IMPLEMENTATION OF EMBEDDED SYSTEM FOR INDUSTRIAL AUTOMATION

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Abstract— designing a system for Implementation of embedded system for industrial automation is possible using various wireless technologies. This paper is useful for industrial equipment as well as household appliance control using RF, Bluetooth, and XBee and DTMF technology. In the proposed system we are using wireless control hence, it can be effectively used in systems were unwired connections are required or desired.

Using wireless technology we are transmitting code, that code is received by receiver and decoded by the microcontroller. According to code it will perform the ON-OFF operation at output we are using Electromechanical Relay and Solid State Relay.

In Industries there are two areas Normal Area and Hazardous Area. Electromechanical Relays are used in Normal Area and Solid state Relays are used for Hazardous Area. At output we are controlling Induction motor, 3 Phase supply and Single phase supply. Presence of every module has been checked out and carefully placed, thus contributing to the best working unit. Using advanced IC's and growing technology, the project has been implemented successfully.

Keywords – RF, Bluetooth, XBee, DTMF

I. INTRODUCTION

The electrical appliance in industry and home can be controlled remotely is an original idea. We can use the appliances, which can be anything like three phase load or single phase load in the industry or home such as induction motor, security system, an air conditioner, light, set top box and so on. The remote control capability & the achieving possibility of it at a reasonably low cost have motivated the need to research into it.

The project aims in designing a system which makes operating of electrical appliances in industry through RF and or Bluetooth and or XBee and or DTMF. Wirelessly the controlling of all electrical appliances is done through various wireless technologies. Here in this project the Android smart phone with Bluetooth feature OR normal mobile with DTMF key pad OR Computer OR special designed transmitter is used as remote to control for operating the electrical appliances using PIC controller and Electromechanical Relay and Solid State Relay.

Using wireless technology transmitter will transmit code, that code is received by receiver and decoded by the microcontroller according to code it will perform the ON-OFF operation. Following wireless technologies are used to implement industrial automation,

1. RF technology for range up to 20 Meters
2. Bluetooth technology for range up to 50 Meters
3. XBee technology for range up to 100 Meters to 1.5 Km.
4. DTMF technology for infinite range.

The controlling device of whole system is PIC Controller board. RF Transmitter / Receiver, Bluetooth module, XBee transceiver, DTMF decoder, three relay and one solid state relay interfaced to PIC controller board.

The data received by RF receiver or Bluetooth or XBee or DTMF is fed as input to the PIC 16F877A controller. The controller acts accordingly on the Relay or solid state relay to switch ON-OFF the electrical appliances. In achieving the task the controller is loaded with a program written using Embedded C programming language.

II. HARDWARE DESIGN

This Project has two sections Transmitter and Receiver. In Both section PIC microcontroller is used. Following figures shows the block diagram of proposed project figure II.a and figure II.b
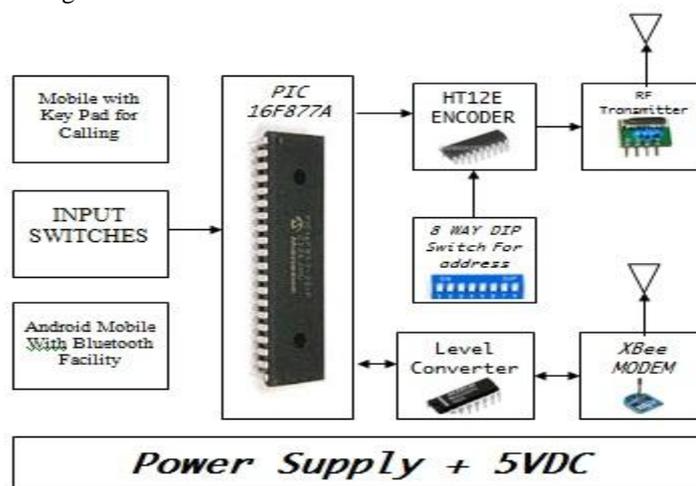

