Smart Home System Using Wireless Module

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Abstract: **This paper discusses the design and implementation of home automation system using microcontroller ARM mbed- FRDM KL25Z and WI-FI module. The main aim of this project is to control our home appliances like tube lights, fans locally using android app. This system includes microcontroller FRDM KL25Z, WI-FI module, opto-coupler and triac circuit for varying intensity of bulb/speed of fan, relay module for switching on and off and an android app for controlling these appliances wirelessly.**

Keywords: **ARM mbed- FRDM KL25Z, WI-FI module- Wi-04, TRIAC BT-136, Opto-coupler MOC-3041, Opto-isolated relay module.**

I.   INTRODUCTION

In the recent years, the development of wireless technology and android system has brought a considerable change in the lifestyle of each and every human being. Wireless systems like WLAN have become more and more common in home networking. Also in home and building automation systems, industries the use of wireless technologies have several advantages that could not be achieved using a wired network. This technology has entered almost every field like health science, industry, sports, military etc. Android is an open-source operating system which means that any customer can use it free of cost. Android is open source software, manufacturers can modify the operating system to suit their respective needs and phones. This becomes a cheaper alternative for the manufacturer, as opposed to developing an operating system or hiring a software company to do it. Deploying a wireless network is especially advantageous when, due to new or changed requirements, extension of the network is necessary. In contrast to wired installations, additional nodes do not require additional cabling which makes extension rather trivial. This makes wireless installations a easy task. Wireless technologies can be classified in different ways depending on their range. Each wireless technology is designed to serve a specific usage segment. The requirements for each usage segment are based on a variety of variables, including bandwidth needs, distance needs and power. Wireless Wide Area Network (WWAN) network enables you to access the Internet via a wireless wide area network (WWAN) access card .These networks provide a very fast data speed compared with the data rates of mobile telecommunications technology, and their range is also extensive. Wireless Personal Area Network (WPAN) these networks are very similar to WWAN except their range is very limited. Wireless Local Area Network (WLAN) this network enables you to access the Internet in localized hotspots via a wireless local area network (WLAN) access card or laptop. It is a type local area network that uses high-frequency radio waves rather than wires to communicate between nodes. These networks provide a very fast data speed compared with the data rates of mobile telecommunications technology and their range is very limited. Wi-Fi is the most widespread and popular example of WLAN technology. Wireless Metropolitan Area Network (WMAN) this network enables you to access the Internet and multimedia streaming services via Wireless Region Area Network (WRAN). This project basically deals with setting up of home automation system that includes Wi-Fi module and an android app to control the home appliances remotely/locally. The proposed system is a very low cost system. The Freedom board used in this project has architecture of ARM Cortex M0+.As it has ARM architecture the durability of this system increases, prototyping of this system can be achieved easily. It has an online compiler which uses embedded C for programming. One can access their home appliances on just a click of the button on their cell phones. This system can be connected LAN or to the internet. Remote operation is achieved by any smart-phone/Tablet etc., with Android OS, upon a GUI (Graphical User Interface) based touch screen operation.

II.   LITERATURE SURVEY

There is existing project on Home and Building Automation using Zigbee Wireless Senor Network and ARM controller, accessible to the user through the Internet. This project has a drawback that the communication cannot be established through internet [1]. Communication can only be established locally as Zigbee is used. Then there is one project which discusses Home Automation by voice recognition using Zigbee. This project has a disadvantage that they have used 8051 microcontroller whose signal processing ability is not good as ARM mbed FRDM-KL25Z. Moreover the voice signals are unreliable [2]. Then one project discusses Home Automation System which uses Wi-Fi as wireless device for communication but they have not mentioned which microcontroller they have used [3]. Ai, Wei, Chen, Cifa had discussed about Green House environment monitor technology implementation based on android mobile platform, which uses android mobile phone as the monitoring terminal. They discussed about parameters in the green house are monitored on the PC as well as the android mobile phone from anywhere in the world as it is connected to the internet through the team viewer software [4]. Home Automation using Bluetooth is also implemented. This project is good but because of the use Bluetooth the range is very limited and the appliances cannot be controlled remotely using internet.

