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# Network Architecture for SCADA Implementation

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**Abstract:** This paper describes the implementation of distributed control systems with network architecture as compared to traditional systems with a central processor. A use of standard protocol, CAN, is briefly presented for industrial automation and compared over other techniques. The work is presented the implementation of smart sensors for monitoring various parameters and for communicating among them self using the CAN protocol. It is protocol of serial communication that allows the control of systems distributed in real time with high level of safety.

**Keywords:** Wireless communication, Zigbee, RF, SCADA, CAN Protocol.

## I. INTRODUCTION

### A. Need for automation

Automation is the key to modernization and has been conceptually understood as a way to increase efficiently and to improve productivity. The process of having machine follow a predetermined sequence of operation with little or no human labour, using special equipment and devices that perform and control manufacturing processes is known as automation. The goals of automation are Integration of various aspects of manufacturing operations to reduce labour cost, to improve productivity or efficiency, quality, to reduce human involvement therefore human error, to reduce work piece damage that manual handling caused, to raise the safety level[1][2].

In modern industrial production, monitoring of various parameters is necessary, which reflects the running status of equipment and changes of many physical characteristics. By monitoring these parameters staff and workers can make the right judgments and operation to ensure the most effective and economical industrial production [3].

So industrial automation systems provide automatic control of various parameters through automation. The historical root and still core domain of automation is the automation of physical parameters in large functional area. Their primary goal is to realize significant savings in energy and reduce cost. Yet the reach of automation systems has extended to include information from all kinds of systems, working toward the goal of industry automation. Since these systems are diverse by tradition, integration issues are of particular importance. The present paper introduces the task of automation and the systems and communications infrastructure necessary to address it. Basic requirements are covered as well as standard application models and typical services [4].

### B. Role of communication in automation

Automated systems use local control systems that utilize sensor information in feedback loops, process this information and send it as control commands to actuators to be implemented. Such closed loop feedback control is necessary, because of the uncertainties in the knowledge of the process and in the environmental conditions. Feedback control systems rely heavily on the ability to receive sensor information and send commands using wired or wireless communications.

Values of important quantities (which may be temperatures, pressures, voltages etc) are sensed and transmitted to monitoring stations in control rooms. After processing the information, decisions are made and supervisory commands are sent to change conditions such as set points or to engage emergency procedures. The data from sensors and set commands to actuators are sent via wired or wireless communication channels. So communication mechanisms are an integral part of any complex automated system

In any system there are internal communication mechanisms that allow components to interact and exhibit a collective behaviour, the system behaviour. For example, in an electronic circuit, transistors, capacitors, resistances are connected so current can flow among them and the circuit can exhibit the behaviour was designed for. Such internal communication is an integral part of any system. At a higher level, subsystems that each can be quite complex interact via external communication links that may be wired or wireless. This is the case for example in antilock brake systems, vehicle stability systems, and engine and exhaust control systems in a car or among unmanned aerial vehicles that communicate among themselves to coordinate their flight paths. Such external to subsystems communication is of prime interest in automated systems.

There are of course other types of communication for example machine to machine via mechanical links and human to machine, but here we will focus on electronic transmission of information and communication networks in automated systems. Such systems are present in

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refineries, process plants, manufacturing, automobiles to mention but a few.

Advances in computer and communication technologies coupled with lower costs are the main driving forces of communication methods in automated systems today. Digital communications, shared wired communication links, and wireless communications make up the communication networks in automated systems today.

**C. Recent trends in automation**

Automation is a programmed, computerized, intelligent network of electronic devices that monitor and control the various systems in a facility. The aim is to create an intelligent, effective automated system and reduce energy and maintenance costs of the facility. Nowadays, modern systems often implement the automation based on direct digital control which consists of microprocessor-based controllers with the control logic performed by software.

Some system implements Zigbee Based Wireless Network for Industrial Applications. The personal computer based wireless network for industrial application using Zigbee can be adopted at micro and macro Industries, it has various types of Processors and Microcontrollers. Here Microcontrollers, sensors, relays are used. The system is fully controlled by the Personal Computer through ADC (Analog to digital converter). All the processor and controllers are interconnected to personal computer through Zigbee.

