| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 9, Issue 5, May 2020||

Industrial Automation Using Bluetooth Technology

Aashish V Gautham[1], Aviral Gupta[2], Bindu R[3], Sanjana Ramesh[4],Venkatesha K[5]

UG Student, Dept. of EEE, B.N.M. Institute of Technology,Bengaluru,Karnataka, India[1-4]

Professor, Dept. of EEE, B.N.M. Institute of Technology, Bengaluru, Karnataka, India[5]

ABSTRACT: Handling machines in non-accessible places is troublesome. The controller is compelled by a phone that gives a Bluetooth accessibility to the Bluetooth module connected to the Arduino. The speed of the equipment in handling ventures, for example, chemical, cement and rubber industries ought to be looked after consistently. Control of such machines situated in remote spots can some of the time be troublesome and furthermore risky. Thus their control should be possible utilizing Bluetooth innovation. Activity of valves situated in remote, blocked off or risky places, for example, in chemical industries, where harmful gases are discharged could be lethal to individuals entering the working environment. In such cases, valve actuation is of extraordinary use. This paper proposes the speed control of AC motor, Boiler valve actuation and illumination control in an Industry using Bluetooth technology thus providing Industrial Automation.

KEYWORDS:Industrial Automation, cell phone, Speed control, Valve actuation, Illumination control, Bluetooth, Arduino.

I.INTRODUCTION

Automation is the innovation by which a procedure or strategy is performed with negligible human help. It further makes use of different control frameworks for the functioning of different equipment. Due to the fast advances in innovation, all mechanical operations in several industries are replaced by computerization. As new and proficient control innovations developed, modernized robotization control is being driven by the requirement for high exactness, quality, accuracy and execution of mechanical procedures. All this can be easily conceived through Industrial Automation.

This paper presents the structure and usage of an ease yet adaptable and secure mobile phone based industrial automation network. The plan depends on an independent Arduino and Bluetooth and the industrial equipment are connected to the output ports of the board. The communication between the mobile phone and Arduino board is distant. Arduino is the most commonly used microcontroller in modern technology. It is an open source platform and is user friendly. Bluetooth technology helps in centralized control of lighting, heating and speed of the motor[1,2]

Controlling the speed of the AC motor using Bluetooth including switching on and off reduces the time taken to execute the task in case of faults and extremities. It also helps disabled workers to perform the job with the same efficiency as that of a normal person. To obtain energy efficiency, instead of running machines at a constant speed, speed control method is used[3]. An AC voltage Controller is used for this purpose. It converts fixed voltage, fixed frequency AC to variable voltage AC. This varied voltage output is used for speed control[4].

In boilers, when there is unexpected change in temperature and pressure of steam, it may lead to explosion. Hence opening and closing of valves using Bluetooth is necessary in order to remove the water/steam to prevent boiler explosion from a safe distance. Regulating the potency of light depending upon the surrounding brightness in the workplace and also the operations that are being carried out will help in saving energy. It also reduces the cost which is incurred due to energy loss[5].

