



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY




INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 9, Issue 9, September 2020

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

 9940 572 462

 6381 907 438

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 www.ijirset.com

Implementation of IoT and Voice control for Industrial Automation

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ABSTRACT: The Internet of Things (IoT) continues to gain traction in all kinds of industries and applications. Industrial Automation is one such industry that's seen a big increase in IoT utilization. This paper is useful for industrial equipment as well as household appliance control using NodeMCU Module, Bluetooth and DTMF technology. In the proposed system we are using wireless control hence, it can be effectively used in systems where 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.

KEYWORDS: IoT, Bluetooth, Relay, DTMF, NodeMCU.

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 recent developments in technology which permit the use of Bluetooth and Wi-Fi have enabled different devices to have capabilities of connecting with each other [1]. This work aims in designing a system which makes operating of electrical appliances in industry through Bluetooth and or IoT and or DTMF. Internet of Things (IoT) is one of the most upcoming technologies which can be used for managing and controlling any object by connecting it to the internet [4]. With the ever increasing internet users over the past few years, it has become a part of everyone's life. All the domestic or industrial electric equipments are controlled using these technologies. Here in this project the Android smart phone with Bluetooth feature OR normal mobile with DTMF key pad OR Blynk application special designed transmitter is used as remote to control for operating the electrical appliances using DIY Arduino uno controller and Electromechanical Relay and Solid State Relay. The proposed system design consists of DIY Arduino Uno Microcontroller [2] that acts as the main controller. Android application, that helps in remote monitoring. The control for switching ON/OFF of the appliances are performed using the relays based on the touch control commands given through android application. It mainly consists of switches to ON/OFF [7]. This system also implements voice controlling using Bluetooth module.

Following wireless technologies are used to implement industrial automation:-

1. Bluetooth technology for range up to 15 Meters.
2. DTMF technology for infinite range.
3. NodeMCU with Blynk Server for infinite range.

II. HARDWARE IMPLEMENTATION



Fig 2.1 System Block Diagram

The main blocks of the project are:-

A. CPU i.e. DIY Arduino Uno with power supply.

B. Input Section:-

B.1. Bluetooth Transmitter and Receiver

B.2. DTMF Transmitter and Receiver

B.3. ESP8266 (NodeMCU) IoT

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 DESCRIPTION

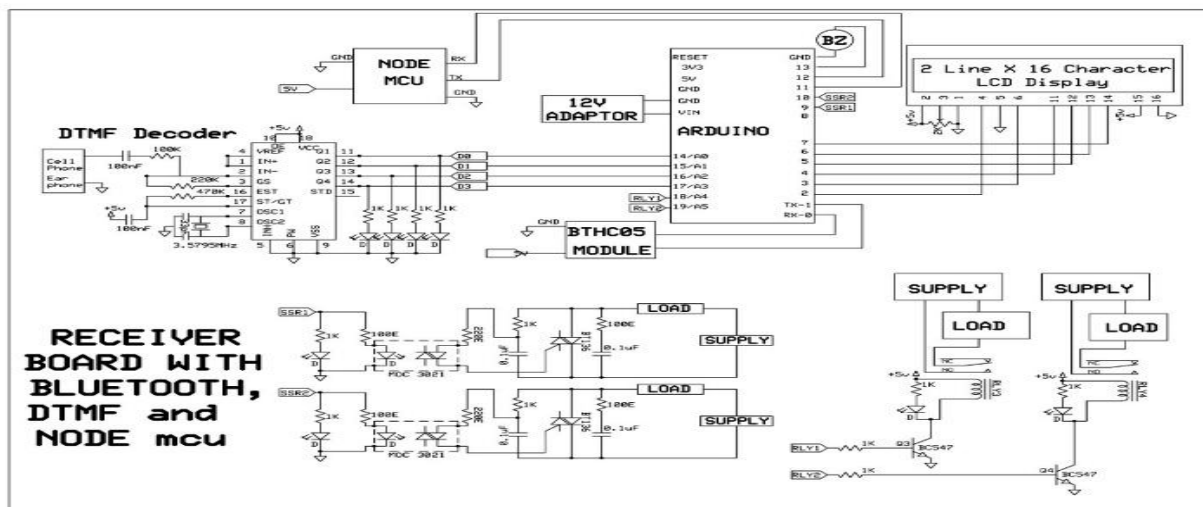


Fig 3.1 System Circuit Diagram

IV. WORKING OF PROJECT

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 microcontroller will receive the serial data decode it and takes the action according to program stored in it [3].

