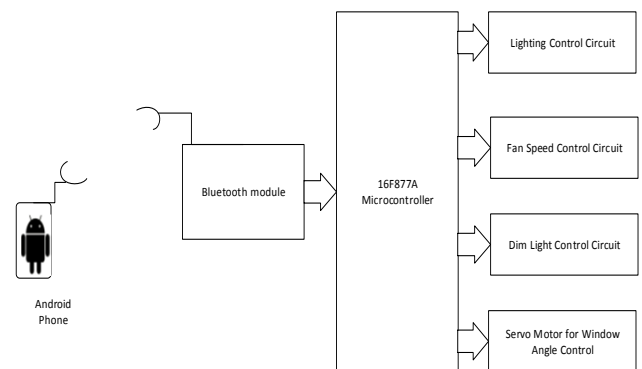
## 1. INTRODUCTION

Microcontroller based living room control system using Bluetooth technology will provide effective and modernized living standard. Bluetooth is a wireless technology standard for exchanging data over short distances (using short wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs). Living room control system from mobile is one of the most popular forms of wireless control technology. Researchers around the world are continuously improving our life by creating innovative applications of computing for our daily activities. Today, mobile phones come out of work place and are effectively used to communicate and to make our life easier and better than ever. In this living room control system, they are used to control the living room appliances via Bluetooth technology. Being inspired by the widespread use of wireless communication technology, we are proposing a concept of Smart Living Room System that will make our home convenient and smart. In this research, the door of the living room opens and closes by using keypad lock system. It is controlled by arduino controller and the status of the door is displayed on serial LCD. The control of light bulbs, fan speed, dim light and window angle based on wireless Bluetooth technology and microcontroller are implemented. Users of the living room can interact with the devices by wireless mobile interface via Bluetooth. This system also requires a specialized android apk to control the living room appliances from mobile. Implementation of Smart Living Room system has several advantages. Door security system was built with a keypad that was controlled by arduino. To open the door, user must enter the correct password and if the wrong password was entered, the door will be still locked. It can save the home from entering thieves and strangers. Old and disable persons can manage the living room without using too much effort. As fan speed can be adjusted, users can maintain the room temperature as the desire. User can also vary the lighting of the room by using dim light. There is also a window system that can be opened and closed between 0 and 180 degree as user desire. Furthermore, four light bulbs are also presented and user can switch on and off them. All the appliances in the living room can be controlled without using too much energy. It can be controlled easily by mobile from any place of the room. While user can't go to open or close the

appliances immediately, he can do it by using mobile. It can reduce the loss of electrical energy and human effort. It can promote the living standard of human beings with the effects of wireless technology. This system can be used not only in living room but also in many other places for many purposes.



**Fig:1** Block Diagram for Keypad Control Door Security



**Fig:2** Block Diagram of Living Room Appliances Control

This section includes the total hardware overview where in the first subsection, the connections of arduino with keypad, DC motor driver circuit, DC motor, switching circuit and serial LCD are explained. Then, after that how to communicate between the PIC and the control circuits such as fan speed control circuit, dim light control circuit, lighting ON/OFF control circuit and window angle control circuit is described. In the next sub-section, it is presented how to connect Bluetooth module and android apk from mobile. The

last sub-section illustrates the overall hardware circuit diagram and its software flowchart.

