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Industrial Appliances Control Using Android Mobile & Bluetooth Technology

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***Abstract*—** as the world is becoming more technologically advanced, industrial automation becoming more popular. Android is open source software, manufacturers can modify the operating system for a particular application. This becomes a cheap and feasible alternative for the manufacturer, as hiring a software company to do it. The Android platform supports the Bluetooth network stack, which allows a device to wirelessly exchange data with other Bluetooth devices. The application framework provides access to the Bluetooth functionality through the Android Bluetooth. This paper is mainly focused on the implementation of a prototype system for industrial appliances control like the speed of DC motor, heating coil and light intensity using Android mobile & Bluetooth technology

Keywords: PIC microcontroller, Bluetooth module, DC motor, Hall Effect sensor, temperature sensor, LDR, Android mobile phone

I. INTRODUCTION

This project is a combination of embedded system and Android mobile technology. Bluetooth modules are more reliable, secure and low power modules and these modules do not require line of sight also. This can use mobile Bluetooth by developing some applications or we can use normal USB Bluetooth dongles by connecting to PC. A Bluetooth application should be installed on android mobile handset to control various industrial appliances. User can send commands using that application. The Bluetooth device connected to the circuit sends code for respective command sent by user.

Now a day, smart phones are becoming more powerful with reinforced processors, larger storage capabilities, richer entertainment functions and more communication methods. Bluetooth, which is mainly used for data exchange, add new features to

smart phones. Bluetooth Technology, created by telecom vendor Ericsson in 1994, shows its advantage by integrating with smart phones. It has changed how people use digital devices at home or office, and has transferred traditional wired digital devices into wireless devices. A host Bluetooth device is capable of communicating with up to seven Bluetooth modules at the same time through one link.

Bluetooth technology and other similar techniques, the concept of Small scale industry automation has offered better opportunity in convenience, comfort and security which include centralized control of lighting, heating and control the speed of DC motor. With dramatic increase in Smartphone users, Smartphone have gradually turned into an all-purpose portable device and provided people for their daily use. In recent years, an open-source platform Android has been widely used in Smartphone. Android has a complete software package consisting of an operating system, middleware layer, and core applications

II. LITERATURE REVIEW

Khairnar *et. al* [1] developed the hardware and software for controlling speed of induction motor. Here wireless operating is preferable for controlling speed of induction motor using Bluetooth and android application. The system is integrated with Android mobile technology and embedded system. Android mobile user has to install an application on his/her mobile handset to control the devices.Juned and Unnikrishnan [2] designed a Bluetooth Based Remote Monitoring & Control System using the Microcontroller (ATmega16) as an embedded target and Bluetooth device. The Bluetooth is connected to the controller along with different sensors to measure different real time parameters such as temperature, pressure & humidity; it also controls the temperature of a process.Belgi et al [3] illustrated the home appliances Control System accessed by a mobile phone to allow the user to control, monitor and coordinate the appliances. The system is capable to control fan speed and light intensity.

III. PROPOSED SYSTEM

1. To control the speed and direction of DC motor using wireless Bluetooth Technology
2. To control temperature.
3. Along with control of light intensity, it also gives feedback for temperature rise.

