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Smart automation system using Bluetooth technology for industrial applications

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ABSTRACT

An Embedded system is a controller programmed and controlled by a real time operating system (RTOS) with a dedicated function within a larger mechanical or electrical system, often with real time computing constraints. Embedded system controls many devices in common use today. The aim of the proposed method is to design an efficient smart automation system for industrial applications using Bluetooth technology. The project is carried out in Siby Solvent Extraction Pvt.Ltd. It is a small-scale industry where white petroleum transmission has been performed. Since white petroleum is very sensitive, it will burst, when high frequency is applied. In Siby Solvent, nearly 60 motors have been running for ON/OFF purpose. They have to travel nearly 500 meters for that we are using low frequency Bluetooth module to ON\OFF motor. In case emergency purpose we can shutdown entire motors. The main objective of the project is to control the 3- phase induction motor (ON/OFF function) in white petroleum transmission industry automatically using Bluetooth technology. Bluetooth HC-12 module covers up to 1 distance. It can be used in two methods. First method is giving input using switch in transmitter side and another method uses android applications to give input. This system is implemented by using Bluetooth terminal HC-12.

INTRODUCTION

Wireless technologies are becoming more popular around the world and the consumers appreciate this wireless lifestyle which gives them relieve of the well-known “cable chaos” that tends to grow under their desk. Now with the embedded Bluetooth technology, digital devices form a network in which the appliances and devices can communicate with each other. Today, home automation is one of the major applications of Bluetooth technology. Nowadays smart phones are available to everyone, it is one of the most easy to use technologies. Bluetooth system is faster than most of the other technologies.

Nowadays smart phones are available to everyone, it is one of the easiest to use technologies. Bluetooth system is faster than most of the other technologies. It can be very effective for serial data communication where data can be transmitted up to 3 mbps speed at a distance of up to 1.8kms.This manuscript has arranged as follows; section 2 presents the state of the art. Section 3 discusses detailed description of proposed system and the algorithm is presented in section 4. Section 5 concludes with future research. Nowadays smart phones are available to everyone, it is one of the easiest to use technologies. Bluetooth system is faster than most of the other technologies.

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There are few issues involved when designing an automation system. The system should be callable so that new devices can easily be integrated into it. It should provide a user-friendly interface on the host side, so that the devices can be easily setup, monitored and controlled. This interface should also provide some diagnostic services so that if there is any problem with the system, it can be tracked down. Moreover, the overall system should be fast enough to realize the true power of wireless technology. Finally, the system should be cost effective in order to justify its application in home automation.

PROPOSED SYSTEM

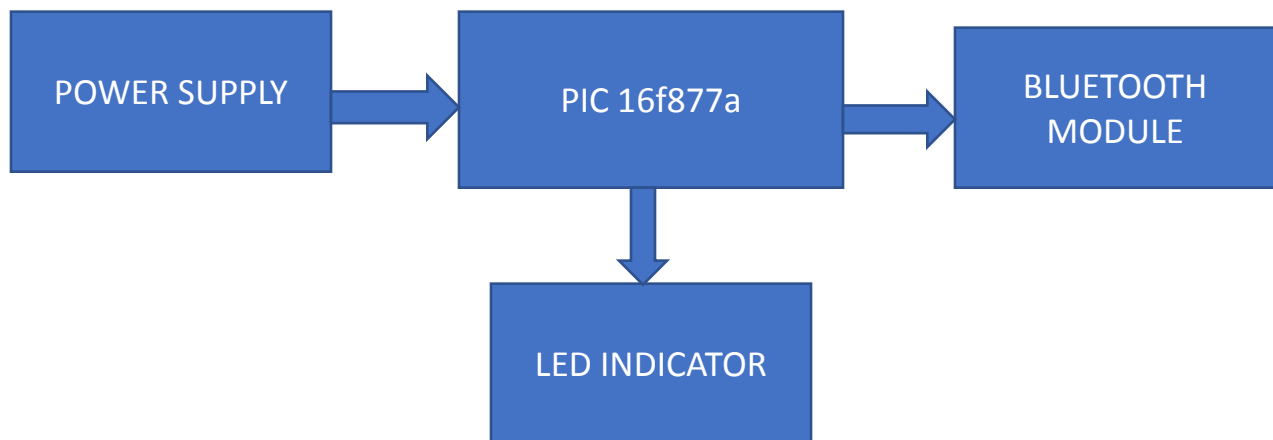
The aim of the proposed method is to design an efficient smart automation system for industrial applications using Bluetooth technology. The project is carried out in Siby Solvent Extraction Pvt.Ltd. It is a small-scale industry where white petroleum transmission has been performed. Since

white petroleum is very sensitive, it will burst, when high frequency is applied. In Siby Solvent, nearly 60 motors have been running for ON/OFF purpose. They have to travel nearly 500 meters for that we are using low frequency Bluetooth module to ON/OFF motor. In case emergency purpose we can shutdown entire motors.