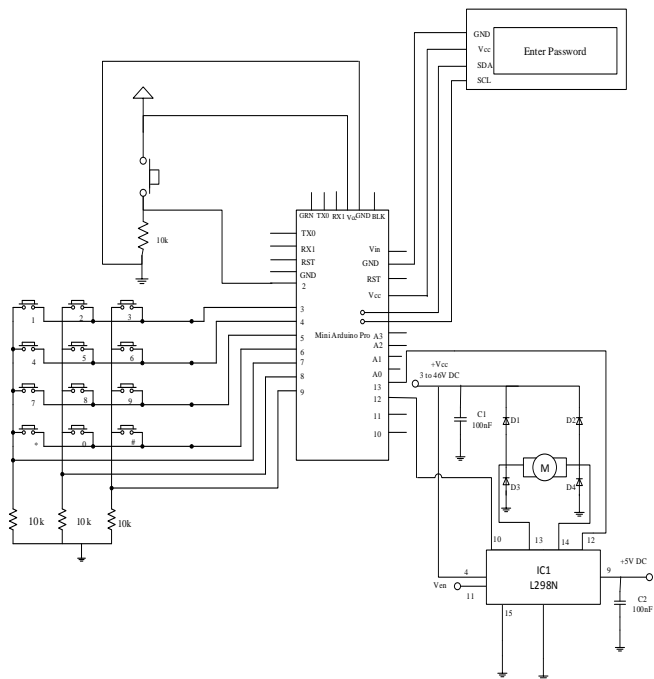
**2. PROPOSED SYSTEM DESIGN**

The hardware configuration of the keypad control door security system is basically the configuring of arduino, keypad, DC motor driver circuit, DC motor, switching circuit and serial LCD. The main hardware components of the living room appliances control system are PIC 16F877A microcontroller, HC06 bluetooth module, android phone, servo motor, fan, light bulbs, IGBT, optocoupler and so on. The complete circuit diagram of the project can be divided into two different sections:

- Interfacing to keypad control door security circuit
- Interfacing to living room appliances control circuit

**2.1 INTERFACING TO KEYPAD CONTROL DOOR SECURITY CIRCUIT**

Fig:3 shows the circuit diagram of the keypad control door security system where we used arduino, one 4\*3 keypad, one serial LCD, motor driver, DC motor and switch and other peripheral circuit components. Here the arduino is used to drive the DC motor depending on the input data from keypad and display the message of the system on LCD.

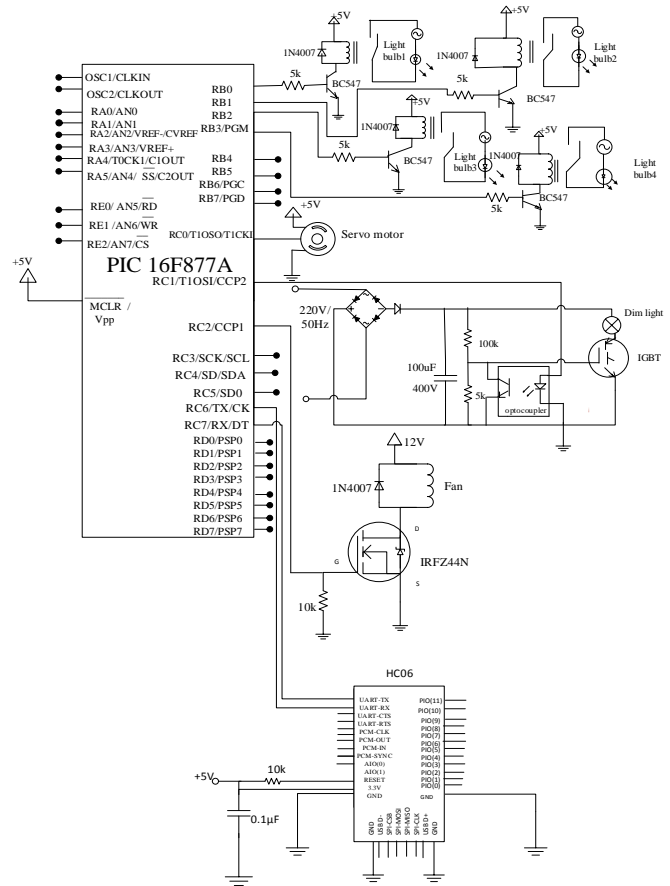


**Fig:3** Circuit Diagram of the Keypad Control Door Security

The arduino is connected with keypad to input the password entered by the user. When the user entered password is the same with the password stored in arduino, the motor driver which is connected to the arduino will drive the DC motor to open the door. Then it will close the door. The delay time is four seconds between opening and closing of the door. There is also a switch which is connected to the arduino. It is used to open the door from inside of the room. A serial LCD is also joined to the arduino to display the message of the system.

**2.2 INTERFACING TO LIVING ROOM APPLIANCES CONTROL CIRCUIT**

Fig:4 shows the circuit diagram of the living room appliances control system based on PIC 16F877A using Bluetooth technology. It can be controlled by android apk from mobile. HC06 wireless Bluetooth transceiver is connected to PIC to communicate with the Bluetooth from mobile. HC06 bluetooth module contains VCC, GND, TXD, RXD pins. To make a connection between PIC and HC06 bluetooth module, TX from PIC and RXD from Bluetooth module, RX from PIC and TXD from Bluetooth module must be joined. Data are transferred with the baud rate of 9600.