From this papers the conclusion is that the cost of the system is little bit high. In addition to it the system is not robust because of the microcontroller architecture used.

Our proposed system is low cost home automation system using ARM mbed FRDM KL25Z to control home appliances using Wi-Fi technology and an android app[5].
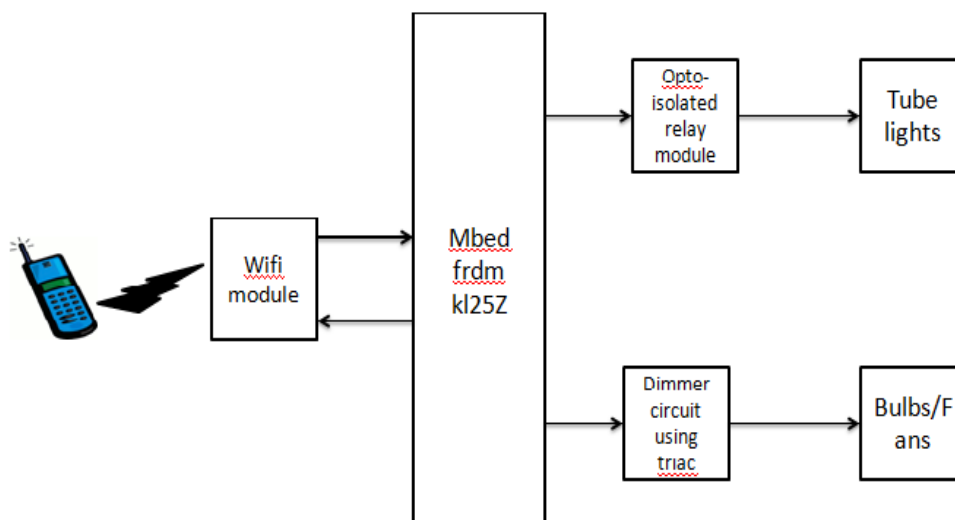
III.   IMPLEMENTATION

1.   *DESIGN:*

Figure: 1. Block Diagram for controlling home appliances

As shown in the figure the basic aim of the project is to build a home automation system which can be controlled using a Wi-Fi technology and an android application. The project includes control of home appliances like tube lights, fans, bulbs using Wi-Fi technology and an android app. The android app will be designed in such a way that one can control fans, light and many more electrical appliances by ease of a touch. The android app will also give the feedback regarding the various parameters like device on off state etc. The android app which will be installed on a mobile phone will send and receive the signal from the Wi-Fi module. After receiving a signal from the mobile device, the Wi-Fi module will forward the signal to the micro-controller. The micro-controller will decide what action to take depending upon the user input i.e. if the user wants to turn on/off a particular device the micro-controller will control the opto-isolated relay module to which the electrical appliances will be connected. By controlling the relay module, the micro-controller can turn on and turn off a electrical device. If the user wishes to vary the intensity of the lights, bulbs, fans then the micro-controller will control the dimmer circuit which will vary the intensity.
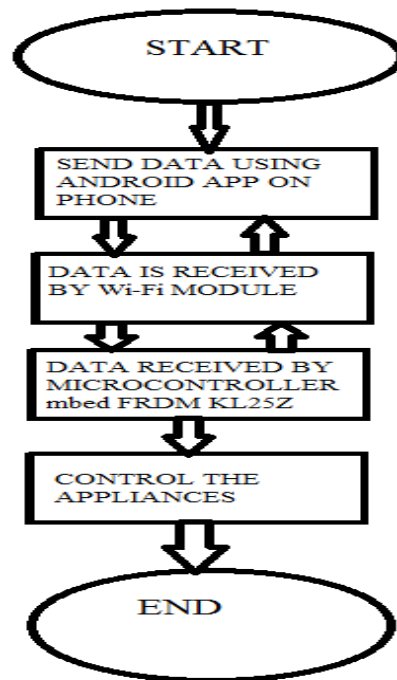
A.   *ALGORITHM:*