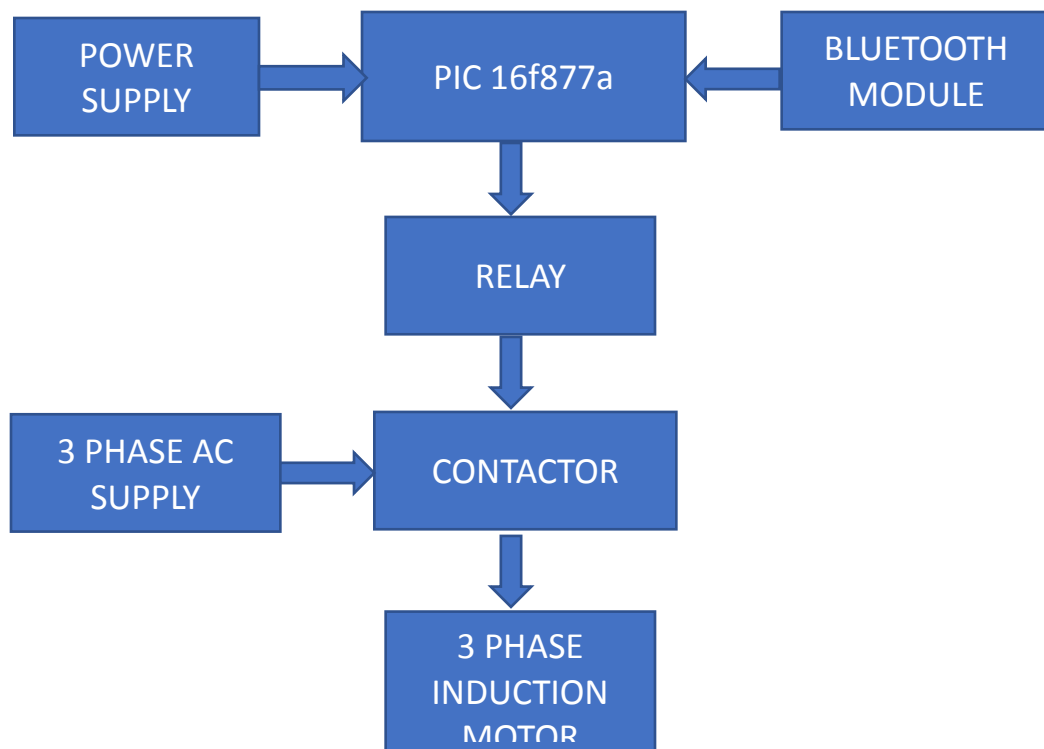
The main objective of the project is to control the 3- phase induction motor (ON/OFF function) in white petroleum transmission industry automatically using Bluetooth technology. Bluetooth HC-12 module covers up to 1 distance. It can be used in two methods. First method is giving input using switch in transmitter side and another method uses android applications to give input. This system is implemented by using Bluetooth terminal HC-12. It can be used in two methods. First method is giving input using switch in transmitter side and another method uses android applications to give input. This system is implemented by using Bluetooth terminal HC-12.

BLOCK DIAGRAM

Transmitter block



Receiver block



Pic microcontroller

PIC is a Peripheral Interface Microcontroller which was developed in the year 1993 by the General Instruments Microcontrollers. It is controlled by software and programmed in such a way that it performs different tasks and controls a generation line. PIC microcontrollers are used in different new applications such as smart phones, audio accessories and advanced medical devices.

There are many PICs available in the market ranging from PIC16F84 to PIC16C84. These types of PICs are affordable flash PICs. Microchip has recently introduced flash chips with different types, such as 16F628, 16F877 and 18F452. The 16F877 costs twice the price of the old 16F84, but it is eight times more than the code size, with more RAM and much more I/O pins, a UART, A/D converter and a lot more features. PIC is a family of microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller, then it

was corrected as Programmable Intelligent Computer. Early models of PIC had read-only memory (ROM) or field-programmable EPROM for program storage, some with provision for erasing memory. All current models use flash memory for program storage, and newer models allow the PIC to reprogram itself. Program memory and data memory are separated. Data memory is 8-bit, 16-bit, and, in latest models, 32-bit wide. Program instructions vary in bit-count by family of PIC, and may be 12, 14, 16, or 24 bits long. The instruction set also varies by model, with more powerful chips adding instructions for digital signal processing functions. The hardware capabilities of PIC devices range from 6-pin SMD, 8-pin DIP chips up to 144-pin SMD chips, with discrete I/O pins, ADC and DAC modules, and communications ports such as UART, I2C, CAN, and even USB. Low-power and high-speed variations exist for many types. PIC devices are popular with both industrial developers and hobbyists due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development

tools, serial programming, and re-programmable Flash-memory capability.

