Wireless Monitoring and Controlling Speed of DC Motor

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Abstract— Nowadays, due to rapid growth in industrial monitoring and controlling, particularly in domain of automation processes. Zigbee is as an emerging standard that is welcomed in the industries like pharma industry, textile, automotive manufacturing etc for wireless monitor and control of automation system. Reason behind implementation of this system is for monitoring as well as controlling the PLC based system using Zigbee. The system consist of two parts one transmitter node and another receiver node .Pair of Zigbee used here, one node of Zigbee i.e. transmitter is connected with DELTA PLC in industry side and another one is connected with computer in control room or substation. The parameters can be displayed on PC with visual basic software. Data from industry side i.e. from PLC side will be transferred continuously to PC’s screen via Zigbee by sending data of process that occurs in industry and will be displayed in the visual basic software and also we can control process by transmitting data of process from computer i.e. from visual basic software to PLC located at the industry through Zigbee. Zigbee is low cost device hence system becomes cost effective. Due to wireless system cost and maintenance of long cables is reduced.

Keywords: Zigbee, PLC, Delta.

I. INTRODUCTION

Nowadays there has been a rapid growth in the extremes of industrial Monitoring and Control, particularly in the domain of automation processes. In industry during certain hazards will be difficult to monitor parameters through wires. To overcome this problem we use wireless device to monitor and control speed of motor. Industries required efficient way of monitoring and controlling. Most of applications recently are wireless. Wireless technology is being widely used since last few years in automation and it has also become a part of our lives because now a day’s people are using in their daily life. RF, GSM, ZIGBEE are some technology that falls in to wireless category. Motion control is required for all manufacturing plants in industries like chemical, pharmaceutical, plastic and textile. Hence motion control plays vital role in automation which may be a flow-control application, flat belt application, or mixing of substances. Motor is device that converts electrical energy into mechanical energy. The motor that utilizes a DC supply to produce mechanical output is direct current (DC) motor. DC motors provide high starting torque so they are used in many industrial applications. The big and practical advantage of DC motor that the range of speed controls. There are different methods to control speed of DC motor.

On the basis of their application different types of motor like AC, stepper motor or DC motors are used. Among the various type of motor used in industrial purpose DC motors are widely been accepted since its speed can be varied very easily. Servo motors are used in robotics. DC motors are widely used in industrial applications. The motor speed can be controlled by controlling armature voltage and armature current. These methods have some demerit because some power is wasted in control resistance. PWM method also can be used to control dc motor speed. PWM circuit work by making a square wave with a variable on to off ratio. The ratio can vary between 0 % - 100%. In this manner variable power is transferred to load. Main advantage PWM circuit over a resistive power control is the efficiency. On PWM 50% amount off pulse and on pulse is equal.

II. LITERATURE SURVEY

I G. A. P. Raka Agung, S. Huda, I W. Arta Wijaya The speed control of direct current (DC) motor for various applications is very important. In particular requirement, setting a speed DC motor as the driving equipment must be performed remotely. Under that condition, conducted a research on a DC motor speed control with pulse width modulation (PWM) method of the infrared remote control. PWM is method that may be used as a efficient DC motor speed control. Controller used TV remote control to send data to Atmega16 microcontroller through the IR receiver. This command controls the L293D driver IC to control the direction and speed of a DC motor.

Vira Manthan Kantilal, Anurag P Lakhani developed project is to monitor and control the PLC based system using wireless technology. In this project they used a ZIGBEE and SCADA technology to get wireless automation system. Pair of ZIGBEE is used here, among that one is connected with the PLC in the industry side and another one is connected with PC in the control room. Data from the PLC side will be transferred continuously to PC via ZIGBEE by sending a bit of the process that occurs in the industry and it will be displayed in the SCADA software and also we can control industry by transmitting a bit again using ZIGBEE from PC side to PLC located at the industry side. Thus we can avoid the maintenance and cost of the long cables that are used to connect the PLC with a PC.

Yu Qiao & Jing Y. Guo TA: Jim Kolodziej Nowadays, there are lots of good-quality motor speed controls on the market. However, their costs are relatively high. A speed control with both low cost and good performance will be highly marketable, especially for small mobility applications. On the other hand, the wireless connectivity has a nature of low cost and less environmental limitations. Combining these ideas together, we came up with this project.