III. SYSTEM ARCHITECTURE

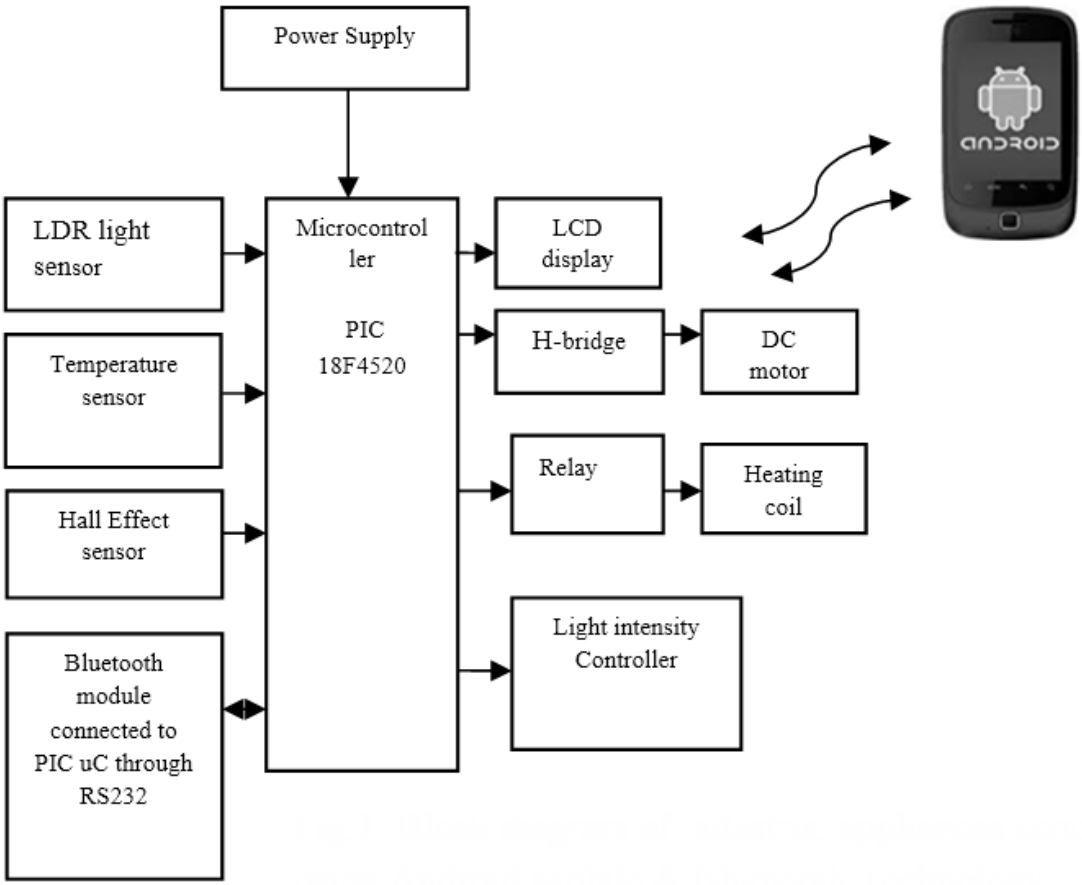


Fig.1: Block diagram of industrial appliances control system using Android Mobile & Bluetooth Technology

In the proposed system we are measuring and controlling the appliances like heating coil and its temperature, light intensity control and its measurement in Lux, DC motor direction, control and measurement of speed. So in order to control these parameters the temperature sensor, LDR for intensity measurement and hall effect sensor for motor speed measurement are interfaced to the PIC microcontroller and the controlling of heating coil, light intensity variation and dc motor are also interfaced. To control these appliances embedded system is interfaced with Bluetooth technology. Operator is controlling these appliances by the Smartphone which is paired with system Bluetooth device. In order to operate, operator has to install an application from which commands for the controlling has to be sent. When commands are transmitted from the operator the Bluetooth device in the system receives those commands and send those to the PIC microcontroller through RS 232 communication channel, then the microcontroller will take the responsibility of controlling particular appliances according to the respective commands sent by the operator. For measuring

the parameters microcontroller receives data from the sensors then manipulate it into a respective data unit and sends them to the Bluetooth device for transmitting to the operator and also display it on the LCD display.

LDR Sensor

A light dependent resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells.

In the system, LDR is used for the measurement of light intensity in terms of lux and also for light intensity control. For the measurement of lux with a LDR the resistance output is converted into voltage with an appropriate signal conditioning circuit. The microcontroller will convert voltage into lux.

Temperature sensor

To measure the temperature of a heating coil LM35 temperature sensor is used whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

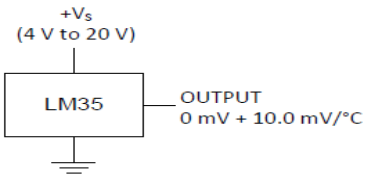


Fig 2: Basic centigrade temperature sensor

Thus theLM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to +150°C temperature range.

