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WIRELESS INDUSTRIAL SWITCHING SYSTEM WITH REAL TIME FEEDBACK

Mikhilesh Kishor Tamboli (mt93439@gmail.com), Shivprasad Ravikant Tiprale (tshiv007@gmail.com), Mayur Murlidhar Gadade (6aprilmayur44@gmail.com)

Dr. D.Y.Patil School Of Engineering, Lohegaon, Pune.

ABSTRACT

The term automation, inspired by the earlier word automatic (coming from automaton), was not widely used before 1947, when General Motors established the automation department. It was during this time that industry was rapidly adopting feedback controllers, which were introduced in the 1930s.

The use of wireless technology can assist the industry to overcome the limitations of wired networks, and benefit from the mobility and design freedom it offers. The advancements in wireless networking technology, specifically in the short-range wireless networking technology, offer an enormous opportunity for wireless connectivity of field devices both in oil and gas and other chemical processing plants. The prerequisite of a field network includes real-time support for mixed traffic, availability, security, reliability and scalability in a harsh industrial environment. These conditions have to be fulfilled by any wireless network in order to operate. This paper presents a brief overview of the requirements for wireless in process automation, relative standings of existing short-range wireless network technologies based on the outlined criteria, and associated shortcomings. Furthermore, an examination of emerging industrial wireless standards which are designed to address the unique and stringent requirements of the process industry is presented.

I. PROBLEM STATEMENT

The wireless industrial switching system can be used to switch on or off four devices that are connected to the system. When these devices are switched on or off the status is shown on the control panel. This status shown is not a mere reflection of which switch has been pressed on the control panel, but is the feedback of the base unit to which the devices to be switched are connected. When a particular device is switched on, it draws current which is sensed and the status of the device is sent back to the control unit. The system also has a built in alarm for RF link failure. The brief set up and description of the system is as under. There are two main units first is the base or switching unit to which the devices to be switched are connected. This section has two ways radio link connected to the other unit which is the command or the control unit. The command or the control unit has four switches on the front panel with which devices can be controlled. Each switch has a corresponding LED aside it which shows the status of the device that is controlled by that particular switch. Global competition is driving the industry to continuously improve process operations, product quality, productivity, reliability and compliance with regulations. Wireless networks can assist the process industry to gather more data from processes, predict maintenance of equipment, increase workforce efficiency through plant-wide network connectivity and provide low-cost connectivity solutions. Wireless technology is attractive as it eliminates the problems associated with wired networks.

Automation or automatic control is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and other applications with minimal or reduced human intervention. Some processes have been completely automated. The biggest benefit of automation is that it saves labor, however, it is also used to save energy and materials and to improve quality, accuracy and precision.eliminate the need for wire and conduit, Less maintenance and servicing, Reliability and compatibilityi.e of the components that a contractor puts into a project must interface with one another and have the utmost reliability. RCT wireless remote equipment has proven to be highly compatible with standard equipment used in most industries, as well as offering unparalleled reliability in use with programmable logic controllers (PLCs), various switches and relays, etc.Wireless switching overcome the problems in wired technology such as Pre-planning requirements, higher installation and maintenance costs of the wired network, Difficulty in troubleshooting connectors, Less flexible infrastructure due to fixed connections, Wired networks have to be designed with spare capacity on cards, marshalling cabinets, junction boxes and so forth, to cater for future expansion, Rotating equipment cause constant twisting of cables which results in fatigue and communication failure. A small motor can be started by simply plugging it into an electrical receptacle or by using a switch or circuit breaker. A larger motor requires a specialized switching unit called a motor starter or motor contactor. When energized, a direct on line (DOL) starter immediately connects the motor terminals directly to the power supply. Reduced-voltage, star-delta or soft starters connect the motor to the power supply through a voltage reduction device and increases the applied voltage gradually or in steps. In smaller sizes a motor starter is a manually operated switch; larger motors, or those requiring remote or automatic control, use magnetic contactors. Very large motors running on medium voltage power supplies (thousands of volts) may use power circuit breakers as switching elements.