PIC 16f877a

The PIC microcontroller PIC16f877a is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is

also easier. One of the main advantages is that it can be write-erase as many times as possible because it uses FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A is used in many pic microcontroller projects. PIC16F877A also have many applications in digital electronics circuits.



PIC16f877a finds its applications in a huge number of devices. It is used in remote sensors, security and safety devices, home automation and in many industrial instruments. An EEPROM is also featured in it which makes it possible to store some of the information permanently like transmitter codes and receiver frequencies and some other related data. The cost of this controller is low and its handling is also easy. Its flexible and can be used in areas where microcontrollers have never been used before as in coprocessor applications and timer functions etc. An EEPROM is also featured in it which makes it possible to store some of the information permanently like transmitter codes and receiver frequencies and some other related data. The cost of this controller is low and its handling is also easy. [1-5]

CIRCUIT DIAGRAM AND CONNECTIONS

The pic microcontroller is interfaced with the energy meter, GSM and the LCD display. The pic microcontroller gets information from the meter. The analog signal is converted to digital form and the reading is compared with the tariff table. Accordingly, the SMS alert is sent to the user and at the end of the month the bill is calculated and it

is sent to the user and the service provider. The LCD is interfaced and the current status is displayed at the display.

SOFTWARE SIMULATION

Proteus

Proteus is software for microprocessor simulation, schematic capture, and printed circuit board (PCB) design. It is developed by Lab centre Electronics. PROTUES combines advanced schematic capture, mixed mode SPICE simulation, PCB layout and auto routing to make a complete electronic design system. The PROTUES product range also includes our revolutionary VSM technology, which allow you to simulate micro-controller-based design, complete with all the surrounding electronic.

Bluetooth module (HC-12)

The HC-12 is a half-duplex 20 dBm (100 mW) transmitter paired with a receiver that has -117 dBm (2×10^{-15} W) sensitivity at 5000 bps. Paired with an external antenna, these transceivers are capable of communicating up to and possibly slightly beyond 1 km in the open and are more than adequate for providing coverage throughout a typical house.

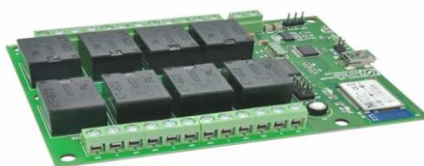


Serial-Port Baud Rate	Over-the-air Baud Rate	Receiver sensitivity
1200 bps	5000 bps	-117 dBm
2400 bps	5000 bps	-117 dBm
4800 bps	15000 bps	-112 dBm
9600 bps	15000 bps	-112 dBm
19200 bps	58000 bps	-107 dBm
38400 bps	58000 bps	-107 dBm
57600 bps	236000bps	-100 dBm

Relay

8 Channel Bluetooth Relay Module is great for controlling your devices over Bluetooth link without any RF design knowledge. This module is

designed to plug in to your design seamlessly. Individual relay can be controlled by simple commands. Numato's 8 Channel Bluetooth Relay Module provides exceptional value for money.

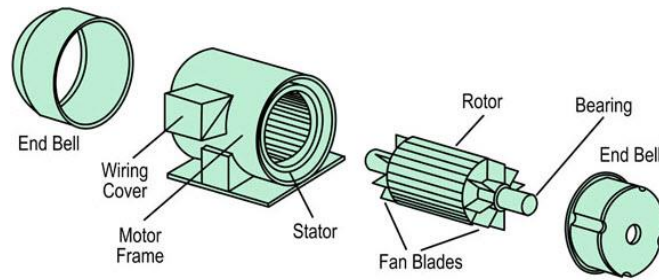


This board has eight on board 12V relays that can switch up to 7A load. The relays are controlled by a Microchip PIC Microcontroller over Bluetooth link and comes with built in firmware that supports simple commands to control relays and read relay status. This board can easily be controlled by writing simple serial port application in VC++, VB, VBA (Word, Excel etc.), Perl, Python etc. A USB Bluetooth Dongle or Bluetooth integrated PC/Laptop would be sufficient to

communicate with this device. A USB connector is available on board for firmware upgrade.

3-phase- induction motor

These three phase motors consist of a stator and a rotor and between which no electrical connection exists. These stator and rotors are constructed with the use of high-magnetic core materials in order to reduce hysteresis and eddy current losses.