Hall Effect sensor

Hall Effect sensor is basically a magnetic field sensor. This sensor is used for DC motor speed measurement. A small magnet is placed in rotating shaft of the dc motor when this magnetic field comes under the sensor, the sensor detects magnetic field and it is converted in terms of rpm. To obtain an rpm value we need not wait for one minute rather wait for 6sec and this will be converted and calculated for revolutions per minute.

Fig.3: Picture of a Hall Effect sensor

Relay driver

A relay is usually an electromechanical device that it is actuated by electrical current. The current flowing in one circuit causes the opening or closing of another circuit. Relay are like remote control switches and are used in many application because of their relative simplicity, long life, and proven high reliability. Relays are used in a wide variety of applications throughout the industry, such as in telephone exchanges, digital computers and automation systems. Highly sophisticated relays are utilized to protect electric power system against trouble and power blackouts as well as to regulate and control the generation and distribution of power.

Heating Coil

A heating element coverts electricity into heat through the process of resistive or joule heating. Electric current passing through the element encounter resistance, resulting in heating of an element. This process is independent of the direction of current flow.

In industrial application there is requirement for maintaining the temperature. A heating coil is used for maintaining the temperature. This heating coil is driven by the electronic relay. This relay requires a +12V power supply. When relay is on the 230V of supply will be connected to the heating coil and this raises the temperature.

H-Bridge

An H-Bridge is an electronic power circuit that allows motor speed and direction to be controlled. The micro controller provides the instructions to the motors, but it cannot provide the power required to drive the motors. An H-bridge circuit inputs the micro controller instructions and amplifies them to drive a mechanical motor. The H-bridge takes in the small electrical signal and translates it into high power output for the mechanical motor.

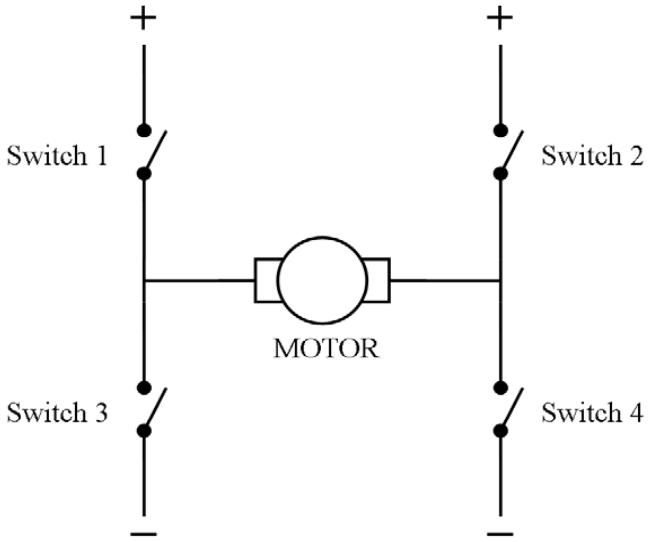


Fig.4: H-Bridge topology

PWM technique for Motor Speed Control

In this system the direction and speed of dc motor are controlled. To control the speed PWM technique is used. Here for one click command we increase the 25 PWM signals and decrease the 25 PWM signals respectively. The maximum of PWM signals can be applied is 1000 PWM signals and can be decreased to zero.