A direct on line (DOL) or across the line starter applies the full line voltage to the motor terminals, the starters or cubicle locations, can usually be found on an ELO drawing. This is the simplest type of motor starter. A DOL motor starter also contains protection devices, and in some cases, condition monitoring. Smaller sizes of direct on-line starters are manually operated; larger sizes use an electromechanical contactor (relay) to switch the motor circuit. Solid-state direct on line starters also exist. A direct on line starter can be used if the high inrush current of the motor does not cause excessive voltage drop in the supply circuit. The maximum size of a motor allowed on a direct on line starter may be limited by the supply utility for this reason. For example, a utility may require rural customers to use reduced-voltage starters for motors larger than 10 kW. DOL starting is sometimes used to start small water pumps, compressors, fans and conveyor belts. In the case of an asynchronous motor, such as the 3-phase squirrel-cage motor, the motor will draw a high starting current until it has run up to full speed. This starting current is typically 6-7 times greater than the full load current. To reduce the inrush current, larger motors will have reduced-voltage starters or variable speed drives in order to minimize voltage dips to the power supply.

A reversing starter can connect the motor for rotation in either direction. Such a starter contains two DOL circuits one for clockwise operation and the other for counter-clockwise operation, with mechanical and electrical interlocks to prevent simultaneous closure.[5] For three phase motors, this is achieved by swapping the wires connecting any two phases. Single phase AC motors and direct-current motors require additional devices for reversing rotation.

An Intelligent Motor Controller (IMC) uses a microprocessor to control power electronic devices used for motor control. IMCs monitor the load on a motor and accordingly match motor torque to motor load. This is accomplished by reducing the voltage to the AC terminals and at the same time lowering current and kvar. This can provide a measure of energy efficiency improvement for motors that run under light load for a large part of the time, resulting in less heat, noise, and vibrations generated by the motor.An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and receiver.

RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry. Good electronic radio design is notoriously complex because of the sensitivity of radio circuits and the accuracy of components and layouts required to achieve operation on a specific frequency. In addition, reliable RF communication circuit requires careful monitoring of the manufacturing process to ensure that the RF performance is not adversely affected. Finally, radio circuits are usually subject to limits on radiated emissions, and require conformance testing and certification by a standardization organization such as ETSI or the U.S. Federal Communications Commission(FCC). For these reasons, design engineers will often design a circuit for an application which requires radio communication and then "drop in" a pre-made radio module rather than attempt a discrete design, saving time and money on development.

RF modules are most often used in medium and low volume products for consumer applications such as garage door openers, wireless alarm systems, industrial remote controls, smart sensor applications, and wireless home automation systems. They are sometimes used to replace older infrared communication designs as they have the advantage of not requiring line-of-sight operation. Several carrier frequencies are commonly used in commercially-available RF modules, including those in the industrial, scientific and medical (ISM) radio bands such as 433.92 MHz, 915 MHz, and 2400 MHz. These frequencies are used because of national and international regulations governing the used of radio for communication. Short Range Devices may also use frequencies available for unlicensed such as 315 MHz and 868 MHz.

II. METHODOLOGY

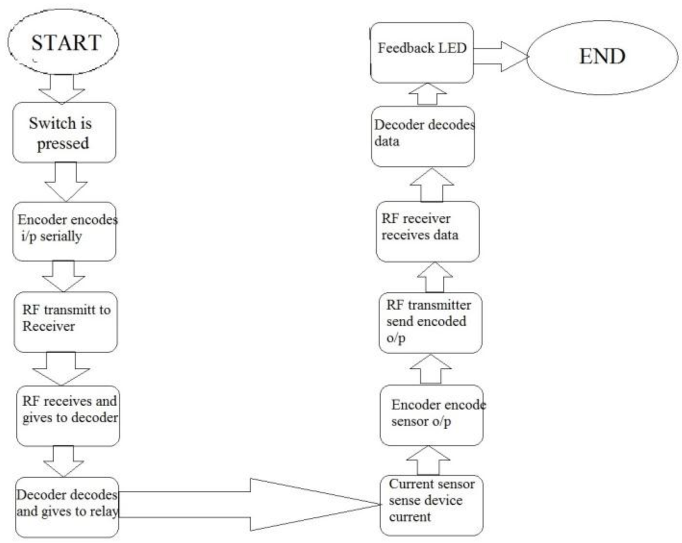


Fig: Flowchart

Fig. shows the flowchart of wireless switching system with realtime feedback. As shown in fig. when process starts, when we pressed switch then encoder encodes the input serially and gives output to the RF transmitter. RF receiver receives the encoded input and gives to the decoder IC. Where decoder IC gives i/p to PIC and respective relays turn on. Current sensor senses the current and encoder encodes it for getting feedback of the system.

