Chapter 7

System Framework and Protocols for Ubiquitous Computing Based Monitoring of an Oil Platform

Mitun Bhattacharyya
R.V. College of Engineering, India

Ashok Kumar
University of Louisiana at Lafayette, USA

Magdy Bayoumi
University of Louisiana at Lafayette, USA

ABSTRACT

This book chapter proposes a system based on the WirelessHART standard for monitoring and controlling oil platforms using sensor networks. The authors propose a hierarchical distributed system where sensor nodes and process components are grouped both functionally and in terms of proximity (i.e., spatially). They harness the existing electrical powering supplies to some of the process components to enhance our network routing protocol. They also propose a component based addressing scheme. Then propose a hybrid routing protocol having proactive paths for high priority data and reactive paths for low priority that can help in load balancing and thus improving the lifetime of the sensor network. Finally, the authors discuss about methodologies for assessing the health (residual energy) of the sensor network system. Related research is discussed at appropriate points.

INTRODUCTION

Presently many cross-disciplinary areas are being explored for application of Wireless Sensor Network (WSN). In this book chapter we explore the area of using WSN for a control system of an oil production platform. It has been suggested that in the near future sensor nodes will be used to measure the flow of petrol consumption at stations. This measured consumption amount along with other economic inputs, will be given to a decision-making system. The system will decide, depending on requirements
in real time, the amount of oil to be produced. The control system will automatically control all parameters to regulate the oil production flow with maximum provisions in place for worker’s safety. Part of this system already exists in the literature (IBM WebSphere).

A key motivation for designing such control system is human safety. From the safety procedure report in (Luther), it is seen that 78% of all injuries come from unsafe acts. The safety procedure report also suggests ways of controlling hazards through the means of removing workers from regions of potential danger; detecting and monitoring new hazards and controlling them automatically; and through isolation of source, lockout procedure, design, process or procedural changes, monitoring and warning equipment. These requirements open up a huge potential where the sensor networks could be employed. In addition WSN could be used to enhance the setup of existing control system infrastructures.

Figure 1 gives a picture of a model of an oil production platform. As seen from the figure, there are several processes that take place. In several industrial environments the interrelation between processes are designed in several tiers, in terms of placement and functionality. The control station has the final display but there is a complex distributed hierarchical control system in the background that monitors and performs all the controlling actions. According to (Dalbro et al, 2008), oil and gas sensor networks need to be heterogeneous in nature. Heterogeneity arises due to the following factors – different data formats, semantics, communication media (both wireless and wired) and different priorities for different data. In addition, distributed data fusion and decision-making mechanisms may be employed that treat all components, instrumentation sensors and wireless sensor network components, as one coordinated system.

OVERVIEW OF PROPOSED SYSTEM SETUP AND EXISTING STANDARDS

Literature Survey

This section gives summaries of works done in the area of oil production platform. The work in (Meijuan, Jin & Jingwen, 2008) proposed a system of remote monitoring of a pumping unit using wireless sensor networks. In a pump station, the following parameters were monitored: three-phase power, flow rate and temperature. Data collection was done periodically or in response to a query given by the control station. In addition to monitoring, the Micro Controller Unit (MCU) also
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