Voice Control:- This system uses Arduino Voice Control app. This app is developed by CemPEHLVAN. This android will use phone's voice recognition feature and convert the voice commands to text and transfer the string via Bluetooth.

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 an 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 microcontroller. The Atmega328p microcontroller is pre-programmed 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' [8].

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 be 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. Relay driver is used to switch ON or OFF the RELAY. The 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 devices 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 to 32 Amp.

Opto-coupler with TRIAC (Solid State Relay):

In industries there are two sections, normal and hazardous area. In hazardous area 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 triac circuit

is used. The output of opto-coupler is connected between gate and MT2 terminal of TRIAC. 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 the 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.

NodeMCU:

NodeMCU is very popular in Home Automation. It's WiFi capabilities and Arduino IDE support making it easier for IoT Applications. It is very tiny and has many Digital I/O pins, Serial Communication and I2C Communication. NodeMCU has a micro USB port to program it using your existing mobile cable (no additional programmer needed). There is a successor called ESP32 Development board which has more Analog pins and Digital pins. You can use any one of them for this project according to your requirements. Here we will be using NodeMCU.

Blynk is a mobile application which has its own server to process user requests. It is an open source application and anybody can use it in their Home Automation to control devices, monitor sensor data and get a notification by some trigger actions. It has a nice GUI with Graphs, Timers, Slider, Joystick and even Video Streaming.