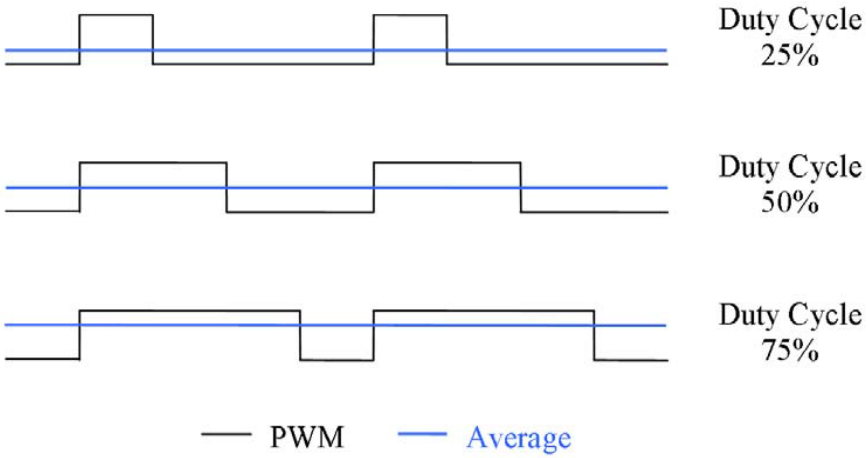


Fig.6: Pulse width modulation waveform used for motor control

DC motor

Almost every mechanical movement that we see around us is accomplished by an electric motor. Electric machines are a means of converting energy. Motors take electrical energy and produce mechanical energy. Electric motors are used to power hundreds of devices. Examples of small motor applications include motors used in automobiles, robots, hand power tools and food blenders. In most cases, regardless of type, electric motors consist of a stator (stationary field) and a rotor (the rotating field or armature) and operate through the interaction of magnetic flux and electric current to produce rotational speed and torque.

Microcontroller

Microcontroller is the main component in this project which will control and monitoring the all appliances with the commands of Bluetooth device. An algorithm is written in this microcontroller to control the appliances. Particularly this microcontroller is chosen because it has 8 ten bit ADC and PWM generator. Programming is done in the microcontroller with the help of software PICKIT tool.

Microcontroller, which gives two great advantages:

• The CPU only recognizes 35 simple instructions. Just to mention that in order to program other microcontrollers in assembly language it is necessary to know more than 200 instructions by heart.

• The execution time is the same for almost all instructions, and lasts for 4 clock cycles. The oscillator

frequency is stabilized by a quartz crystal. The execution time of jump and branch instructions is 2 clock cycles. It means that if the microcontroller‘s operating speed is 20MHz, the execution time of each instruction will be 200nS, i.e. the program will execute 5 million instructions per second!

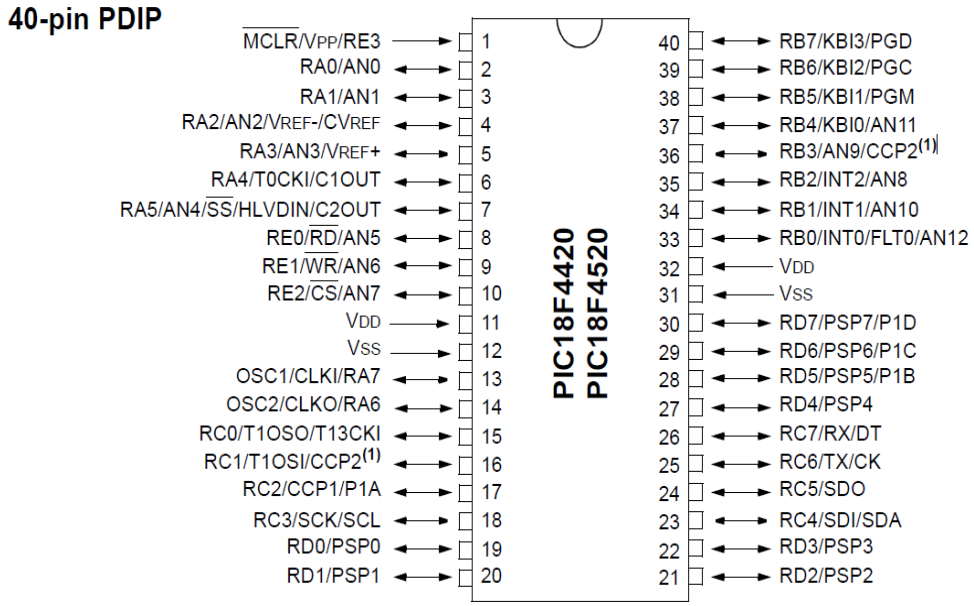


Fig.7: Pin description of PIC Microcontroller 18F4520

A. Android

A Smartphone is a mobile phone built on a mobile operating system, with more advanced computing capability and connectivity than a feature phone. Android is a software stack for mobile devices that includes an operating system, middleware and key applications. Android, by simple definition, is an operating system for many mobile phones.

