

Programmable Wireless Sensor Network for Industrial Automation and Environmental Safety

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Abstract

This paper proposes the industrial environment safety monitoring and industrial automation using wireless sensor networks. The wireless sensor networks are controlled by Programmable logic controller (PLC) programming. In the traditional method the wireless sensor networks are controlled by microcontroller. The programmable logic controller programs the sensor network and monitor and control the industrial environment. The data collected by the sensors are stored on the database.

Keywords— PLC, WSN, Accident Data Recorder (ADR), sensors.

I. INTRODUCTION

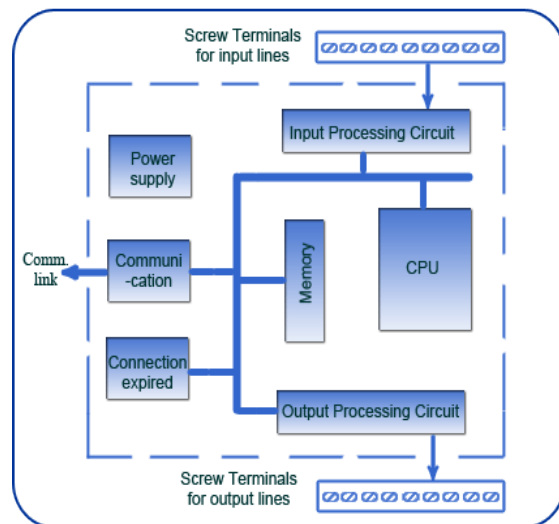
In all the industries now a days the machines and instruments are handled by robotics because of cost and safety of the industry. The Programmable logic controller (PLC) system is a emerging technology for the industrial automations and industrial safety. PLC is a electronic device used for automation of real world machineries. Normally the inputs and outputs of the PLC are wired but this paper there is no wires between the input and output of the PLC kit, all the inputs and outputs are gathered via wireless connection with help of wireless sensor networks. At the same time the sensors inputs and outputs are programmed by PLC. This type of automation system reduces the man power, cost and also the maintenance of industrial equipments. Based on the human security this system provides more secure than some other systems. Using sensors we can provide some security alerts and constraints to the instruments and workers.

II. PROGRAMMABLE LOGIC CONTROLLER (PLC)

Programmable logic controller is small computer commonly used to program the industrial automation. It consist of Programmable memory, Central processing unit (CPU) and I/O ports. Input devices such as switches and relays and output devices motors and other industry loads are controlled by programming as per the application. It implements the function such as sequencing, counting, logic timing, and arithmetic in order to

control the functions of the machineries. The important advantage of the PLC is we can change the operations of the machines easily, all the programs are modifiable. The main operations of PLC are as follows: Check the inputs whether it is On/Off, Executing the program by continuously scanning the program instructions and updating the output status.

Fig.1 PLC Architecture



To program with PLC following things are needed:

- PLC Kit
- Programming software
- Programming device
- Connecting cable

III. WIRELESS SENSOR NETWORK

The wireless sensor network is combinations of sensing, communicating and computing the parameters of the given wireless network. The sensor nodes are deployed on the given industrial machineries and they share their information's with each other, there must be a sink node for each sensor network which receives all the sensors information and sent to the control centre. It can be dynamically adopt the changes in the network, by changing its routing path. All the sensors are work on the battery power which is built in with the sensor and also one transceiver present in that for transferring and

receiving the information between them. The three main applications of sensor networks is as follows:

- Security monitoring
- Environmental information collection
- Tracking

Security monitoring in the wireless sensor networks are placed at fixed location of specified environment. The sensors which collecting the environmental information's are may be fixed or mobile like sensors. Tracking is one of the major applications in sensor network which tracks humans and mobile vehicles. The main problem in the wireless sensor network is lifetime, the life time of the sensor are limited because it is battery powered. To reduce the power consumption of sensors, it needs the energy efficient routing.

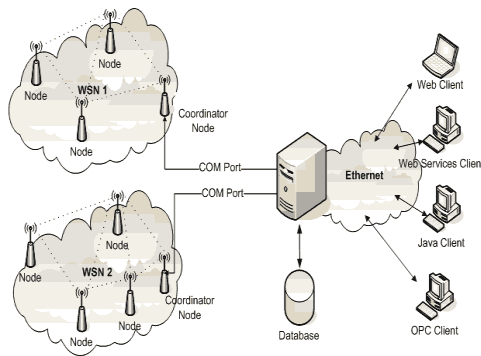


Fig.2 Sensor Network Architecture

IV. SYSTEM IMPLEMENTATION

The industries need an accurate automation system as well security system. With this PLC based wireless sensor network system we can approach this two things. The sensors placed on the industrial equipments are interconnected via wireless connection and there is one sink node that connected with each other sensor nodes and forwards the collected information to the base station. These types of sensors are used for security purpose by tracking the humans and machine activities. The PLC controlled sensors are used for controlling the functions of industrial equipments. With the PLC kit the inputs are getting directly by the sensors via input modules and the outputs are directly connected to the load (machines). The functions of the machines based on time, temperature, pressure and other parameters are programmed previously. There must have an access point to gather information from various sensors and control the network activities of sensor network. Generally wireless sensors have a limited lifetime because it is battery powered device. To minimizing the power consumption of wireless sensor network there must apply low power consumption routing algorithm. The sensors used for the monitoring are may be cameras and other

multimedia based devices. The monitoring information are collected and stored as a data base.