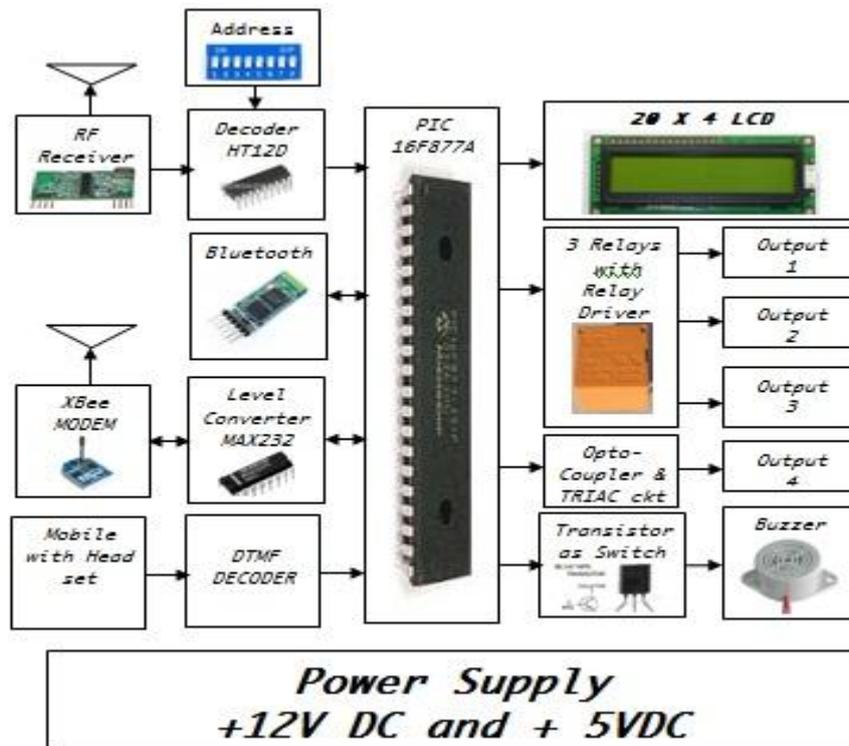**Figure II.a – Transmitter Section Block Diagram**

Figure II.b – Receiver Section. Block Diagram

The main blocks of project are:

    A. CPU i.e. PIC Board with power supply.

    B. Input Section

        B.1 RF Transmitter and RF Receiver

        B.2 Bluetooth Transmitter and Receiver

        B.3 XBee Transmitter and Receiver

        B.4. DTMF Transmitter and Receiver

    C. Output Section

        C.1 20 X 4 LCD Display

        C.2 Relay with Relay Driver

        C.3 Opto-coupler with TRIAC (Solid State Relay)