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 9, Issue 5, May 2020||

II.BLOCK DIAGRAM WORKING

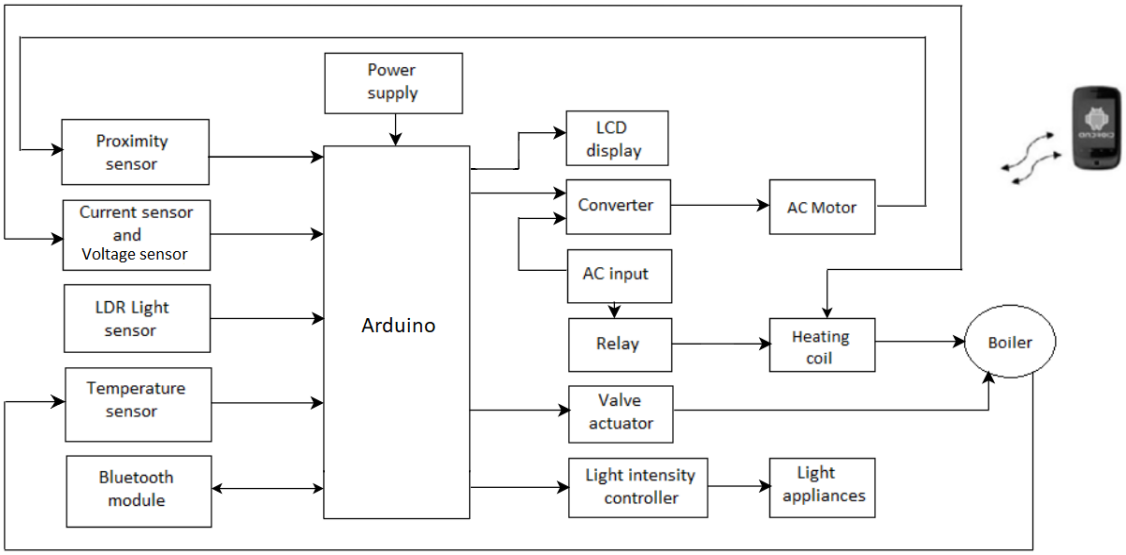

Fig. 1 Block Diagram of System

The Bluetooth module HC05 is used for communication purposes. The speed of the AC motor rated 23W, 230V AC and 0.14A is determined by the IR Sensor and the output is given to the Arduino. The Arduino sends gate pulses to the AC voltage controller. Modification in the gate pulse of TRIAC is used to differ the speed of the motor. This speed is displayed on the LCD using a proximity sensor. In this arrangement, a DS18B20 temperature sensor is employed. This is submerged in water. A 24V DC valve is used to control the outflow of water from the boiler. In the event that the estimation of the temperature surpasses the pre-set value stored in Arduino, the relays will operate and impart a signal to the heating coil and the valve, the valve opens and the water flows out. The operator can view current and voltage of the heating coil on the LCD. The light intensity controller makes use of the output provided by the LDR sensor in order to determine the intensity of light.

III.IMPLEMENTATION OF AC MOTOR SPEED CONTROL

The circuit diagram for controlling the AC motor speed shown in Figure 2 consists of a TRIAC controlled fan controller. The estimations of the resistance connected to the NO (Normally Open) terminal of the transfer are found subsequent to directing a test on the TRIAC controlled fan controller. The values are shown in Table 1. Fan controller circuit is supplied by a 230V AC single phase supply. The circuit of the fan regulator depends on the principle of power control utilizing a TRIAC. By differing the firing angle of the TRIAC, the circuit will work. When the potentiometer is differed, the capacitor will begin to charge. When the capacitor voltage becomes higher than the DIAC break over voltage, DIAC begins conducting. In this manner, the capacitor begins discharging towards the gate terminal of TRIAC through DIAC. The TRIAC will start conduction and thus the current flow into the fan through the closed path which is formed by TRIAC will start. Because of the bidirectional control ability of both TRIAC and DIAC, it is conceivable to control the TRIAC's firing angle in positive and negative directions of the input.

Table 1: Test Results of AC-AC Voltage Controller

FIRING ANGLE (DEGREE)	RESISTANCE (kΩ)	VOLTAGE (V)
81	416.2	85.1
72	250.4	122.7
54	68	161.6
45	47	177.5
36	24.16	196.1
18	0.01	221.8

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 9, Issue 5, May 2020||

Among the resistance values which are listed in table 1, resistances taken for the converter circuit are 416kΩ, 250kΩ,68kΩ and 10Ω. The speeds obtained for these resistances in the converter circuit are 18 RPM, 427 RPM, 916 RPM and 2312 RPM respectively.