**Fig:4** Circuit Diagram of the Living Room Appliances Control

This system includes four parts such as dim light control, fan speed control, window angle control and lighting ON/OFF control. Dim light control circuit is made up of the IGBT dimmer, optocoupler and other electronic components. Its brightness can be varied by user from android apk. IGBT (Insulated Gate Bipolar Transistor) is a three-terminal power semiconductor device primarily used as an electronic switch which, as it was developed, came to combine high efficiency and fast switching. It is designed to turn on and off rapidly. The IGBT combines the simple characteristics of MOSFETs with the high-current and low-saturation-voltage capability of bipolar transistors. The IGBT combines an isolated gate FET for the control input, and a bipolar power transistor as a switch, in a single device. Fan speed control circuit is mainly constructed with IRFZ44N MOSFET, fan and others. Fan speed will depend on the PWM (Pulse Width Modulation)

from PIC. Window angle control is operated by servo motor which is connected to PIC. Its opening degree will also depend on PWM. Lighting on/off control consists of four light bulbs and they are connected with relays to switch on and switch off. All above appliances can be controlled by mobile as user desires.

### 3. SOFTWARE IMPLEMENTATION

The arduino compiler is used in keypad control door security. To implement the actual algorithm of the living room appliances control in the PIC 16F877A, the mikroC Pro compiler with debugger is used.

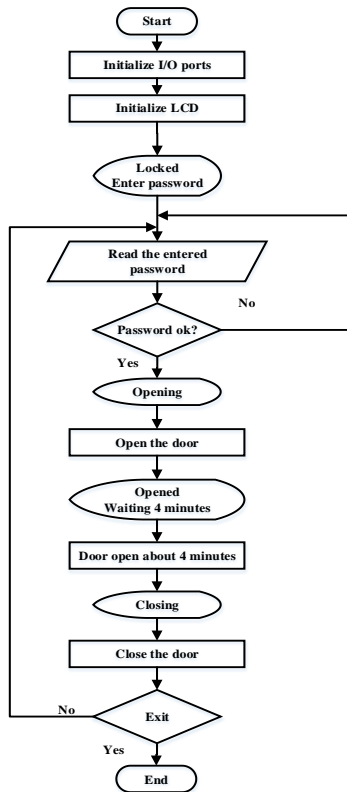


Fig:5 Flow Chart of the Keypad Control Door Security

The flowchart of the keypad control door security system is shown in fig:5. Firstly, initialize the I/O pins and initialize the serial LCD. In this stage, LCD will display “Locked” and “Enter Password”. When the user enters the password, the arduino will check it. If the password is correct, LCD will display “Opening” and the door will open. When the door is fully opened, LCD will display “Opened” and “Waiting 4 minutes”. Then the door will keep opening about four minutes. Finally, the door will close automatically. If the wrong password is entered, the door will be still locked. Fig:6 shows the flow chart of the switch control door security system. Firstly, I/O pins and serial LCD must be initialized. LCD will display “Locked” and “Enter Password”. When user press the switch to open the door from inside of the room, LCD will display “Opening” and the door will open. When the door is fully opened, LCD will display “Opened” and “Waiting

4 minutes”. Then the door will keep opening about four minutes. Finally, the door will close automatically.