        C.4 Buzzer with Buzzer Driver

III. HARDWARE IMPLEMENTATION

    Following figure shows the circuit diagram for hardware implementation.
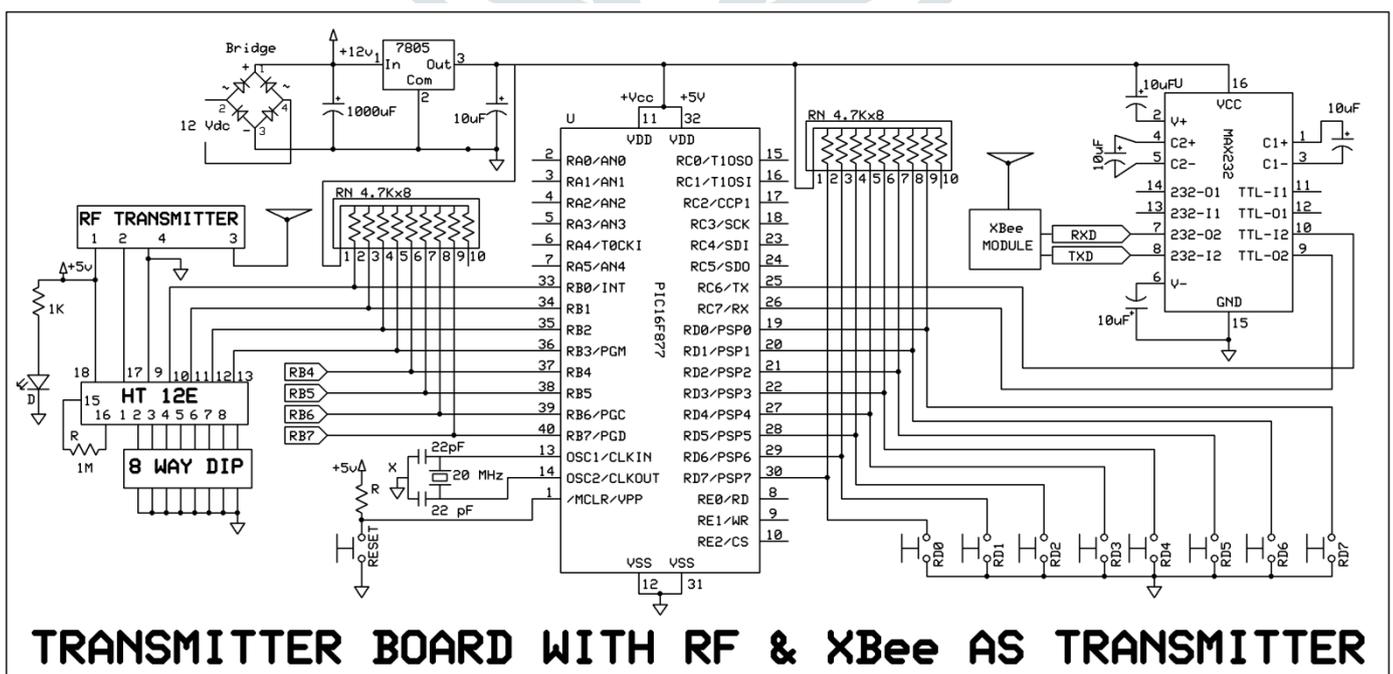

Figure III.a – Transmitter Section Circuit Diagram for hardware implementation
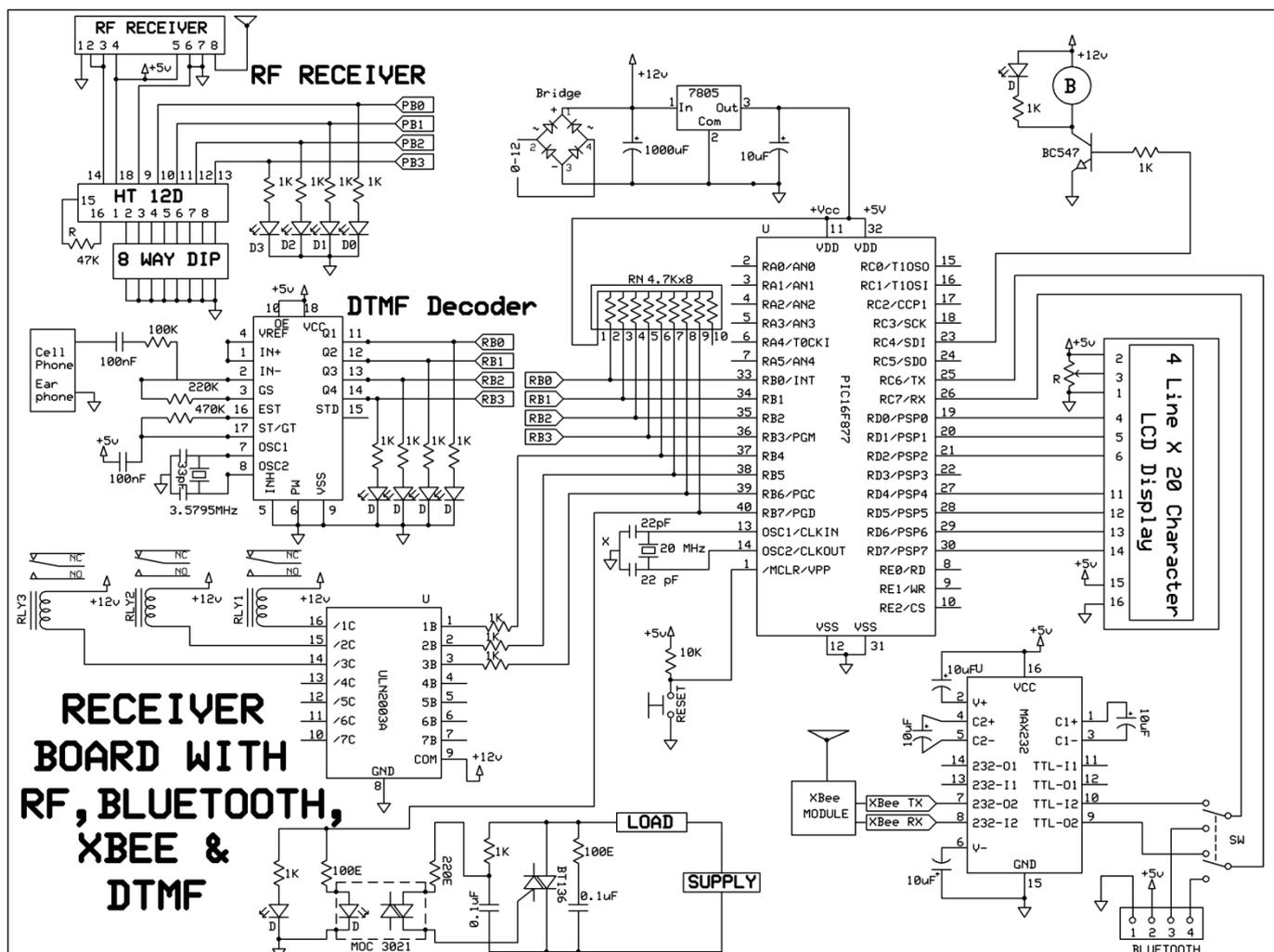
Figure III.b – Receiver Section Circuit Diagram for hardware implementation