Figure: 2. Home Automation System Algorithm

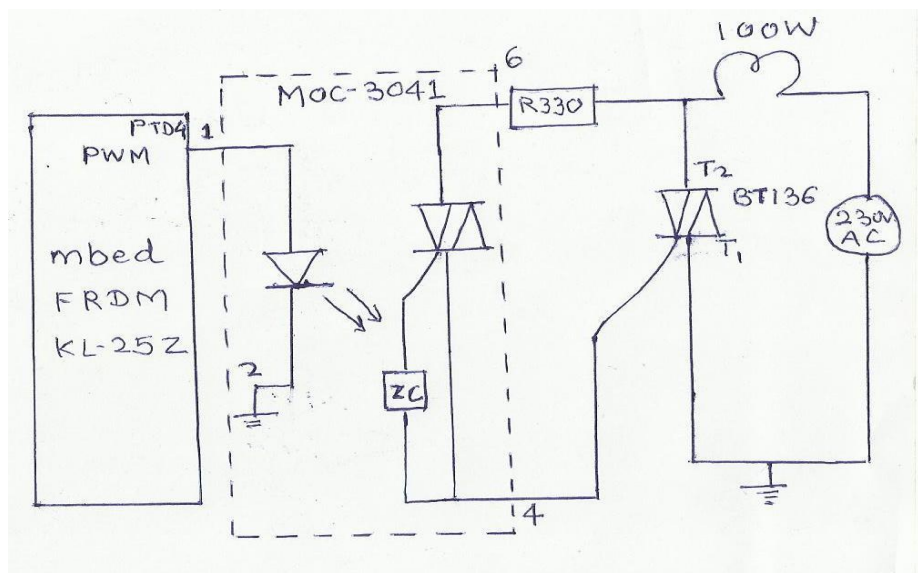*B.*   *LIGHT DIMMER CIRCUIT:*

Figure: 3. Light Dimmer Circuit[7].

As shown in figure 3. The microcontroller will give output to the input of opto-coupler MOC-3041 which is a PWM waveform, whose frequency is varied from 0% to 100% using embedded C programming. The opto-coupler contains zero crossing detector circuit which detects the PWM waveform and gives current according to the pulses to the triac. If the PWM waveform is greater than the reference voltage of zero crossing detector the output of triac will go high which will result in increased brightness of the bulb and vice versa.

C.   OPTO-ISOLATED RELAY MODULE:

Figure: 4. Opto-Isolated Relay Module [7].

The figure is an opto-isolated relay module. It has relays that turns on when we apply 1 and turns off when we apply 0 to the rx pin of module from the microcontroller. It has an opto-coupler which couples low voltage end with the high voltage end providing isolation.

D. SENDING DATA WIRELESSLY

The wireless communication between micro-controller and mobile phone is achieved through Wi-Fi module WI-04. [6]For this we need to put Wi-Fi module in client mode. We have to create a server and connect this Wi-Fi module to that server. Connect tx pin of micro-controller to rx pin of Wi-Fi module and vice versa. Then check the ip address of this module and by feeding this ip address in the android app we can start communication with the micro-controller.

Figure 5.Wi-Fi module WI-04[7].

IV.   RESULTS AND DISCUSSION

A.   TEST CONDITIONS:

This system was first tested using multimeter and changes in output voltage across load to the corresponding changes in the duty cycle of PWM was measured. The duty cycle of PWM was varied from 0% to 100%. The PWM waveform and voltage across triac was recorded on CRO. The connection was wired connection. And after getting satisfactory results wireless connection was established.