Android is a customizable platform that can look and feel very different on every different handsets. Android gives us tools for creating apps that looks great and take more advantage of the hardware capabilities available on each device. The purpose of use of android in our project is to send the control signals from smart phone through Bluetooth [4].

B. Bluetooth Technology

Bluetooth is a wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the \ from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs). Invented by

telecom vendor Ericsson in 1994, it was originally conceived as a wireless alternative to RS-232 data.

Bluetooth was selected as our way of communicating mobile with a central system. Bluetooth module receives the data serially in RS232 format from controller and sends it to wireless network.

IV. RESULTS AND DISCUSSION

Measurement of parameters & controlling the Appliances using Smartphone

STEP 1) Turn on the power supply of the circuit.

STEP 2) Turn on the Bluetooth module

STEP 3) Open Android Bluetooth application in the Smart Phone. Select the parameter to be monitored and controlled.

Fig. 8 shows the screenshot of control panel in Smartphone when connected with system Bluetooth device.

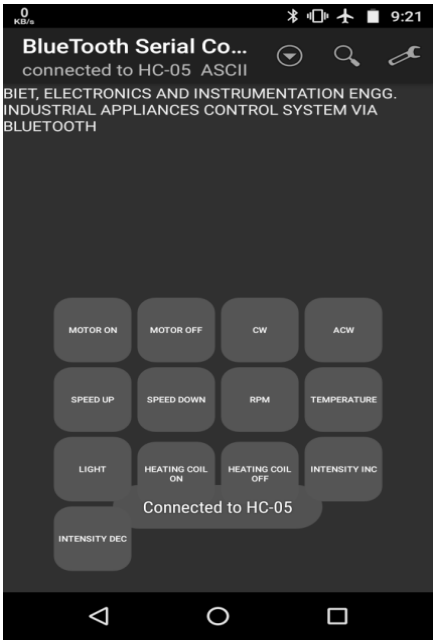
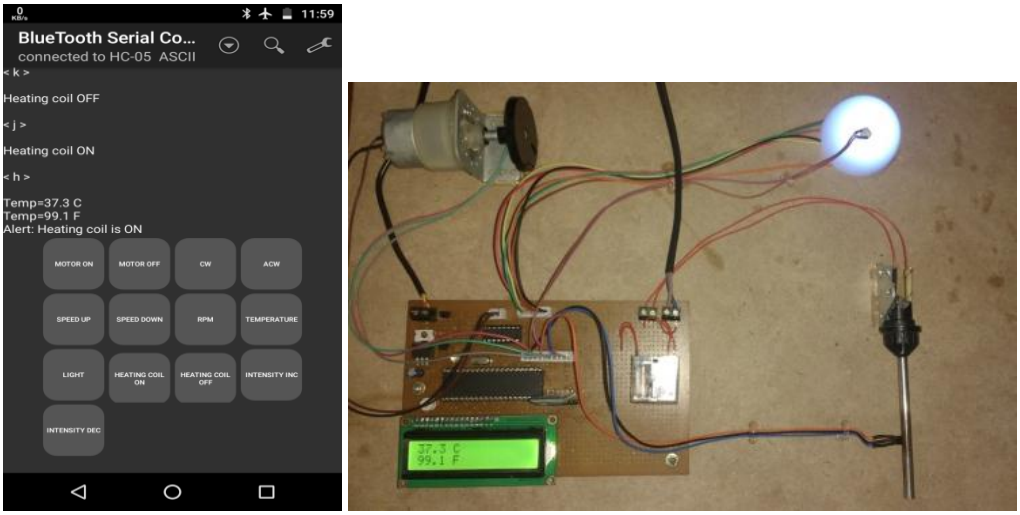