IV. WORKING OF PROJECT

Working using RF Transmitter and receiver:

Microcontroller will give 4 bit parallel code to the HT12E encoder. HT12E encoder will convert this parallel data into serial format. And gives this serial data to the RF transmitter. RF transmitter will add 434MHz carrier frequency in it and transmit the data in air.

At receiver, the data is received from air by RF receiver. RF receiver will remove 434MHz carrier frequency from it, and gives serial data to HT12D Decoder. HT12D decoder will convert this serial data into 4 bit parallel code, which is given to the PIC Microcontroller.

In this 8 way DIP switches are connected t both side, to provide the 8 bit address. If address at transmitter and receiver are same then and then only there is communication between both transmitter & receiver.

If address doesn't same at both sides then there is no proper communication between receiver and transmitter.

Working using Bluetooth Transmitter and Receiver:

Bluetooth wireless connection enabled system communicates with GUI (graphical user interface) on PC or laptop or smart phone without cable. So transmitter uses Android SMART phone with Bluetooth control app.

At receiver, the data is received from air by Bluetooth receiver. Bluetooth receiver module operates in serial communication with 9600 baud rate. The PIC microcontroller will receive the serial data decode it and takes the action according to program stored in it.

Working using XBee Transmitter and receiver:

Microcontroller will give ASCII code to the XBee Tarang through the level converter MAX232. XBee tarang is transceiver used for serial communication up to 100 meter to 1.5Km range. It operates on 9600baud rate.

At receiver, the data is received from air by XBee Tarang and given to PIC microcontroller through the level converter MAX 232. As XBee tarang operates on 9600 bits per second, the PIC microcontroller is designed to operate at 9600 bits per second.

Bluetooth module is configured by using AT commands.

Working using DTMF Transmitter and Receiver:

Mobile phones today become an essential for one and all and so, for any mobile based applications there is great reception. In this scenario making a industrial automation using mobile phone is good idea.

Conventionally, wireless-controlled remote control use RF circuits, which have the drawbacks of limited control, limited frequency range and limited working range. Use of a mobile phone for remote control can overcome these limitations. It provides the advantages working range as large as the coverage area of the service provider, robust control, and up to twelve controls and no interference with other controllers.