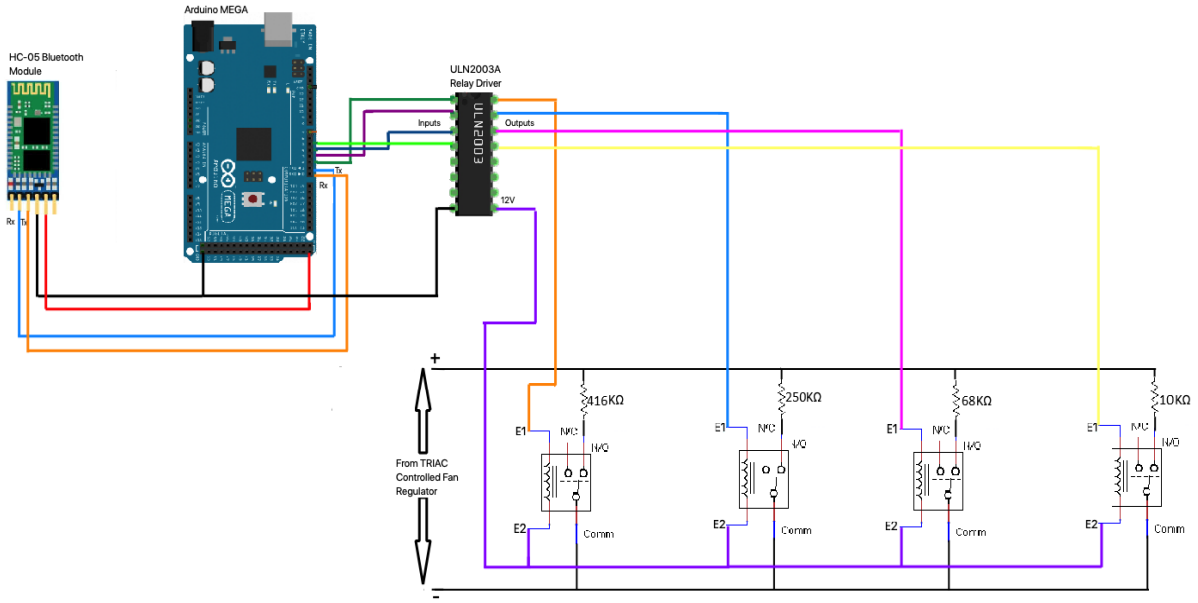

Fig .2 AC Motor Speed Control Circuit

Arduino is linked up with HC-05 Bluetooth module. A relay driver ULN2003a is connected to the Arduino digital pins. Serial command from the smartphone is received by the HC-05 Bluetooth module and based on this command the respective relay is activated so that the required resistance gets included. A 12V supply is given to the common terminal of the ULN 2003a Relay driver.

The speed of the AC motor is measured utilizing an IR module. This module is interfaced with Arduino and 16X2 LCD module for display as shown in Figure 3. The three pins present in the IR module are +5V, output and ground. There is a connection between the 5V pin of the module and 5V pin of the Arduino and also between the output pin of the IR module, the digital pin of the Arduino and the ground pin to the ground of the system. This IR module has an IR Transmitter and an IR Receiver. The IR transmitter will transmit IR radiations. At the point when an obstacle is recognized, these radiations get reflected back and the signals are received by the collector. The IR Module produces a pulse which is distinguished by the Arduino controller and is persistently checked. These produced pulses are then converted to rpm and the motor speed is displayed on the LCD.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 9, Issue 5, May 2020||