Fig .8: Screenshot of Control Panel

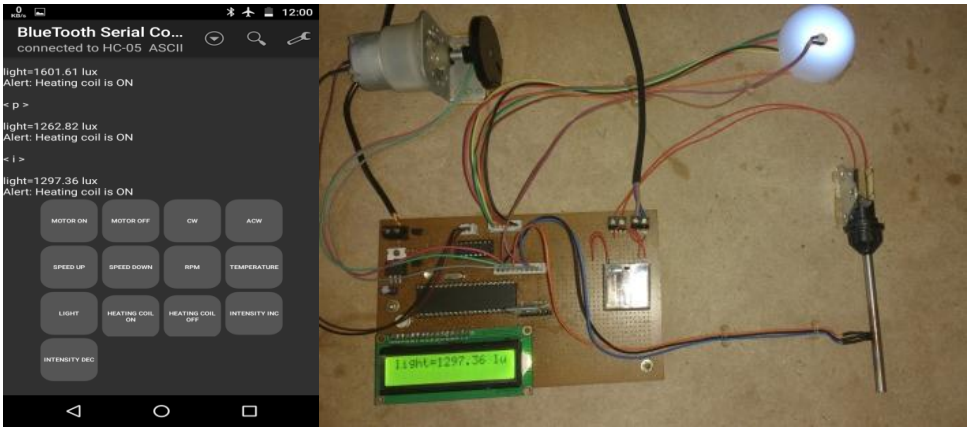
Fig. 9 (a) shows the screenshot and status of the heating coil and sensed temperature is displayed on both Smartphone system and LCD display. Fig. 9 (b) shows the photograph of the system output for the mentioned condition.



(a) (b)

Fig.9: (a) Screenshot displaying temperature reading and the status of the heating coil (b) Photograph of the corresponding system output

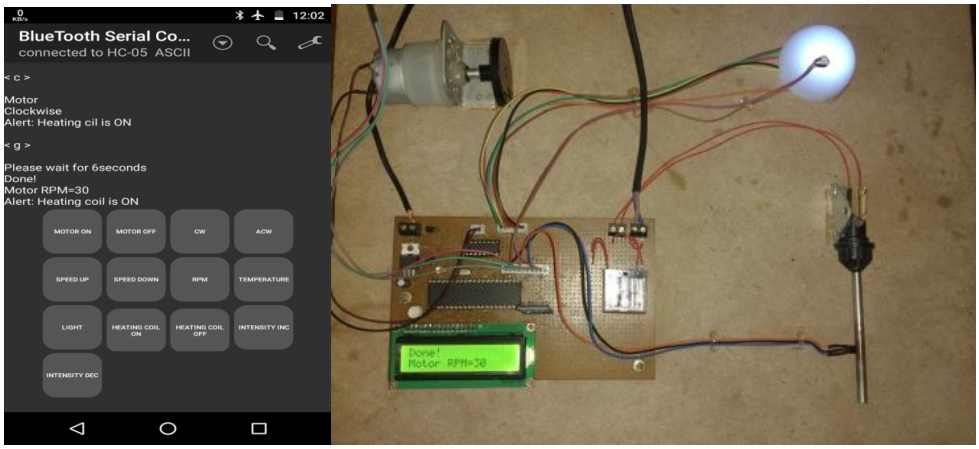
Fig.10 (a) and (b) shows the measurement of intensity in lux in both operators screen and system display. It also gives alert message that heating coil on.



(a) (b)

Fig.10: (a) Screenshot of controlling of Intensity (b) Photograph of the corresponding system output

Fig.11 (a) and (b) shows the speed measurement of DC motor in revolutions per minute and also system can control the direction and speed control.



(a) (b)

Fig.11: (a) Screenshot of measurement of motor speed (b)Photograph of the corresponding system output

CONCLUSION

The developed industrial appliances control system using android mobile & Bluetooth technology is useful and convenient in monitoring and control of industrial appliances. As this system has interface between Bluetooth and android smart phone provides easy operation with monitoring the parameters by wireless communication in real time. By this system the operator can continuously monitor the appliances so not to exceed the desired set point ranges like temperature, intensity level and speed and direction of the DC motor. Herewith it is believed to provide good control all over the appliances.

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