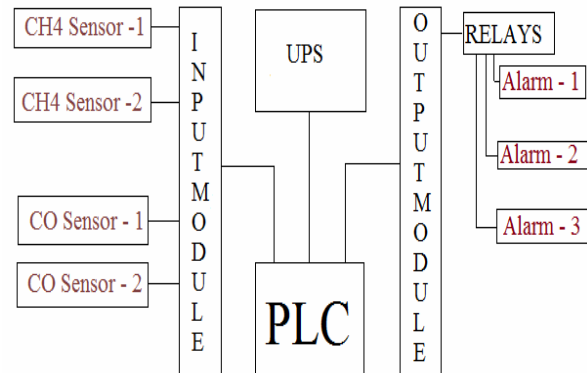


Fig.3 Combination of WSN and PLC for security issues

Based on the type of sensor and constraints made on the sensor the load will activate at a time. For example the infrared sensors are placed on the production area then activities of workers are tracked, if any accidental activities are occurred then the alarm will activate. And also camera can be used to monitor the production area and package area to identify the damages on the product that are caused by the machines and workers. It increases the quality of the product. The accidental information are monitored and stored on the data base are used for producing First Information Report (FIR). PLC takes various decisions depending on the various inputs get from different sensors. The inputs are processed by the central processing unit of PLC and corresponding action will take as an output. The PLC programming software is installed on the pc to make the program, the program can be made by three different methods ladder logic, functional block diagram and statement list.

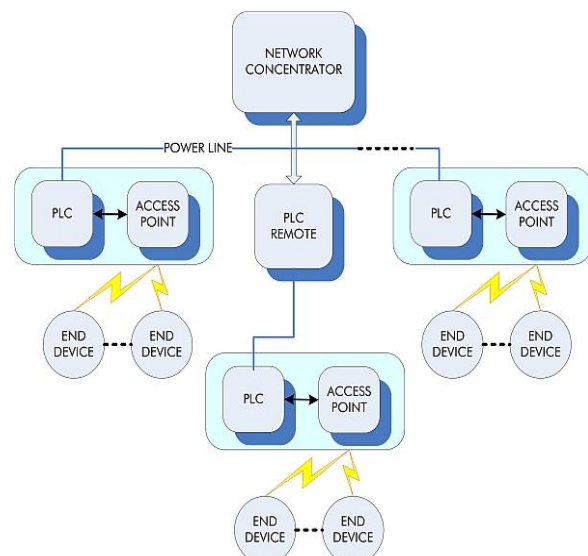


Fig.3 Overall System Architecture

The inputs to the PLC kit are analog signal, because the sensors use the analog signal. The program used in the PLC kit is easy to learn and understand.

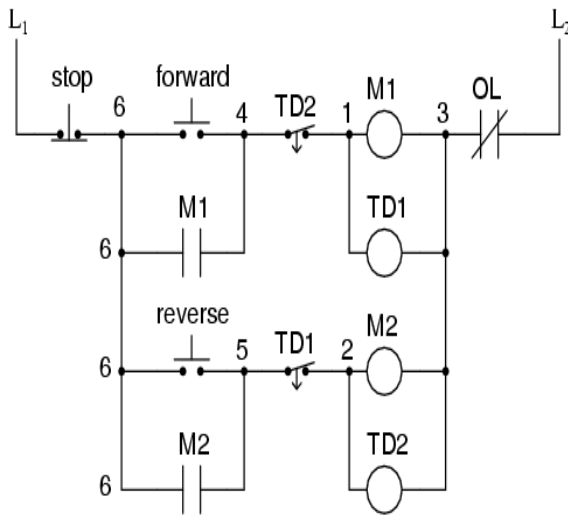


Fig.4 Sample PLC ladder Program

V. CONCLUSION

This paper provides a better way to control industrial machineries and monitor the industrial environment to provide safety and improve the quality of the product. This paper proposes the wireless sensor network based automation and monitoring activities with help of Programmable Logic Controller. The PLC controller provides a platform to program the wireless sensor network. This method will reduce the cost and maintenance of the industrial environment automation and safety.

The PLC dominates all the control system of the industrial automations. In future the PLC plays an important role in industrial automation. Even though the PLC provides a efficient control system, the sensor networks reduces the wired connections between input and output of the PLC kit.

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