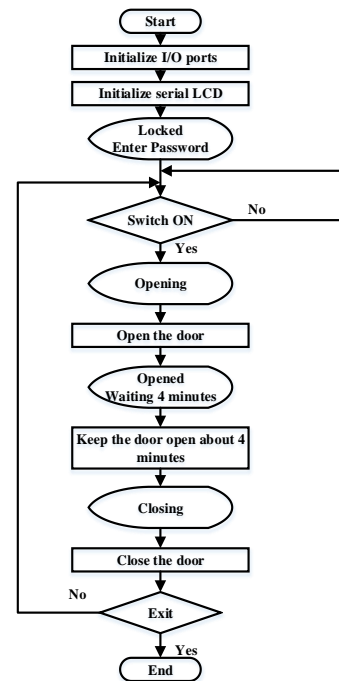


Fig:6 Flow Chart for Switch Control Door Security

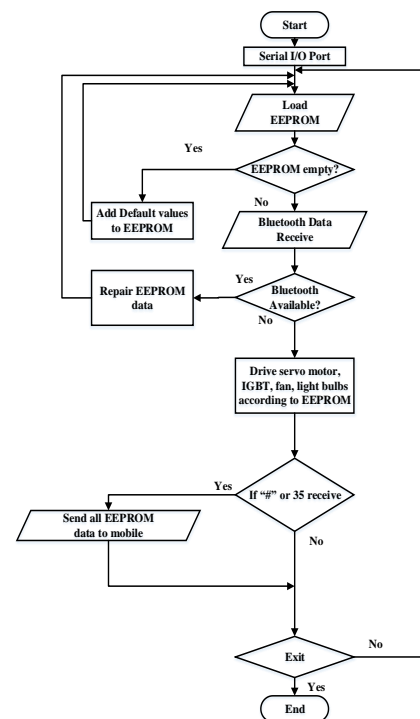


Fig:7 Flow Chart of the Living Room Appliances Control

Fig:7 shows the flow chart of the living room appliances control. Firstly, serial I/O ports will be initialized. When there is no data in EEPROM of the PIC microcontroller, default values must be added to EEPROM. On the other hand, PIC will accept the data from Bluetooth and it will check whether wireless Bluetooth connection is available or not. If it is

available, the data from EEPROM will be repaired. Then, it will loop to load EEPROM. When there is no new data from Bluetooth, PIC will drive all the control circuits according to the data from EEPROM. When PIC receives "#", the past conditions of the control system will be displayed on android apk. To avoid signal collision, different intervals of ASCII characters were managed separately in Android Application Package Design. According to the following table, each seek bar in Android provides specific code for transmission.

Servo	Chr	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
	Dec	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
	Hex	30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
Fan	Chr	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	Dec	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
	Hex	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
DimLight	Chr	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
	Dec	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
	Hex	50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
Relay	Chr	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
	Dec	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
	Hex	60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F
	Chr	p	q	r	s	t	u	v	w	x	y	z	{		}	~	
	Dec	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
	Hex	70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F

Fig: 8 ASCII character map for all control sections

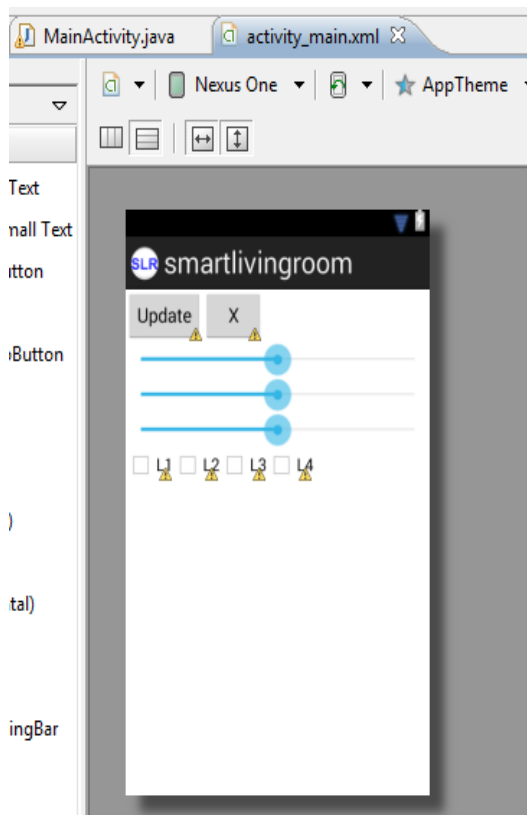


Fig:9 Android UI for smart living room

All control panels for home appliances are considered in Android GUI(Graphical User Interface).

```

setOnSeekBarChangeListener(new OnSeekBarChangeListener() {
    public void onStopTrackingTouch(SeekBar arg0)
    {
        sendMessageHandler( Character.toString(((char) (arg0.getProgress()+48)));
    }
    public void onStartTrackingTouch(SeekBar arg0)
    {
    }
    public void onProgressChanged(SeekBar arg0, int arg1, boolean arg2)
    {
        sendMessageHandler( Character.toString(((char) (arg1+48)));
    }
});
    
```

Fig:10 Java code for seekbar Android UI control

For matching ASCII character arrangement, seekbar value is added with minimum number of predefined control. PIC microcontroller will save incoming character to EEPROM of PIC.

```

if(UART1_Data_Ready()==1)
{
    count=UART1_Read();
    if (count==48 && count<=63) EEPROM_Write(0x00,count);
    else if (count==64 && count<=79) EEPROM_Write(0x01,count);
    else if (count==80 && count<=95) EEPROM_Write(0x02,count);
    else if (count==96 && count<=127) EEPROM_Write(0x03,count);
    else if (count==35) feedback();
    code_read();
}
    
```