Table: 1. Results observed with the dimmer circuit

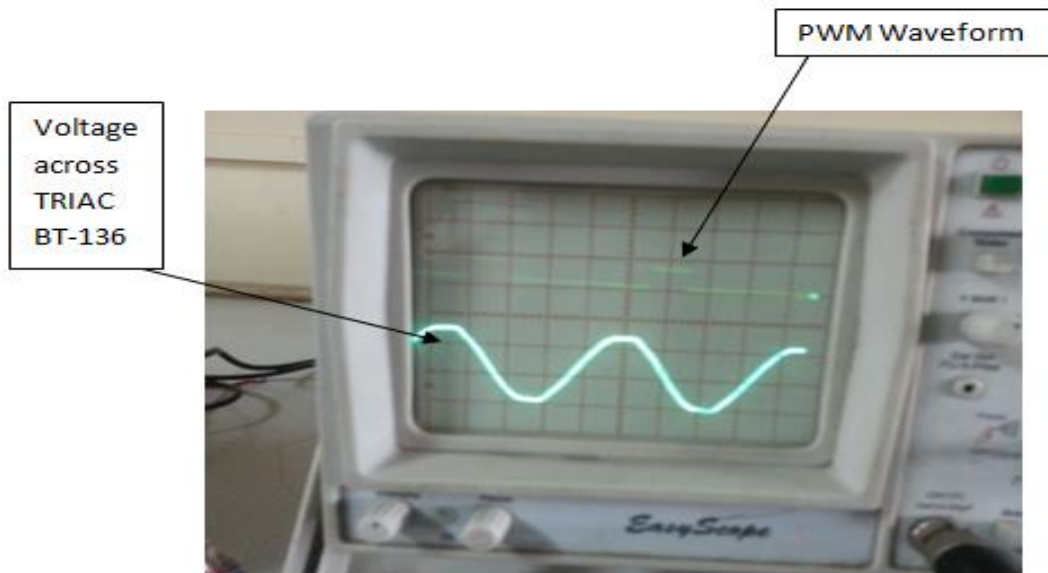| DUTY CYCLE IN %	VOLTAGE ACROSS LOAD IN V
0	0
10	12
20	36
30	61
40	82
50	101
60	122
70	155
80	183
90	211
100	230

Figure: 6. PWM waveform and voltage across TRIAC BT-136

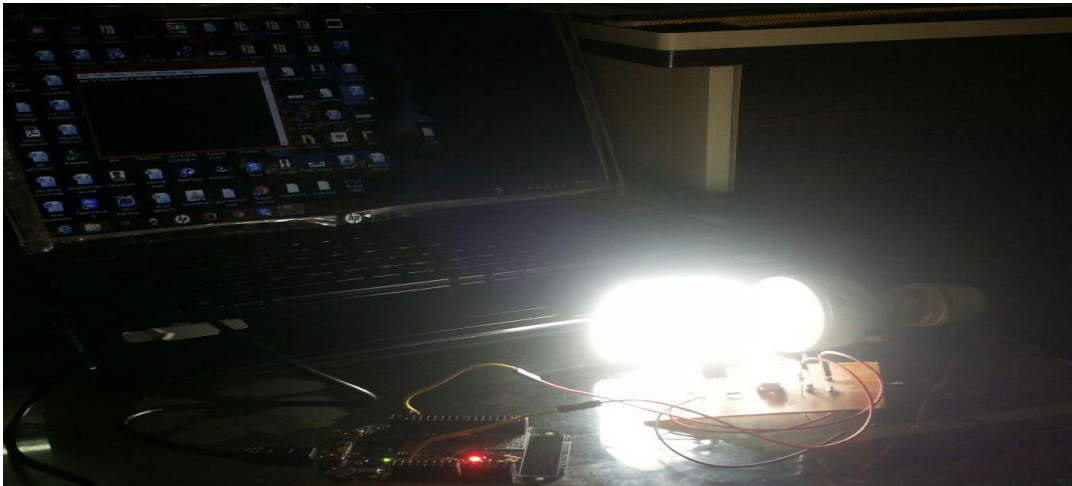**Figure: 7. Bulb Off**

Figure: 8. Varying intensity of bulb

IV.   CONCLUSION

This paper presents home automation system using wireless module. The observations were within the expected range and quite accurate. There was some flickering as intensity was varied. Future efforts will be made to eliminate this flicker and provide a remote access to this system via internet i.e INTERNET OF THINGS (IOT) system can be implemented.

ACKNOWLEDGEMENT

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