In this project, mobile phone that makes a call to the mobile phone attached to the system. In the course of a call, if any button is pressed, at the other end, a tone corresponding to the button is heard. This tone is called 'dual-tone multiple-frequency' (DTMF) tone. The receiver circuit perceives this DTMF tone with the help of the phone stacked in the receiver. The received tone is processed by the DTMF decoder MT8870. The decoder decodes the DTMF tone into its equivalent binary digit and this binary code is sent to the PIC Microcontroller. The

PIC Microcontroller is preprogrammed to take a decision for any given input and outputs its decision to relay drivers in order to take action on electrical devices.

The mobile that makes a call to the mobile phone stacked in the receiver acts as a remote. So this project does not require the construction of transmitter and receiver units. DTMF (Dual Tone Multiplex Frequency) signaling is used for telephone signaling over the voice-frequency band to call switching centre. DTMF used for telephone tone dialing is known as 'Touch-Tone.'

20x4 LCD Display:

LCD display is used to display the status of the project i.e. which output device is ON or OFF. For our project first two lines are used to display project name and last two lines are used to display the status of the project.

Relay with Relay driver and outputs:

Relay is electromechanical switch. This electromechanical switch is used to operate 230Vac devices. 230Vac devices can not connected directly with the microcontroller. Therefore relay as switch is used. And to drive the relay driver i.e Transistor as switch is required. In this project transistor array IC ULN 2804 as relay driver is used.

Relays driver is used to switch ON or OFF the RELAY. PIC controller will send data to the base of transistor. If base of transistor is at zero volts then transistor is off and relay is in de-energized condition. Therefore NO contact remains NO.

If base of transistor is at +5 volts then transistor is ON and current flows through transistor as well as relay. Therefore relay is in energized condition. Therefore NO contact will become NC. This NO contact is used to switch ON or OFF the electrical appliances.

Output device are 230Vac supply operating devices. The output may be single phase or three phases. For three phase output 3 phase contactor is used as three phase switch. Bulb, Fan, Air conditioner, ac motor etc can be connected as output..

The relay used has maximum current rating up to 7 Amp and three phase contactor has maximum current rating up to 32 Amp.

LEDs are used as indicator to indicate the output status.

Opto-coupler with TRIAC (Solid State Relay):

In industries there are two sections, normal and hazardous area. In hazardous are Relay i.e electromechanical switch is not used, as in it the contacts are make and break type. So for hazardous area SSR is used to control circuit which doesn't have make and break contact. So the option is SSR i.e Solid State Relay.

For making SSR, opto-coupler and traic circuit is used. The output of opto-coupler is connected between gate and MT2 terminal of Traic. So when the opto-coupler is ON then gate is triggered and Triac turns ON which turns ON the load. And when the opto-coupler is OFF then gate is not triggered therefore Triac remains OFF, which turns OFF the load.

Microcontroller will give logic 0 and logic 1 as input to the opto-coupler

Buzzer with Buzzer Driver

In my project emergency button is used. When this button is pressed then all outputs will turn OFF and buzzer will turn ON to indicate emergency.

So for emergency I have to turn on the buzzer. But we can't connect buzzer directly. The output of micro-controller is insufficient to operate buzzer directly. Therefore to drive the buzzer transistor as switch is used, which will drive the buzzer. When there is emergency then and then only Buzzer turns ON. Otherwise buzzer will be turned off.