Block Diagram:

There are two main units first is the base unit to which the devices to be switched are connected. This section has two ways radio link connected to the other unit which is the command or the control unit. The command or the control unit has four switches on the front panel with which devices can be controlled. Each switch has a corresponding LED aside it which shows the status of the device that is controlled by that particular switch. For better understanding of the system it can be divided into following parts:

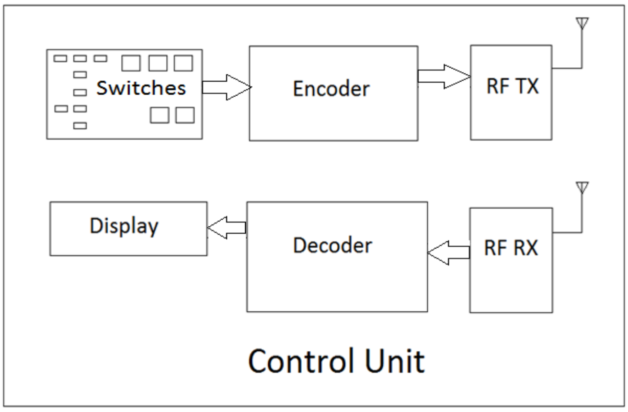


Fig: Control Unit

- Keypad:

A push switch is a momentary or non-latching switch which causes a temporary change in the state of an electrical circuit only while the switch is physically actuated. An automatic mechanism (i.e. a spring) returns the switch to its default position immediately afterwards, restoring the initial circuit condition. There are two types: A push to make switch allows electricity to flow between its two contacts when held in. When the button is released, the circuit is broken. This type of switch is also known as a Normally Open (NO) Switch.

- Encoder:

The encoder will serially transmit nine bits of binary data as defined by the state of the A1/D1-A9/D9 input pins. These pins can be in either of three states (0,1, open) allowing 39 =19683possible codes. The transmit sequence will be initiated by a low level of the TE input pin. Each time the TE input is forced low the encoder will output two identical data words. This redundant information is used by the receiver to reduce errors. If the TE input is kept low, the encoder will continuously transmit the data words. The transmitted words are self-completing (two words will be transmitted for each TE pulse). Each transmitted data bit is encoded into two data pulses. A logic zero will been coded as two consecutive short pulses, a logic one by two consecutive long pulses, and an open as a long pulse followed by a short pulse. The input state is determined by using a weak output device to try to force each input first low, then high. If only a high state results from the two tests, the input is assumed to be hard wired to VDD. If only a low state is obtained, the input is assumed to be hardwired to VSS. If both a high and a low can be forced at an input, it is assumed to be open and is encoded as such. The transmit sequence is enabled by a logic zero on the TE input. This input has an internal pull up device so that a simple switch may be used to force the input low. While TE is high the encoder is completely disabled, the oscillator is inhibited and the current drain is reduced to quiescent current. When TE is brought low, the oscillator is started, and an internal reset is generated to initialize the transmit sequence. Each input is then sequentially selected and a determination is made as to input logic state. This information is serially transmitted via the Data Out output pin.

- RF Transmitter and Receiver:

An RF module (radio frequency module) is a (usually) small electronic device used to desirable to communicate with another device wirelessly. Commercially- available RF modules, including those in the industrial scientific and medical(ISM) radio bands such as 433.92 MHz, 915 MHz, and 2400 MHz.

- Display Section:

It consist of LED'S , shows status (on/off) of connected devices.

- Decoder:

The decoder will receive the serial data from the encoder, check it for errors and output data if valid. The transmitted data consisting of two identical data words is examined bit by bit as it is received. The first five bits are assumed to be address bits and must be encoded to match the address inputs at the receiver. If the address bits match, the next four (data) bits are stored and compared to the last valid data stored. If this data matches, the VT pin will go high on the 2nd rising edge of the 9th bit of the first word. Between the two data words no signal is sent for three data bit times. As the second encoded word is received, the address must again match, and if it does, the data bits are checked against the previously stored data bits. If the two words of data (four bits each) match, the data is transferred to the output data latches and will remain until new data replaces it. At the same time, the Valid Transmission output pin is brought high and will remain high until an error is received or until no input signal is received for four data bit times. Although the address information is encoded in binary fashion, the data information must be either a one or a zero. A binary (open) will be decoded as a logic one.