III. DETAILED STUDY

PLC is digital electronic device which is used for automation in industries. PLC and controller both can be used for controlling the equipment but controller requires the external hardware for connection such as max232, capacitors, resistors etc. while PLC is a device with complete modular structure. Thus using PLC we can easily connect the input and output directly to the port given in the PLC. Here in this project delta plc DVP14SS used.
ZIGBEE falls in the category of wireless domain like GSM and RF technology. ZIGBEE is low cost wireless communication technology. That means ZIGBEE only reduces the cost and maintenance of the wires used for connections else all the process will be same such as ZIGBEE will provide a particular bit on/off status to the other side due to which same message or data we can get on the other side as wire provides. Thus ZIGBEE replaces the connecting wires and provides a wireless communication.

IV. METHODOLOGY
The methodology used in this project divided into two parts hardware and software implementation. Hardware part consist of motor driver circuit, PLC and Zigbee module while software part consist of visual basic for GUI and WPL soft for plc programming.

V. PROPOSED ARCHITECTURE
Architecture contains the pair of ZIGBEE modules, Delta PLC DVP 14SS, Visual basic software installed in computer. PLC is a central unit to control the process and sensors and other inputs are connected at input terminal of the PLC and ZIGBEE is connected with PLC via communication port RS485 (RS485 to RS232 converter is required) and output such as conveyor belt motor, dc motor etc are connected at output terminal of the PLC. At the other side PC is connected with ZIGBEE directly through the RS232 port and this ZIGBEE will communicate with PLC through another ZIGBEE as shown and display the status in visual basic software.

A. Delta PLC
The DVP-SS series provides the 14-point Main Processing Unit and the expansion unit with 8–16 points, and the maximum input/output points could be extended up to 128 points. Since the power supply unit is independent of the main unit, and with the volume of the device being smaller, the installation is thus easier.

B. Zigbee Module
Zigbee is a low power spin off of Wi-Fi. It is a specification for small, low power radios based on IEEE 802.15.4 2003Wireless Personal Area Networks standard. The specification was accepted and ratified by the Zigbee alliance in December 2004. Zigbee Alliance is a group of more than 300 companies including industry majors like Philips, Mitsubishi Electric, Epson, Atmel, Texas Instruments etc. which are committed towards developing and promoting this standard. The alliance is responsible for publishing and maintaining the Zigbee specification and has updated it time and again after making it public for the first time in 2005. Most of the recent devices conform to the Zigbee 2007 specifications have two feature sets—Zigbee and Zigbee Pro. The manufacturers which are members of the Alliance provide software, hardware and reference designs to anyone who wants to build applications using Zigbee.

C. Pulse width modulation technique
PWM is a method for binary signals generation, which has 2 signal periods (high and low). The width (W) of each pulse varies between 0 and the period (T). The main principle is control of power by varying the duty cycle. Here the

Fig. 3: Programming in Delta PLC

Fig. 4: Zigbee Protocol
conduction time to the load is controlled. Let for a time \( t_1 \), the input voltage appears across the load i.e. ON state and for \( t_2 \) time the voltage across the load is zero. A microcontroller based PWM solutions uses fewer components and has flexibility of varying duty cycle and frequency through software.

![Fig. 5: PWM Signal](image)

![Fig. 6: Relation Of Supply Voltage With Speed](image)

The pulse width modulation (PWM) techniques are adopted in dc motor control system. An optical encoder was used to measure the speed of the motor. The output of the encoder is a stream of pulses with variable frequency according to the speed of the motor. The resolution of the encoder in this work was 500PPR.

![Fig. 7](image)

Some features of Speed controller
1. Speed Controlled through microcontroller and PLC.
2. Speed monitoring done through visual basic.
3. Start stop command from PLC.

![Fig. 8: L293D IC Circuit](image)

The pins of L293D IC are connected to ATmega8 port are Enable1 (1EN) to PB2, IN1 (1A) to PB0, and IN2 (2A) to PB1 , while OUT1 (1Y) and OUT2 (2Y) pins is connected to DC motor terminals. Fig. 8. shows the L293D IC circuit.

VI. CONCLUSION

The main idea was to control speed of dc motor using PWM technique and monitoring of speed by wirelessly interfacing Visual Basic 6.0 and Delta PLC DVP14SS using Zigbee for more effective and efficient process control. By using Visual Basic it offers many advantages over SCADA packages as it comes free and not expensive. Thus speed of DC motor has been controlled using PWM technique. PLC based simultaneous motor speed control used in multiple process control industrial application. The efficiency of PLC control is about 95% of the synchronous speed; PLCs prove themselves as effective tool to control the electric drives application. PLC program has been developed to start/stop and to control direction of motor i.e. forward and reverse.

REFERENCE