SCADA systems are highly distributed systems used to control geographically dispersed assets. SCADA control centre performs centralized monitoring and control for field sites over communications networks, including monitoring alarms and processing status data. Based on information received from remote stations, automated or operator-driven supervisory commands can be pushed to remote station control devices, which are often referred to as field devices. Field devices control local operations such as opening and closing valves and breakers, collecting data from sensor systems, and monitoring the local environment for alarm conditions.

Also in many industries controlling of various devices or machines is very difficult. In industries each motor or machine is switch on or off manually. So that it increases number of labours and also time is waste. In order to avoid this, RF based techniques used. Also it can be used for controlling speed of fan or speed of AC or DC motors. Rotate these motors in forward or in reverse direction. It is convenient to use RF based multiple channel remote control for switching or controlling industrial devices.

## II. PROPOSED SYSTEM

**A. Block Diagram of SCADA**

SCADA systems are highly distributed systems used to control different parameters. It will collect information from various sensors and supervisory control commands are given to actuators to control operations.

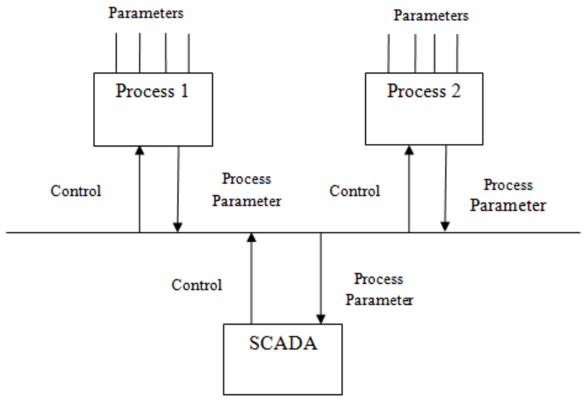


Fig. 1 Block diagram of SCADA

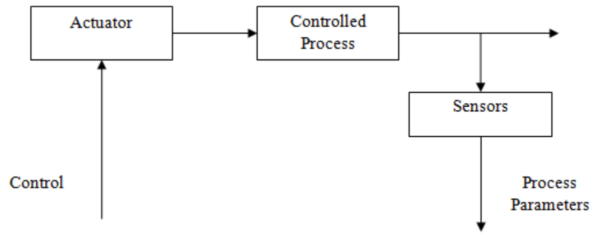


Fig. 2 Distribution monitoring and control

**B. Automation using Zigbee**

It uses the wireless network for industrial data communication. Zigbee uses the IEEE 802.15.4 physical and MAC layers to provide standard-based, reliable wireless data transfer. Zigbee adds network structure, routing, and security to complete the communication suite. On top of this wireless engine, Zigbee profiles provide target applications with the interoperability and inter compatibility required to allow similar products from different manufacturers to work seamlessly .The fig.3 shows that the basic blocks diagram of secured wireless communication for industrial automation.

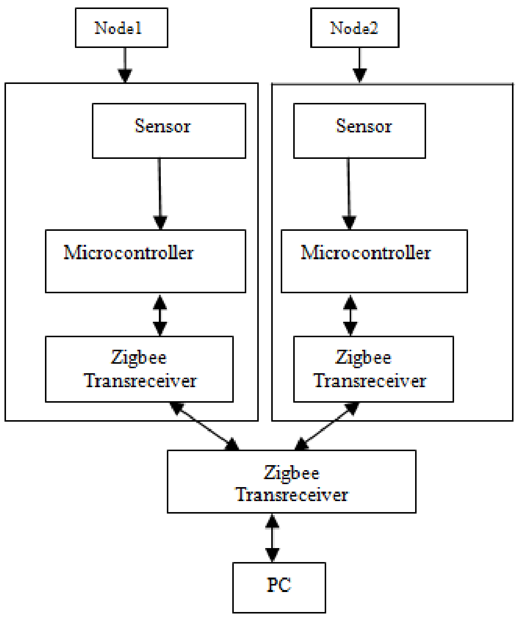


Fig. 3 Block diagram of secured wireless communication for industrial automation.