Fig:11 Java code for saving data to EEPROM of PIC

After retrieving EEPROM data, PIC will calculate absolute value within ASCII character, and then it will calculate delay time for Servo control and duty cycle ratio as shown in fig:12.

```

PORTC.B0=1;
Delay(1000+(user1[0]-48)*66.67);
PORTC.B0=0;
Delay(19000-( user1[0]-48)*66.67);

current_duty1=(user1[1]-64)*17;
PWM1_Set_Duty(current_duty1);

current_duty2=(user1[2]-80)*17;
PWM2_Set_Duty(current_duty2);

PORTB=user1[3];
    
```

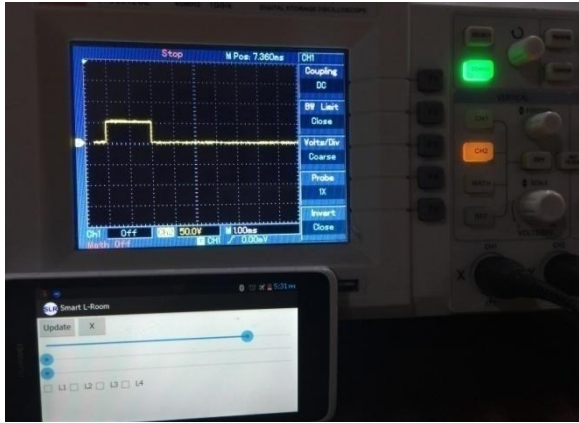
Fig:12 Java code for delay time and duty cycle

#### 4. TESTS AND RESULTS

The prototype of the smart living room system is with the dimensions of 1ft 8in (length,width) and 1ft 2in(height). The prototype will be constructed. In this work, the control system is designed to control the prototype of smart living room system. This overall system is mainly controlled by Bluetooth technology. Since it uses mobile phone to communicate with the appliances, android apk is very essential in this system. To create an android apk, eclipse software is used. Arduino software is used to implement the program in arduino controller. The program of the PIC16F877A microcontroller is written in mikroC language using mikroC software. It is a powerful, developed feature rich tool for PIC microcontrollers. mikroC makes a fast and



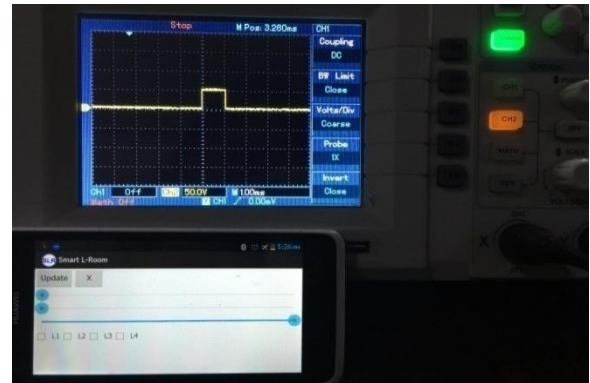
reliable tool. Proteus software is used to test the simulation results of the living room appliances control using microcontroller. Fig:13to fig:18 show the tests of the measurements of PWM(Pulse Width Modulation) for window angle control , fan speed control and dim light control. Four light bulbs for lighting on/off control are constructed with relay drivers.



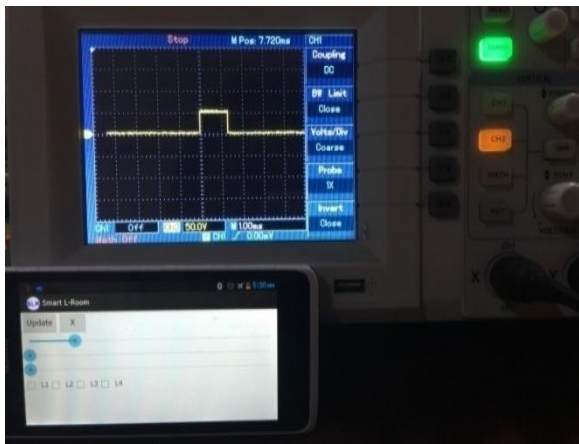
**Fig:13** Test of Servo motor for window angle with PWM (High Degree)