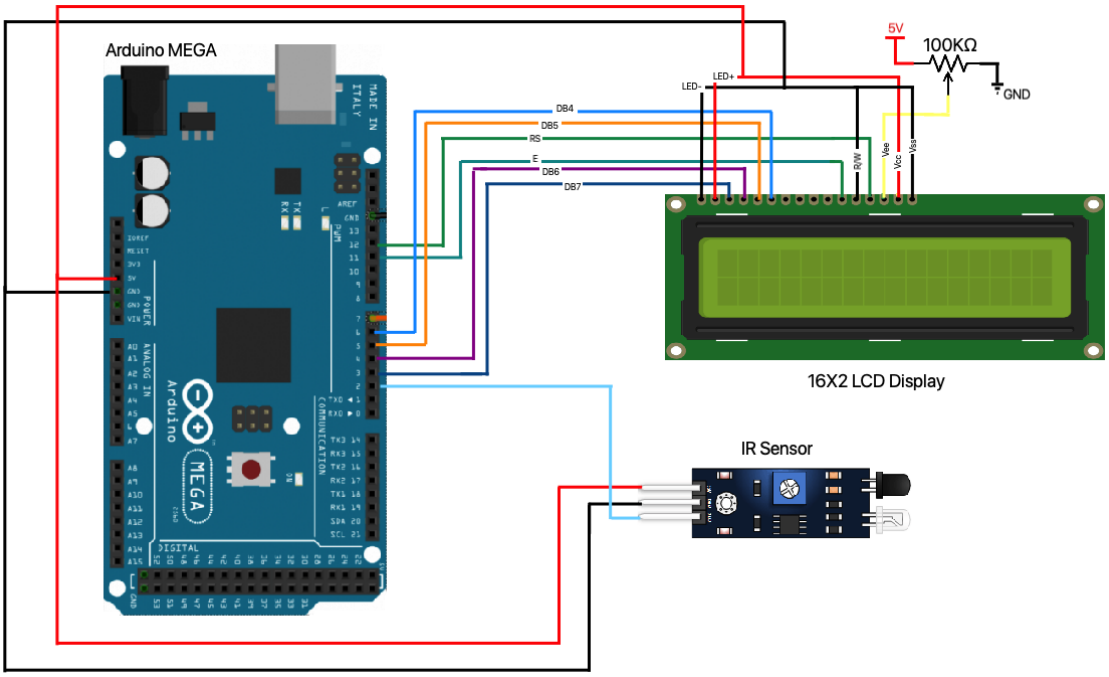

Fig .3 Sensing and Display Speed Using IR sensor

IV.IMPLEMENTATION OF BOILER VALVE ACTUATION

The circuit connection for boiler valve actuation is shown in Figure 4. Here, a 12V connector is utilized to convert 230V AC to 12V DC. The 12V DC present is tapped by utilizing a Berg strip which can be given as supply to ULN2003a common terminal and the 12V DC valve. A 7805 IC is utilized to convert 12V DC to 5V DC. Berg strip is again used to tap the 5V for supplying various components, for example, HC-05 Bluetooth module and the submersible 5V water pump.

Here, a ULN2003a relay driver is utilized and is connected to different digital pins of the Arduino. A relay is connected to the output pins of ULN2003a relay driver.The HC-05 receives commands from the cell phone. Based on these commands, the respective digital pins are made high in the Arduino and these digital pins are connected as input to the relay driver which operates the relay. The NO terminal of the relay is associated with the water pump and boiler valve. When power supply is on, both the water pump and valve will be in off state whereas the heating coil is connected to NC of the relay and is in on state. At the point when the supply is turned on, the heating coil begins heating the water in the boiler.
The temperature sensor that is made use of in this system is DS18B20. DS18B20 temperature sensor is submersible in water and in this system is submerged in the boiler water to measure the temperature of water. The heating coil heats the water and the deliberate estimation of temperature is shown on the LCD.

First, the motor pumps water to the heater by utilizing the commands given from the cell phone. At the instance when 'PUMP ON' is pressed, a pre-set serial command 'a' is sent to the Arduino and the digital pin 2 is made high. The state of pin 2 is given as input to the ULN2003a relay driver pin 1. The output pair of pin 1 of ULN2003a relay driver is associated with a relay and this relay operates turning on the motor. After the water is filled in the boiler, when the button 'PUMP OFF' is pressed in the smartphone, a serial command 'b' is sent to the Arduino. The digital pin 2 of the Arduino is made low and the input to the relay driver is also low and consequently the relay operates and the pump is turned off.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 9, Issue 5, May 2020||