Stator frame can be constructed using cast iron, aluminum or rolled steel. Stator frame provides necessary mechanical protection and support for stator laminated core, windings and other arrangements for ventilation. Stator is wound with three-phase windings which are overlapped with one another at 120-degree phase shift fitted into slotted laminations. The six ends of the three windings are brought out and connected to the terminal box so that these windings are excited by three-phase main supply. [6-10]

These windings are of copper wire insulated with varnish fitted into insulated slotted laminations. At all working temperatures, this impregnated varnish remains rigid. These windings have high-insulation resistance and high resistance to saline atmosphere, moisture, alkaline fumes, oil and grease, etc. Whichever suits the voltage level, these windings are connected in either star or delta connections. The rotor of three phase AC induction motor is different for the slip-ring and squirrel-cage induction motors. Rotor in slip-ring type consists of heavy aluminum or copper bars shorted on both ends of the cylindrical rotor. The shaft of the induction motor is supported on two bearings at each end to ensure free rotating within the stator and to reduce the friction. It consists of stack of steel laminations evenly spaced slots that are punched around of its circumference into which un-insulated heavy aluminum or copper bars are placed.

A slip-ring-type rotor consists of three-phase windings are internally starred at one end, and the other ends are brought outside and connected to the slip rings mounted on the rotor shaft. And for developing a high-starting torque these windings are connected to rheostat with the help of carbon brushes. This external resistors or rheostat is used at the starting period only. Once the motor attains the normal speed, the brushes are short circuited, and the wound rotor works as squirrel cage rotor.

Contractor

A contactor is an electrically-controlled switch used for switching an electrical power circuit. A contactor is typically controlled by a circuit which has a much lower power level than the switched circuit, such as a 24-volt coil electromagnet controlling a 230-volt motor switch.

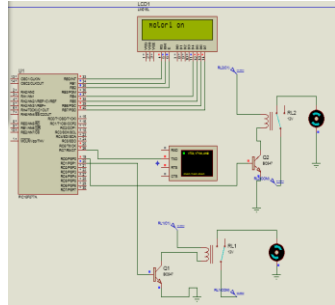
Unlike general-purpose relays, contactors are designed to be directly connected to high-current load devices. Relays tend to be of lower capacity and are usually designed for both normally closed and normally open applications. Devices switching more than 15 amperes or in circuits rated more than a few kilowatts are usually called contactors. Apart from optional auxiliary low-current contacts, contactors are almost exclusively fitted with normally open ("form A") contacts. Unlike relays, contactors are designed with features to control and suppress the arc produced when interrupting heavy motor currents.



Contactors come in many forms with varying capacities and features. Unlike a circuit breaker, a contractor is not intended to interrupt a short circuit current. Contactors range from those having a breaking current of several amperes to thousands

of amperes and 24 V DC to many kilovolts. The physical size of contactors ranges from a device small enough to pick up with one hand, to large devices approximately a meter (yard) on a side.

Interfacing bluetooth with pic microcontroller (16f877a)



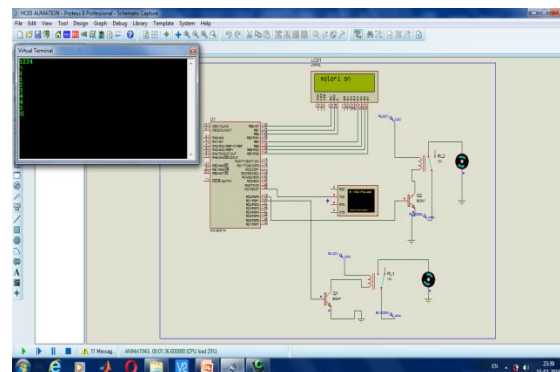
In Command Mode we will be able to configure the Bluetooth properties like the name of the Bluetooth signal, its password, the operating baud rate etc. The Operating Mode is the one in which we will be able to send and receive data between the PIC Microcontroller and the Bluetooth module. Hence in this tutorial we will be toying only with the Operating Mode. The Command mode will be left to the default settings. The Device name will be HC-05 (I am using HC-06) and the password will be 0000 or 1234 and most importantly the default baud rate for all Bluetooth modules will be 9600. The module works on 5V supply and the signal pins operate on 3.3V, hence a 3.3V regulator is present in the module itself. Hence, we need not worry about it. Out of the six pins only four will be used in the Operating mode. [11-13]

Advantages

- Bluetooth based user-friendly interfacing.
- Low power consumption.
- Controls high and low voltage devices.
- Long life.
- Highly sensitive.

Simulation results

We have simulated the project in PROTEUS 8.0 which one of best simulation software for electronic design. First, we have designed the counter using the Pic microcontroller where pulse on the pin is given by signal generator then the data will be displayed in the LCD. We have connected the 3phase induction motors.



CONCLUSION AND FUTURE WORK

Here a low-cost smart switching system is proposed which is easy to operate from smartphone devices. This automation system is not only acceptable for aged, handicapped people, and Parkinson's patient, but it is also helpful for minimizing the human labour. The appliances (like

fan, light, 3 phase induction motors or other useful devices) where 240V power supply is needed can be connected and installed with this switching system. As Bluetooth is used so the range of this system will be much more than the other home automations systems.

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