V. PROJECT PHOTO
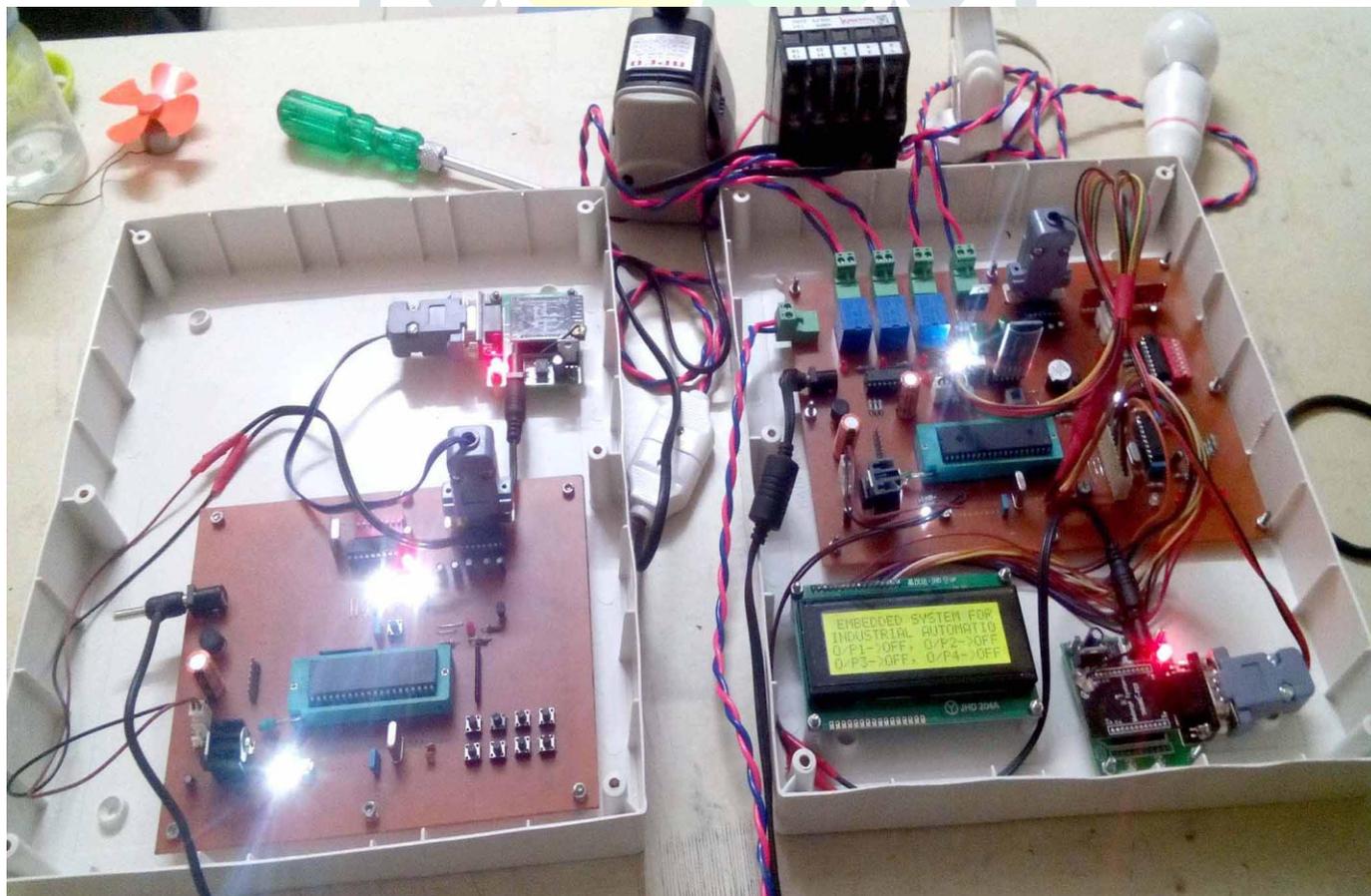
VI. EXPERIMENTAL RESULT OF PROJECT

Device 1 ON	Device 1 and 2 ON	Device 1, 2 an d 3 ON	Device 1, 2, 3 and 4 ON
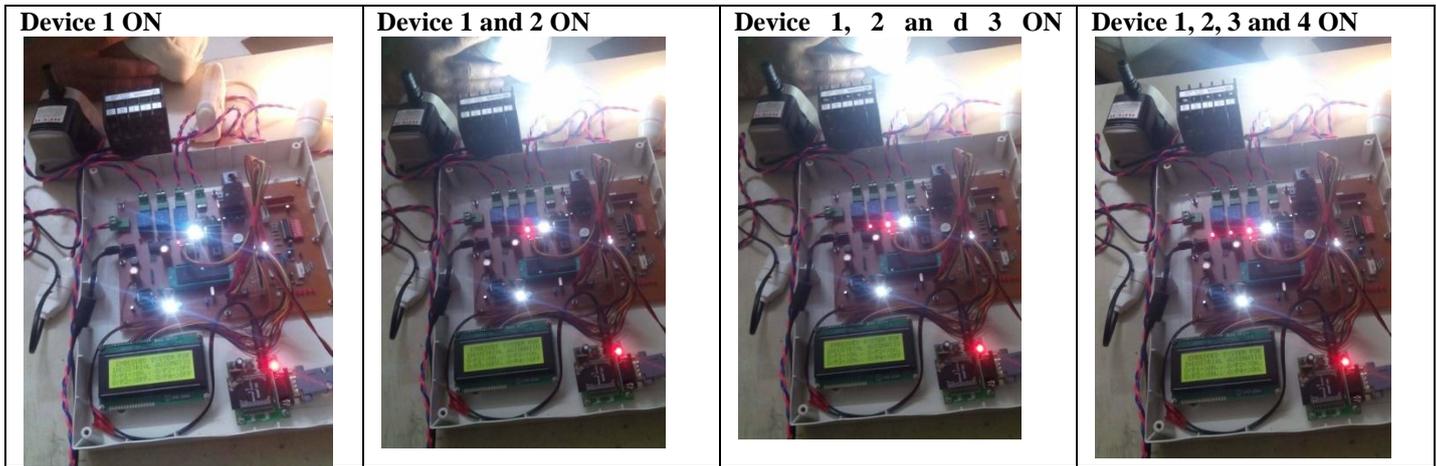
VII. CONCLUSION AND FUTURE SCOPE

Conclusion

Integrated feature of all the hardware components used have been developed in this project. Presence of every module has been checked out and carefully placed, thus contributing to the best working of the unit.

According to distance range requirement of remote control unit, the transmitter is selected. For example for range up to 20 meter RF transmitter is used. For range up to 50 meters Bluetooth transmitter i.e. ANDROID mobile is used. For range up to 100 meters to 1500 meters XBee transmitter is used. And for infinite range DTMF transmitter i.e. our normal mobile with calling facility is used.

Finally, using advanced ICs and growing technology, the project has implemented successfully.

Future Scope:

This project can be extended using GSM module, using which the device can be controlling from unlimited distance. The GSM module gives the SMS message of devices status intimation through SMS.

Again this project can be extended with the ARDUINO board, ARM Processor or Raspberry pi controller.

VIII. REFERENCES