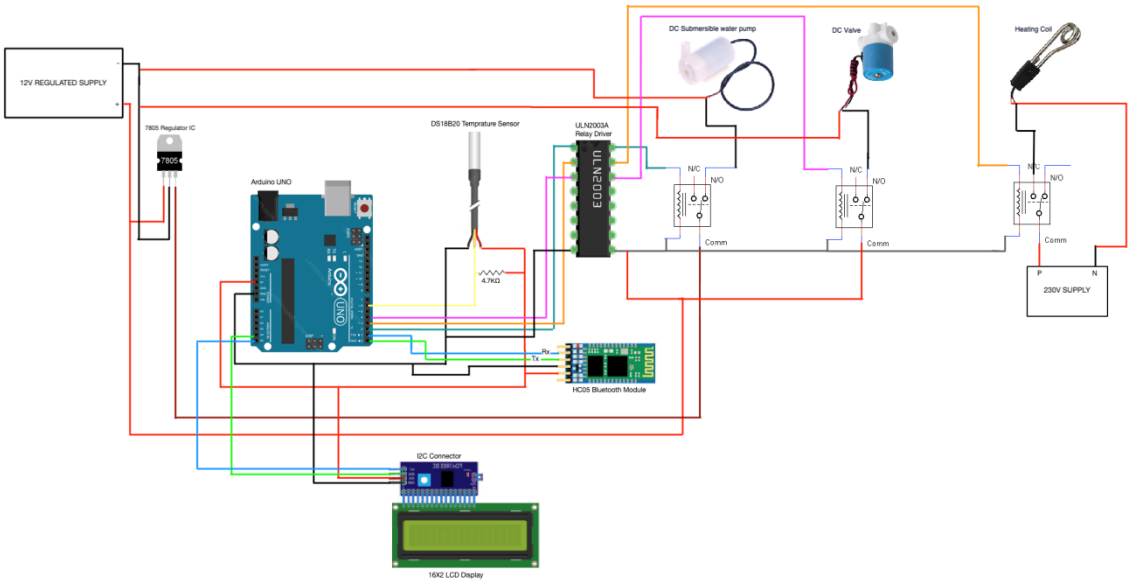

Fig .4 Boiler Valve Actuation Circuit

In this framework, a voltage sensor is used to obtain the heating coil voltage. This obtained value is stepped down through a transformer and a rectifier to regulate it to 5V. The combined output of the transformer and rectifier is in-turn given as input to an inbuilt ADC of the Arduino. For example, if the voltage sensed by the voltage sensor is 230V, the corresponding step down value of the transformer is 5V, then all the pins are digitally high in the ADC and the voltage is calculated in a ratio form as (5/5)*230V=230V and then this value is displayed on the LCD.
If the voltage sensed by the voltage sensor is 161V, the corresponding step down value of the transformer and rectifier is 3.5V. The corresponding pins are made digitally high in the ADC and the voltage is calculated in a ratio form as (3.5/5)*230V=161V and then this value is displayed on the LCD.

In this system, the current sensor used here is ACS712 rated for 20A. ACS712 current sensor gives a simple voltage that is corresponding to the current (current of heating coil in this case). ACS712 is interfaced with the Arduino for estimating the current of the heating coil. ACS712 current sensor has been connected to VCC of Arduino.At an instance when no current is flowing through the input and output terminals of ACS712 current sensor, the output obtained is 2.5V and this is to be subtracted from the measured analog voltage. The value of the current of the heating coil is obtained by taking the difference between the ADC voltage and the offset voltage and further dividing the result by the sensitivity of the current sensor which is 100 mV/A for 20A rating sensor.This current of the heating coil is to be displayed on the 16X2 LCD display.

Final Current value of heating coil= (ADC voltage-Offset voltage)/(Sensitivity)

V.IMPLEMENTATION OF ILLUMINATION CONTROL

The LDR gives analog output values and is associated with the analog pin of the Arduino. The output from LDR is used for controlling the potency of the lamp connected. The analog data received from the LDR is changed over to digital quantities with the assistance of inbuilt ADC in Arduino to give values in range (0-255) digital values.

There are two modes:

1. Automatic mode: LDR is connected to the VCC of the Arduino. The other end of the LDR is connected to a 100kΩ resistor and is interfaced to the analog pin from the Arduino and the ground forming a potential divider circuit. Depending upon the surrounding environment's lightning data received the light intensity is varied.
2. Manual mode: The circuit diagram and methodology for controlling manually is similar to that of AC motor speed control. Here an inductive lamp is employed in place of the AC motor. When a serial command is received by the HC-05 Bluetooth module, the respective relay gets activated. The potency of the light bulb is altered according to the value of the resistance that gets included in the circuit.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 9, Issue 5, May 2020||

VI. RESULT AND DISCUSSION

This undertaking targets controlling the speed of an AC motor utilizing an AC-AC converter, Boiler valve actuation dependent on the temperature variation inside the boiler and Light intensity control. Additionally, it also expects to show the speed of the AC motor, current and voltage of the heating coil on the LCD display. It is expected to get smooth speed variation of the motor and valve actuation of the boiler for labourer security. The light intensity is controlled as per need based on the external conditions.