Switching Unit:

This section is what receives the data from the control unit about switching on or off a certain device. All the receivers and transmitters used in the system are of same type. They are given numbers due to the fact that a full duplex mode of communication has been realized in the working of the system. The first part of the link which comprises of receiver 1 at the switching unit and transmitter 1 at the control and command unit is used to send and receive commands from the control unit to the switching unit. The second link which comprises of the RF transmitter 2 which is housed at the switching unit and the RF receiver 2 which is stationed at the control unit is used to transmit and receive the status of the devices from the switching unit to the control unit. Both the pairs utilize readymade transmitter-receiver modules that communicate in the ISM (industrial, scientific and medical band) which is a license free band. Both the pairs utilize ASK type of modulation. The pairs utilized are tailor made for digital serial communication and are compatible with TTL signal levels.

The output of the receiver 1 is fed to the decoder one; the transmitter 2 is fed data from the output of encoder 2. In the same way at the control unit the receiver 2 is feeds the input of the decoder 2 where as the transmitter 1 is fed from the output of encoder 1. The RF pair has a maximum range of about 100m in constricted environs whereas in open environs it would permit a communication range of 300 to 500 m.

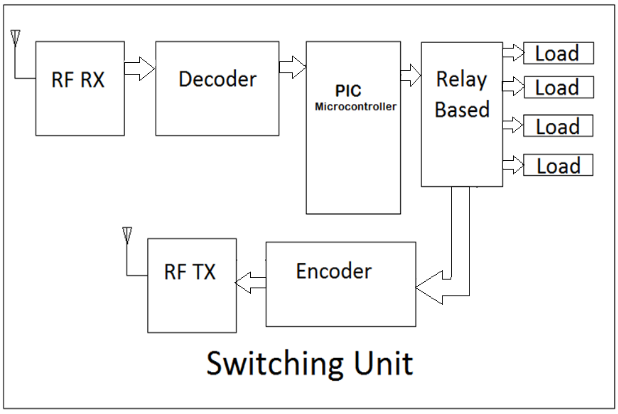


Fig. 3.3 Switching Unit

Circuit Diagram:

Many embedded systems have substantially different designs according to their functions and utilities. In this project design, structured modular design concept is adopted and the system is mainly composed of a single microcontroller, RF transmitter and receiver, temperature sensor, TRIAC and bulb.

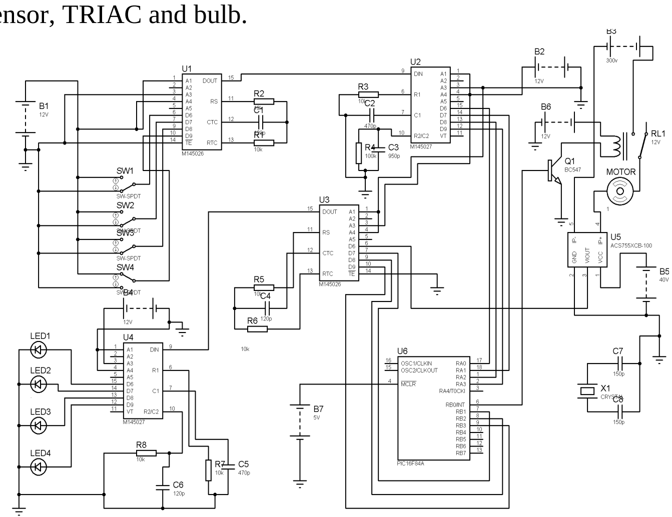
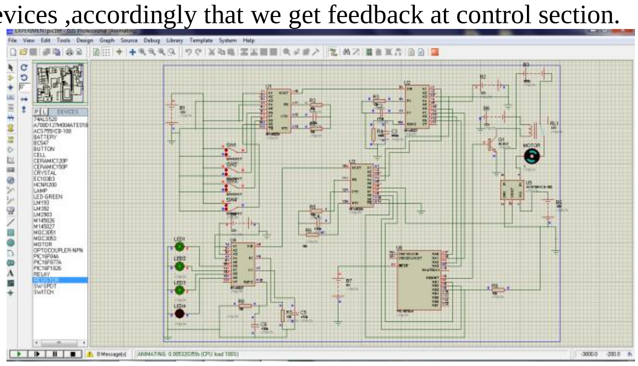