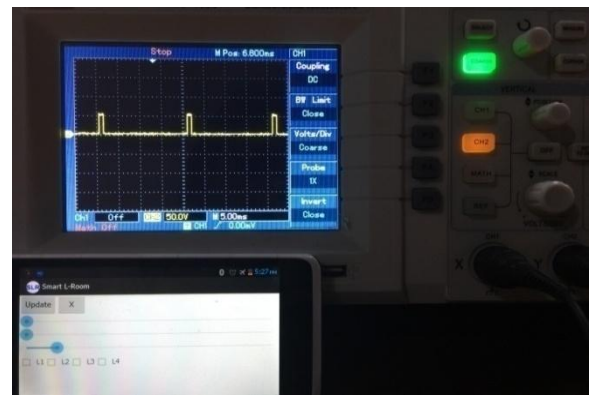
**Fig:16** Test of Dim Light with PWM (Low Brightness)



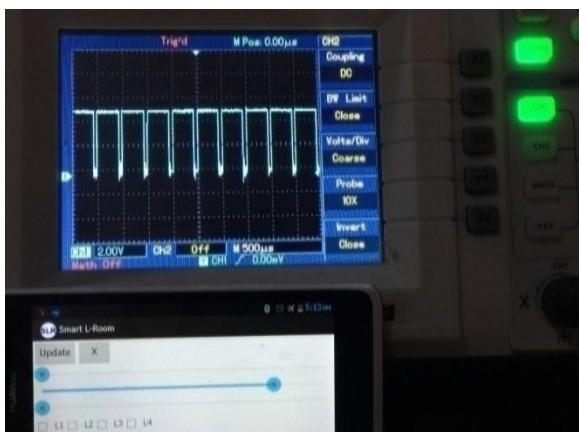
**Fig:17** Test of Fan Speed with PWM (High Speed)



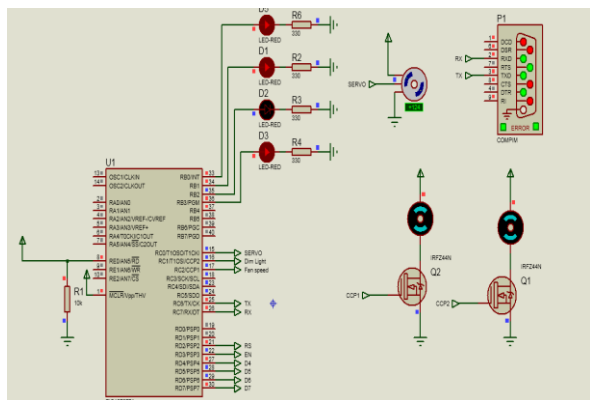
**Fig:14** Test of Servo motor for window angle with PWM (Low Degree)



**Fig:18** Test of Fan Speed with PWM (Low Speed)



**Fig:15** Test of Dim Light with PWM (HighBrightness)



**Fig:19** Simulation test of Servo, fan, dim light and four light bulbs

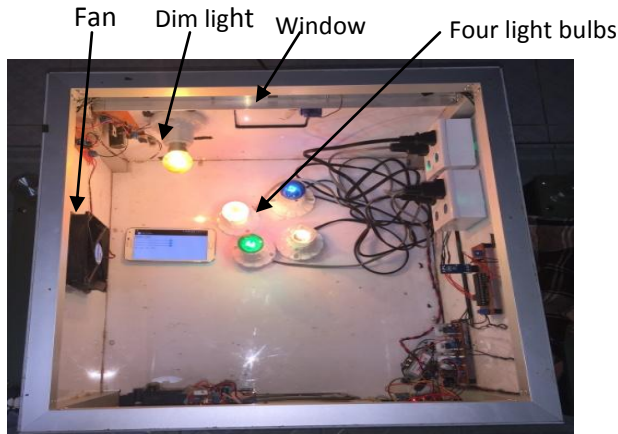


Fig:20 Constructed prototype of the Smart Living Room (Living Room Appliances Control)