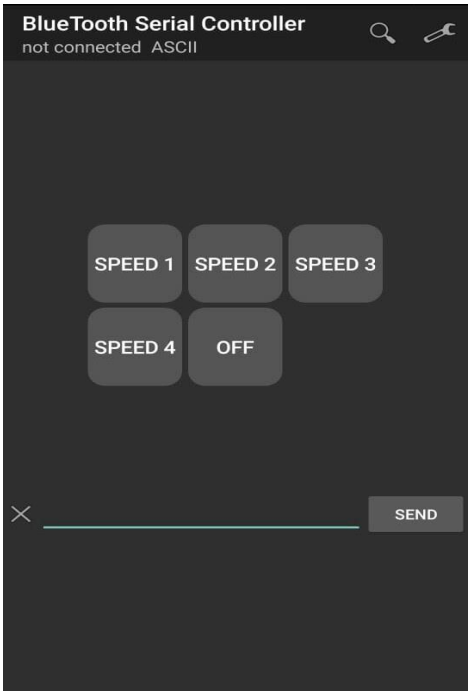

Fig .5 Screenshot of Bluetooth Serial Controller App for AC motor Speed Control

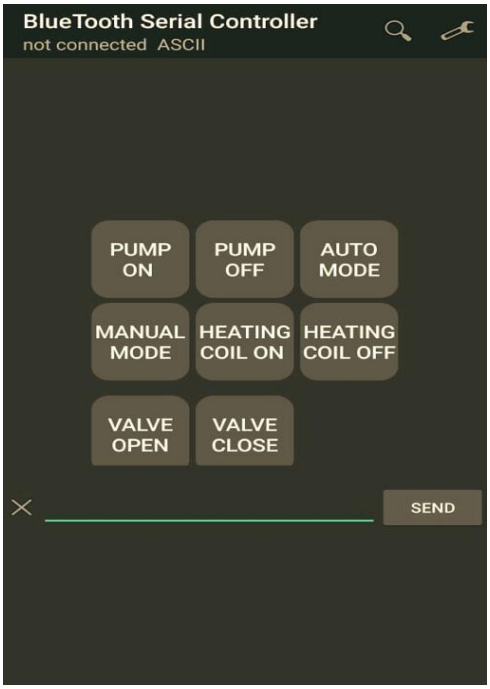

Fig .6 Screenshot of Bluetooth Serial Controller App for Boiler Valve Actuation

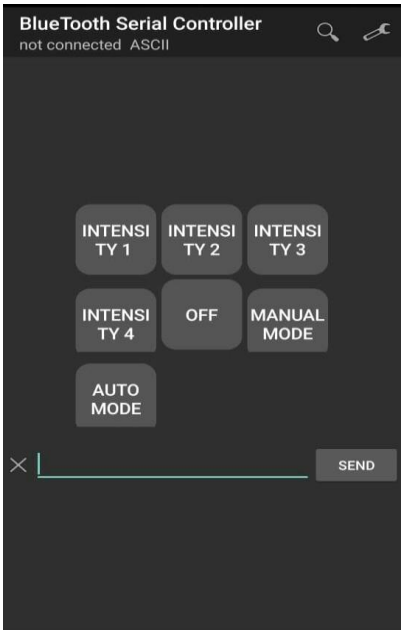

Fig .7 Screenshot of Bluetooth Serial Controller App for Illumination Control

Fig .8 Speed Display of AC motor

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.122|

||Volume 9, Issue 5, May 2020||

The figures 5-7 show the screen captures of the Bluetooth application for controlling AC motor speed, boiler valve incitation and brightening control. In the app, when a button is pressed, the HC-05 Bluetooth module will get a serial command and relay operates accordingly. Figure 8 is the showcase of speed of the AC motor on the LCD. The speed is seen to change on the LCD at differing speeds of the AC motor.