V. PROJECT PHOTO

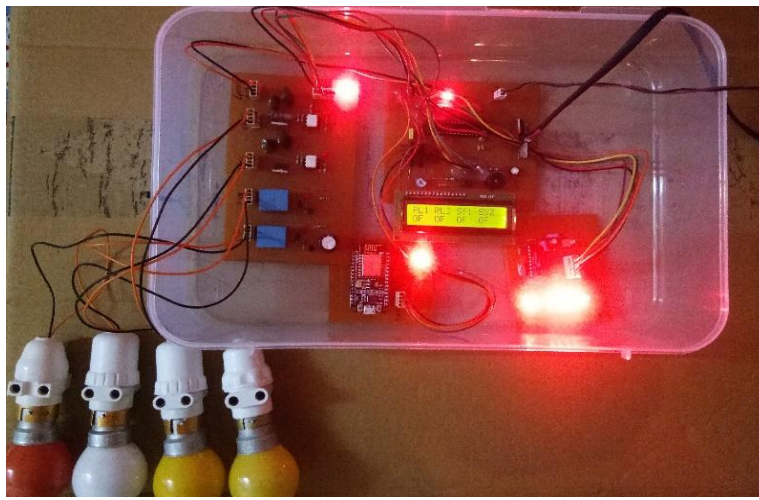


Fig – Prototype

VI. EXPERIMENTAL RESULTS

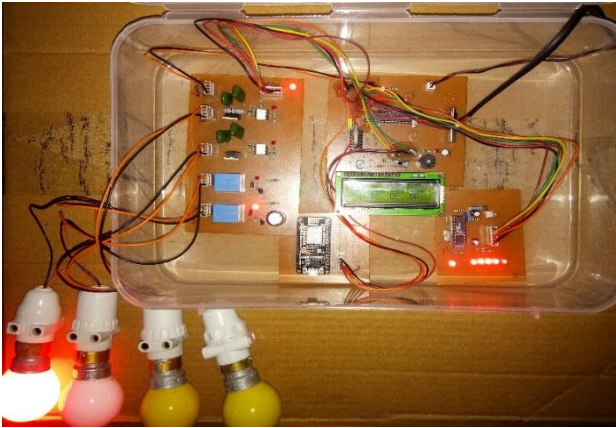


Fig 6.1 - Device 1 ON using Bluetooth

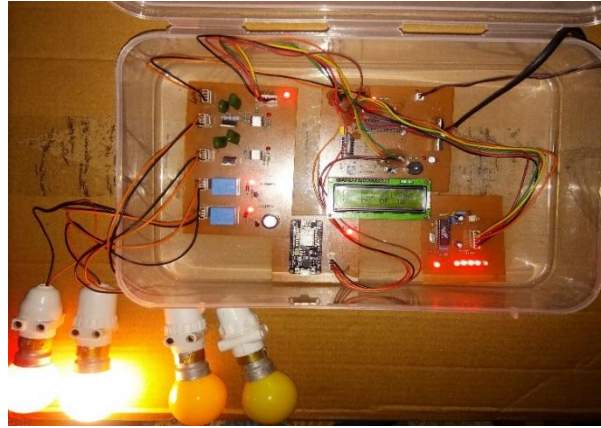


Fig 6.2 - Device 1 and 2 ON using Bluetooth voice

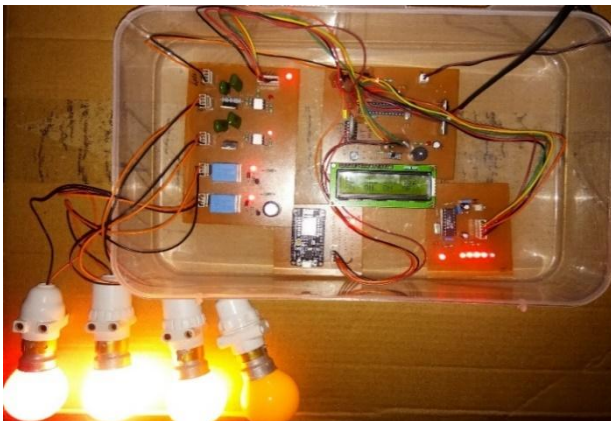


Fig 6.3 - Device 1, 2 and 3 ON using DTMF

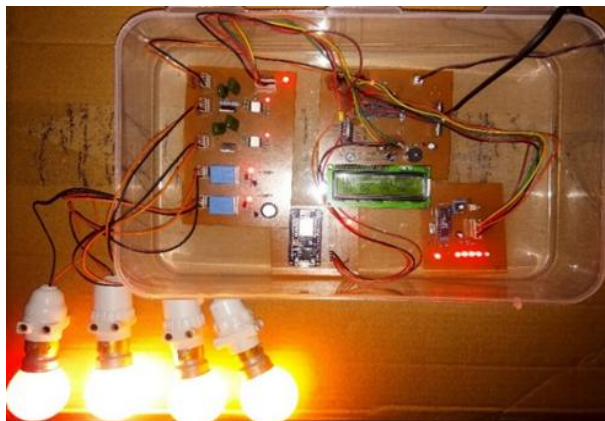


Fig 6.4 - Device 1, 2,3 and 4 ON using IoT

VII. CONCLUSION

In this model we have have controlled the devices using three communication protocols i.e., Bluetooth, DTMF and IoT

Fig 5.1 shows switching of the bulb by using Bluetooth which is operatable between 10 to 15 meters of range

Fig 5.2 shows the switching of bulb through voice by using Bluetooth.

Fig 5.3 shows the switching of bulb by using DTMF which has infinite range

Fig 5.4 shows the switching of bulb through IoT.

Finally, using advanced ICs and growing technology, the prototype has implemented successfully From the convenience of a micro- controller, a user is able to control industrial accidents, human errors and for manual safety. The end product will have a simplistic design making it easy for users so that they can interact. This will be essential because of the wide range of technical knowledge that industries have. This System can be used even in simple automation system where the internet facilities and even PC are not provided, one can use mobile phone based control system which is simple and cost effective.



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