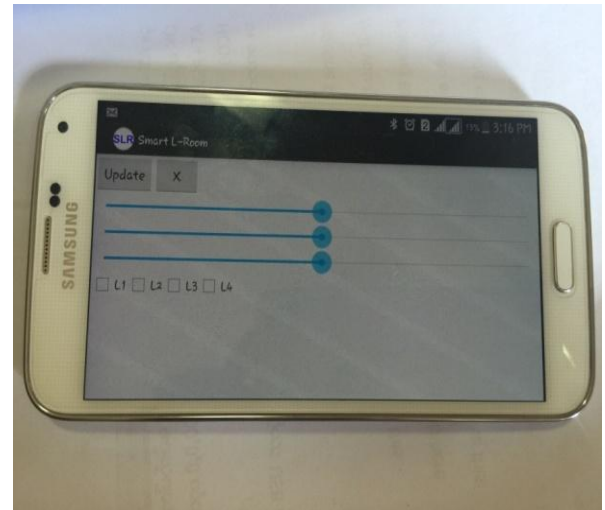


Fig: 23 Android Apk in Samsaung Galaxy S2

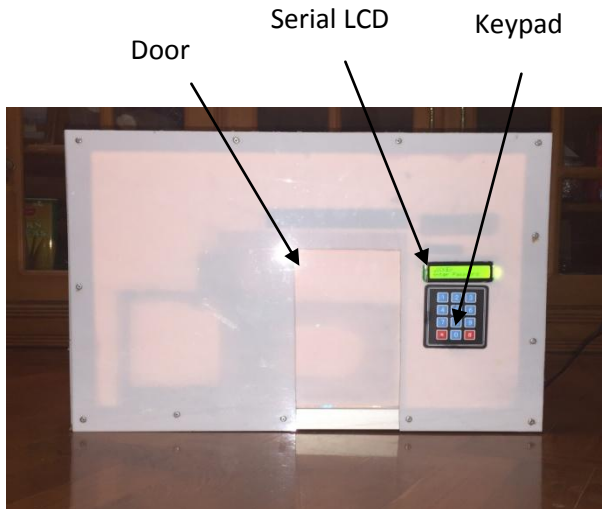


Fig:21 Constructed prototype of the Smart Living Room (Keypad Control Door)

Fig:19 shows the simulation test of the living room appliances control. The constructed prototype of the research is shown in fig:20 and fig:21. Fig:20showsthe constructed prototype of the living room appliances control and fig:21shows the constructed prototype of the keypad control door.Android apk and android phone used in this project are shown in fig:22 and fig:23.

**5. CONCLUSION**

Smart living room wireless control using android phone is described. The components required for smart living room are chosen. The overall circuits for the research are designed and constructed. How to implement the PIC programis described with flowchart. The developed PIC program and designed circuit are tested with Proteus software. The connection between Bluetooth and android apk is also tested. Any kind of android phone which consists of bluetooth can be used by installing smart living room apk. Since this smart living room system can be controlled by mobile, it becomes reliable and convenient to use for user. It can reduce the loss of energy.This system makes the user comfort and cost effective.It can provide high safety for the room.The proposed control system can be implemented to provide high standards of living by increasing the facilities of the living room.

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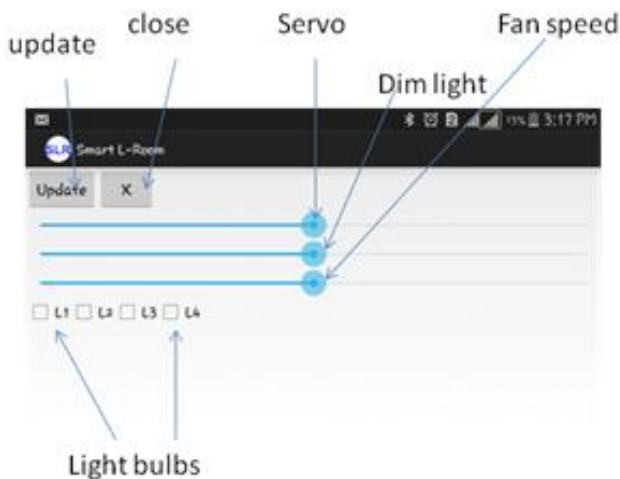


Fig: 22 Smart Living Room Apk in android phone

**REFERENCES**

- [1] Smart Room: An Intelligent and Energy Conserving Living Environment, 2007
- [2] Research and Thinking of Smart Home Technology, (ICSEE'2012) December18-19,2012 Phuket (Thailand)
- [3] Remote Control of Home Appliances Using Mobile Phone, IEEE Vol 6, No.5, December 2013
- [4] Arduino Microcontroller Guide, University of Minnesota, oct-2011  
[www.me.umn.edu/courses/me2011/arduino/](http://www.me.umn.edu/courses/me2011/arduino/)
- [5] How Bluetooth Works  
<http://www.computer.howstuffworks.com/bluetooth.htm>