[1] Sougata Das, Nilava Debabhuti, Rishabh Das, Sayantan Dutta, Apurba Ghosh,, "Embedded System for Home Automation Using SMS", IEEE International Conference on Automation, Control, Energy and Systems (ACES), Feb 2014

[2] Sharon Panth & Mahesh Jivani, "Home Automation System (HAS) using Android for Mobile Phone", International Journal of Electronics and Computer Science Engineering, ISSN- 2277-1956

[3] D.Jaya Sree & M.Jhansi Lakshmi, "ANDROID MOBILE BASED HOME AUTOMATION USING BLUETOOTH" , International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 3 Issue 9, September 2014

[4] Website for HC-05 Bluetooth module :- www.iteadstudio.com

[5] Website for XBee tarange : http://www.nskelectronics.com

[6] Website for PIC Micrcontroller : http://learn.mikroe.com/ebooks

Books Referred:

[1] PICmicro MCU C®,An introduction to programming, The Microchip PIC, By Nigel Gardner, Topic 1 to 5, pp 1 to 78

[2] MICROCONTROLLER INTERFACING CIRCUITS, By Revolution Education Ltd. Business Innovation Centre, Innova Park, Mollison Avenue, Enfield, Middlesex, EN3 7XU Tel: 020 8350 1315 Fax: 020 8350 1351 Email: info@rev-ed.co.uk Web: www.rev-ed.co.uk

[3] Microcontroller Programming, The Microchip PIC®, by Julio Sanchez - Minnesota State University, Mankato and Maria P. Canton, South Central College, North Mankato, Minnesota. pp 129-139