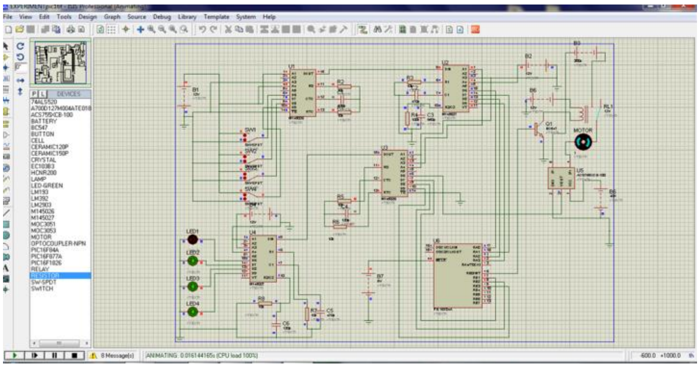
Fig: Circuit Diagram

III.RESULTS AND DISCUSSION

Here first three switches used to control the individual devices ,accordingly that we get feedback at control section.



And fourth one for automation purpose, PIC16F84A control different devices according programming.



IV. CONCLUSION AND FUTURE SCOPE

Conclusion:

We first design encoder and decoder for controlling the device over single control line ,for that purpose we use IC HT12E and HT12D assign same address, also for feedback purpose we design same encoder and decoder but address different than first one . And use LED's for indication i.e to display status(on/off) of device. For wireless control purpose we use RF module which operate on ISM band, we also implement the PIC based system for automation purpose, here PIC control the operation of various devices automatically and feedback circuit gives feedback of these devices to control unit. In future we can ON/OFF any distant object. we can also operate any machines in industry through it and used these in any small or big architectural company.

Future scope:

We design the project for large scale system and also use advanced processor for controlling the industrial devices ,in present we use RF module for wireless controlling purpose, instead of using RF module use zigbee for short range ,and for long distance use GSM modem. For user comfort we use touch screen display with necessary control with suitable LPC processor.

V. REFERENCES

[1] Jämsä-Jounela, S.-L. [2007], 'Future trends in process automation', Annual Reviews in Control 31[2].

[2] Egea-Lopez, E.; Martinez-Sala, A.; Vales-Alonso, J.; Garcia-Haro, J. & Malgosa-Sanahuja, J. [2005], 'Wireless communications deployment in industry: a review of issues, options and technologies', Computers in Industry.

[3] H. Wang, D.L. Mao, "Real-time Transfer Protocols and Real-time Transfer Services", Computer Applications and Software, China Academic Journal Electronic Publishing House, Beijing, December [2000].

[4] G.F. Zhao, "The Analysis of the Serial Standards of WLAN IEEE 802.11", Network Security Technology & Application, China Academic Journal Electronic Publishing House, Beijing, May [2007].

[5] Forgue, B. [2010], Next-Gen Wireless in Control Systems, Going Wireless: Why and How?, 23rd February [Presentation]: IET London: Savoy Place, UK.

[6] F. Basile, P. Chiacchio, and D. Gerbasio, “On the implementation of industrial automation systems based on plc,” in IEEE, Transaction science and Engineering, vol. 10, no. 4, October 2013, pp. 990 – 1003.

[7] F. Ferreira, G. He, and S. Qin., “Automated verification of the freertos scheduler in hip/sleek,” in IEEE Sixth International S ymp o s i um on Theoretical Aspects of Software Engineering, 2012, pp. 51 – 58.

[8] D. Fennibay, A. Yurdaku, and A. Sen, “A heterogeneous simulation and modeling framework for automation systems,” in IEEE Transactions on Computer-Aided Design of Integrated circuits and systems, vol. 31, no. 11, November 2012, pp. 1642 – 1655.

[9] Dolejs, O., Smolik P., e Hanzalek Z. "On the Ethernet use for real-time publish-subscribe based applications". In 5th IEEE International Workshop on Factory Communication Systems, Vienna, Austria, Sep. [2004].

[10] Drathen, H., Process Automation Trends, ACHEMA Worldwide News, Available at: http://www.dechema.de/ dechema_media/. [Accessed on 20th November 2009].

[11] Ferris, M. [2010], 'Next-Gen Wireless in Control Systems. Real World Wireless', 23rd February [Presentation]: IET London: Savoy Place, UK.

[12] I. S. M. Valeriy Vyatkin, “Software engineering in industrial automation: State-of-the-art review,” in IEEE, Transaction on industrial informatics, vol. 9, no. 3, August 2013, pp. 1234 – 1249.