

Work Flow Scheduling Based Industrial Automation Using Closed Loop Wireless Control

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Abstract

The paper provides industrial automation environment using work flow scheduling algorithm. Scheduling is the process of organizing, sharing and utilizing the given resources in efficient manner. The scheduled process manages work flow of industrial automation systems. The common functionalities of industries can be controlled by pre scheduled manner via computer. This system is achieved by using closed loop wireless control method. Closed loop application provides distributed control with feedback loops closed over wireless links.

Keywords — ZIGBEE, Workflow scheduling, Networks, Connectivity, Centralized control, Open-loop Control, Closed-loop Control.

I. INTRODUCTION

Every day our life is associated with the networking and machinery environment. Generally IEEE 802.15.4 wireless network is used for infrastructure based network using base stations and access point for centralized data communication. This paper provides a better scheduling algorithm which implements on Zigbee based wireless network. The combination of workflow scheduling algorithm with wireless network provides a better resource utilization and efficient performance for industrial automation.

The rest part of this paper is as follows: Section 2 explains 802.15.4, Bluetooth and Zigbee, Section 3 details the background and related work and Section 4 details the Work flow scheduling algorithm and Closed-loop system and Section 5 explains the System model.

II. WIRELESS NETWORK STANDARDS

A. IEEE 802.15.4

IEEE 802.15.4 is came from IEEE 802 family, IEEE 802.15.4 provides a specific services in PHY layer and MAC layer related to ZigBee network. IEEE STD 802.15.4 specifies the RF, PHY and MAC layers services for wireless communication. This protocol is designed for low data rate, low power, and low cost wireless communication devices. IEEE 802.15.4 has 16 channels at the transmission rate of

250 kb/s and frequency of 2.4-2.4835 GHz. CSMA/CA mode is used for media access.

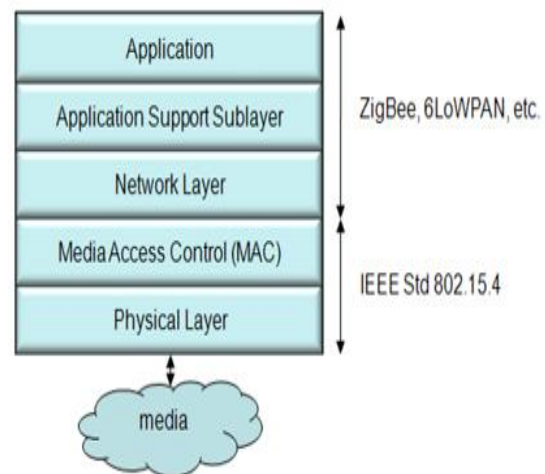


Fig. 1 IEEE 802.15.4 Protocol Stack

B. Zigbee

Zigbee is designed for low data rate, low cost and low power wireless sensor network. Zigbee comprises with three types of device object: Zigbee Coordinator, Zigbee router and Zigbee end device. Zigbee coordinator act as a network control center, Zigbee router performs the routing, packet forwarding and finding shortest data transmission path.

The range of data transmission is 10-100 meter in line of sight. The data transmission rate is 250kbps at 2.4GHz, 40kbps at 915MHz and 20kbps at 868MHz. Zigbee protocol supports three kinds of network topology star topology, mesh topology and tree topology. Zigbee uses 128 bit encryption key for the data security. Beacon and non-beacon networks are supported by the zigbee protocol. Zigbee can be used for health care monitoring, home automations, personal area network (PAN). CCM mode (Counter with CBC-MAC) is supported by zigbee protocol for data security.

III. BACKGROUND

Data loss is one of the important problems in wireless network. The real time environment needs a better quality of service (QOS) in wireless network. In this paper the workflow scheduling algorithm is used to schedule a task of machines in industries as well as monitoring the environmental coordinates. There are more number of wireless data transmission algorithms are available but the suitable algorithm for industrial automation is Work flow scheduling algorithm. Work flow scheduling algorithm provides a better Quality of Service and efficient resource utilization for the industrial real-time automations.

This paper considers two connectivity methods: Open-loop system and closed loop system. For industrial based automations closed –loop connectivity is better to control the machineries. In Open-loop connectivity there is a link only for gathering data from the instruments and no Feedback connections with the access point. In the Closed-loop system there is a feedback loop between the sensors and control system.

IV. ALGORITHM

A. Workflow Scheduling Algorithm

The work flow scheduling algorithm is used for heterogeneous execution of tasks on the industrial machineries. The input given to the work flow scheduling algorithm is abstract, without specifying the location of machines workflow is defined.