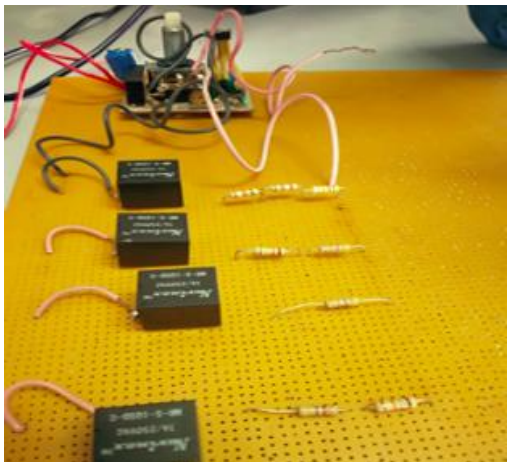

Fig .9AC-AC Converter Circuit

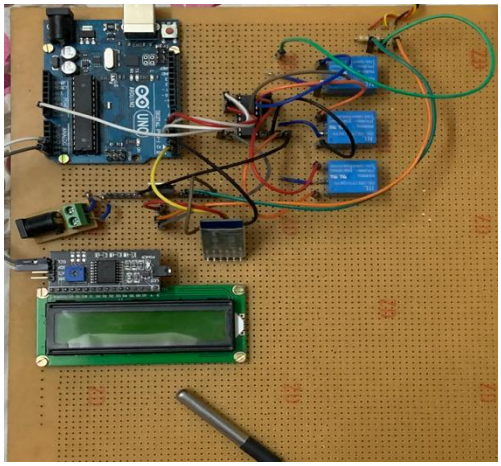

Fig .10 Boiler valve Actuation Circuit

Figure 9 shows the converter circuit for AC motor speed control and Figure 10 shows the circuit for Boiler Valve Actuation.

The speed of the AC motor, Boiler Valve actuation and Illumination were controlled using Bluetooth. Furthermore, the actuating parameters including speed of the AC motor, Temperature of water in boiler, current and voltage of the heating coil were displayed on the LCD.

VII. CONCLUSION

The proposed system has been implemented. Speed control of the AC motor using Bluetooth has been achieved with 4 speeds and additionally these speeds are respectively displayed on the LCD. Speed control has become an essential integral part of AC motor employed systems like fan and pump applications. Boiler valve actuation using Bluetooth has been carried out. Additionally electrical parameters such as voltage and current of the heating coil have been displayed on the LCD. Both manual and automatic mode of boiler valve actuation have been achieved. Implementation of boiler valve actuation in industries helps in prevention of Boiler explosion. Illumination control through Bluetooth has also been carried out. The variation of the light intensity for 4 levels has been achieved. With the merits such as low cost, flexibility and fast response, it proves to be a promising solution for the control of smart and energy efficient LED lighting systems.

REFERENCES

[1] Deepashri K M, Sachidanand P B, Latha.H.S "Industrial Appliances Control Using Android Mobile & Bluetooth Technology", *International Journal of Engineering and Manufacturing Science.* ISSN 2249-3115 Volume 8, Number 1 (2018).

[2] Yusuf Abdullahi Badamasi, *Nigerian Turkish Nile University*, "Working Principle of Arduino", IEEE, 2014.

[3] M. Narayanan, R. Vidhya, P.Yuvaraj "Phase Angle Control Method of Speed Control of Single Phase Induction Motor ",International Journal Of Innovative Research In Electrical, Electronics, Instrumentation and Control Engineering, Vol. 3, Issue 11, November 2015.

[4] R.Swathi, E. Sunaina, M. Ashwini, K. Akhil Reddy, "Implementation Of Arduino Based AC Voltage Controller Using Single Phase Controller Techniques", *International Journal Of Engineering Research In Electrical And Electronics Engineering* Volume 4, Issue 2,February, 2018.

[5] Deepak Kumar Rath, "Arduino Based: Smart Light Control System", *International Journal of Engineering Research and General Science* Volume 4, Issue 2, March-April, 2016.