The data from the sensor are taken from the ADC and the values are stored in the AT mega 16 microcontroller. The data from node1 and node 2 is transmitted to master node. The overall information is transmitted to PC using USART. Threshold values of each sensor are set and appropriate actions will be taken for e.g. temperature is controlled using fan and pump is turned on when LEVEL is reduced. Zigbee is used for wireless data transmission which comes under ISM band. The master node that collects overall information from node 1 and node 2 and transmitted it to PC using USART.

### C. Automation using RF

Traditionally, industrial automation systems are realized through wired communications. In this technique, only one remote can control up to 9999 devices and multiple devices may be connected and controlled with the help of single remote. Radio frequency has traditionally been used to remotely control barriers, automatic gates & doors, industrial access control systems and motorized gates and doors by utilizing hand held transmitters and remote receivers. Due to high speed and more flexibility, it has multiple ports so connection and control of multiple devices is possible. Many nodes can be interfaced to RF through microcontroller. Its practical implementation is very easy and RF module range is very high so it can control long range easily.

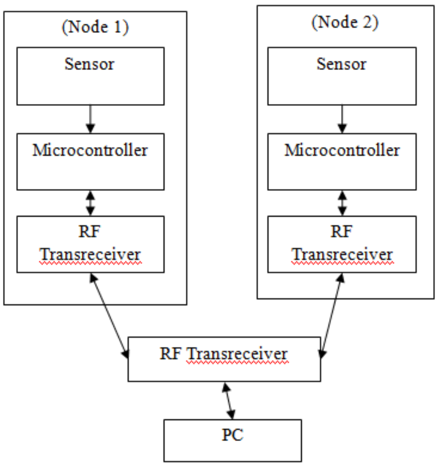


Fig. 4 Block Diagram RF network

This system can be used for industrial based automation systems, also used in small scale industries or used in offices or for Home appliances. This can also be used in Security, Data Networking, Relay controlled devices and Robotics manufacturing systems.

### D. Automation using CAN (Controller Area Network)

CAN stands for Controller Area Network. It is a protocol which defines a set of rules of data transfer from one point to another point. CAN protocol was developed for making sure data from one node gets transferred to another node between two connection safely and securely without any data corruption and without missing any of the data. CAN protocol was mainly intended for short length data transfer like in automobiles. CAN Protocol is used in automation of factory machinery for example two machines which interacts between each other and transfers data to take some mutual decision and then act accordingly.

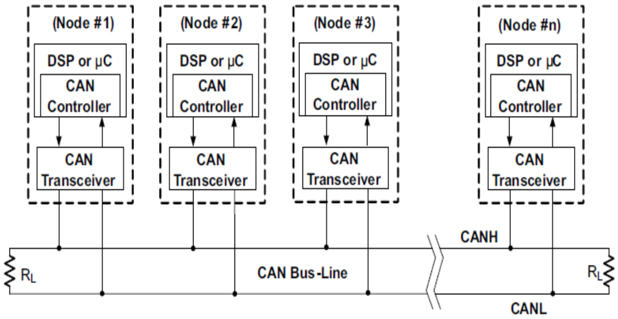


Fig. 5 CAN Bus

It is also used in medical automation, marine ships, military applications and at all other places where a simple yet robust data transfer network is needed. CAN is not a complete network. It consists of only the physical layer, the priority scheme and the error checking system. It is just a connection between two nodes of a network

## III. CONCLUSION

So for industrial automation CAN derive its robust noise immunity and fault tolerance from differential signalling. Balanced differential signalling reduces noise coupling and allows for high signalling rates over twisted-pair cable. Balanced means that the current flowing in each signal line is equal but opposite in direction, resulting in a field-cancelling affect that is a key to low noise emissions. The use of balanced differential receivers and twisted-pair cabling enhance the common-mode rejection and high noise immunity of a CAN bus.

The High-Speed ISO 11898 Standard specifications are given for a maximum signalling rate of 1 Mbps with a bus length of 40 m with a maximum of 30 nodes.

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