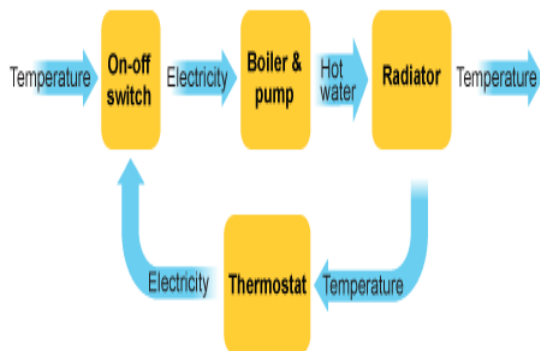


Fig.2:Typical work flow scheduling

The work flow is defined by the users by using the work flow modelling tools. The tasks are managed by the work flow enactment engine. The work flow enactment engine comprises the following components: data movement, work flow scheduling and fault management. The resources are provided to the different task as per the scheduling. The data movement manages the data transfers between the source (Control centre) and destination (machines). Proper scheduling provides a better performance and efficient resource utilization in industrial environment.

C. Closed-Loop Application

With the wireless adhoc networks to collect data, monitoring the environment and control the systems of industries the closed loop application is used. The closed-loop application provides a feedback loop between the source and destination. It is better to suit the needs of centralized industrial automations.

To maintain the control system accurately the data transfer over the industrial environment should be reliable, accurate and timely. Packet loss due to interference, path loss and multipath propagations must be avoided because the attenuation in data transfers over the wireless medium usual. And also there is more security issues on wireless network, there must introduce the encryption and decryption techniques using cryptographic algorithms. Usually password protections are provided to the wireless adhoc networks for authentication and authorization.

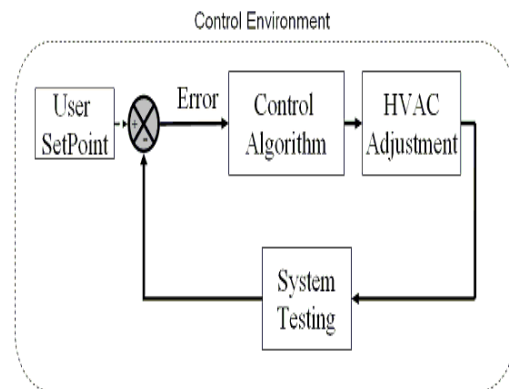


Fig.3 Closed-Loop Wireless Control System

V. SYSTEM MODEL

The workflow scheduled industrial automation system provide better system utilization, less power consumption, easy to install and easy to handle. The combination of workflow scheduling and closed loop application provides an absolute reliable automation environment for the industries. The tasks on the industrial environment to provide a complete product are based as per the predefined schedules. The schedules can be modified by the network experts. The schedules are placed on the workflow database server. This server is connected and runs over a wireless environment of closed loop applications. The pc is connected with the server and act as a Master or Admin. Then the pc connected with the controller and the output of the controller is fed to the Zigbee transceiver.

At the receiver side (The machines are receivers) also have a Zigbee transceiver, it will receive and forward the signal to the microcontroller and the output of the microcontroller is fed to the switching and relying circuit. The switching and relying circuit is used for controlling the machines operations such as ON/OFF. The machines in the

industrial environment are considered as a load. The task of microcontroller is to modifying the signals as per the application.

Based on the scheduling the relay will switch the machines on and off. This method provides a better power consumption and utilization and cost of the industrial maintenance.

Fig.4 Typical System Architecture

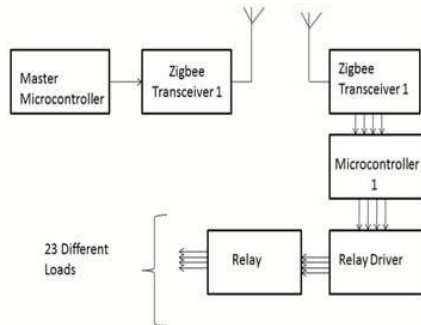
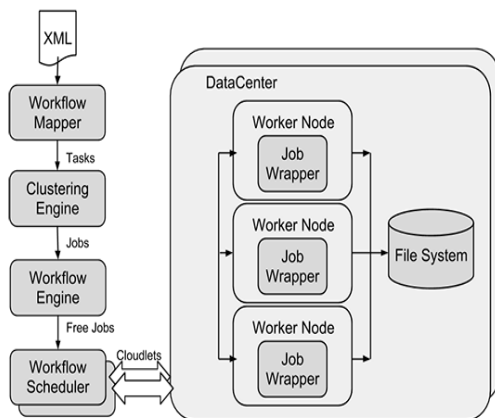


Fig.5 Overall System Architecture



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The processed information of industrial instruments is get back to the data base server by using closed-loop feedback application; it is very useful for benchmarking the working progress of the industry.

VI. CONCLUSIONS

This paper provides a better way to control and manage the tasks performed by the machines on industrial environment. The algorithm used to schedule the tasks of industrial environment is providing a good way of organizing and utilizing the resources in effective manner. The wireless networks are used to reduces the cost of wiring and maintenance, the faults can be identifies easily.

The author believes the wireless ad hoc network plays a vital role in industrial automations. In future there may be a better scheduling algorithm used for the industrial automations.