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Industrial Communication based on Modbus and NodeRED

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Abstract

Over the next few years, the Industrial Wireless Sensor Network (IWSN), which is a major part of the Industrial Object Internet (IIoT), will play a crucial role in transforming the industrial world by opening a new era of economic and competitive growth in the Industrial Revolution known as Industry 4.0. IIoT is able to help organizations achieve better benefits in industrial manufacturing markets by increasing productivity, reducing costs and developing new services and products. In this paper we present a wireless industrial communication system based on NodeRED platform using Modbus protocol for smart factories.

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Keywords: industrial communication, Industry 4.0, NodeRED, MODBUS, IIOT, MQTT.

1. Introduction

In 1980, the 3rd Industrial Revolution was the cause of a huge evolution of the industrial world. This evolution has been accompanied by network complexity that exceeds the reliability and strength of automation systems. Thus, the need to find a more comprehensive means of information exchange, which can ensure interconnection on a wider and more refined scale2,4,5. Today, with the new technology, the gateway to the 4th Industrial Revolution, known as Industry 4.0, makes it possible to add intelligence to industrial systems based on interconnected physical or virtual objects, capable of communicating and transmitting information in a lesscomplex way. This, with less error, based on two main strategies, the Internet of Things (The Internet Of Things, IoT) and Cyber Physical Systems (CPS) 3,7.

Industrial wireless sensor networks (IWSN) have several advantages, including reducing the cost of deploying and building a controlled workspace. By installing IWSNs on workstations and attaching labels to current products, information about production operations can be collected efficiently and flexibly, and cyberphysical decisions can be made instantly with great accuracy1,2,4.

To make manufacturing operations more agile, more flexible, more responsive to customer needs and to promote competitive advantages, industrial companies intend to rely on the fourth industrial revolution for more automation and flexibility. With industry 4.0, it is now possible to create an intelligent factory where wireless sensors and many other advanced technologies are used. These tools enable the company to react more quickly to market changes and thus optimize production and improve customer satisfaction4,7,9.

With this paper we are particularly interested in the application of the Internet of things in the industrial field especially for smart factories wireless communication. We aim to replace all the heavy wiring in the factories with an intelligent and agile system based on smart things and smart communication for control and monitoring. We present in this paper an industrial communication based on NodeRED Framework using Modbus protocol and MQTT protocol.

This article is organized as follow: in section 2 we present a stateofart of industry 4.0. , the strategy of cyper physical system in industry will be presented in section 3. In section 4, we present the main objective of IoT in industrial application. Implementation with NodeRED and all discussion will be presented in section4. Finally, conclusion and perspectives.

2. Industry 4.0

In the context of industry 4.0 and intelligent manufacturing, it is essential to support factory automation as well as flexibility in industrial environments that are considered difficult environments for wireless communication due to high noise, physical barriers, multipath and interference from coexisting wireless devices1,3,6. The industry 4.0 concept designates the use of digital technologies and consists of building a controlled workspace using a largescale deployment of wireless sensors. Introducing digital technologies into a manufacturing company requires building a digital factory to create digital products and provide a digital customer experience.

The strength of Industry 4.0 lies in the integration of human, machine and systems at the same time. It is not yet clear how future developments will actually progress; the results of research in this direction still cannot tell when the era of automation will end.

Today, it is the largest projects that drive the debate on industry 4.0, its future projections and the different long term visions. According to the researchers, we will have to wait at least ten years to see the deployment of this revolutions technologies. The journey from the era of automation to the era of industry 4.0 is not so obvious, training needs to be put in place, new standards, costly installations and high investment requirements, basically a new ground with new ground rules. Overall, it can also be assumed that the individual elements of industry 4.0 will

be carried out on a larger scale in subsequent stages. Automated systems will continue to play a central role in production control over the next five years. However, they will have to meet additional requirements such as providing data for new business models and exchanging information online with other operational systems. The merging of virtual and physical worlds with cyberphysical systems and the resulting fusion of technical and business processes paves the way for a new industrial era better defined by the concept of the intelligent factory4,5.

3. CyberPhysical Systems in Industry 4.0

Industrial sectors, the automotive industry, energy saving and, in particular, production technology will be transformed by new value chain models. Globalization, urbanization, demographic change and energy transformation are the transformative forces that stimulate the technological impulse to identify solutions for a world in flux. In the future, industry 4.0 will make contributions to human safety, efficiency, comfort and health in a way that is not imagined before. In doing so, they will play an important role in tackling the fundamental challenges posed by demographic change, scarcity of natural resources, sustainable mobility and energy change1,3,7.

The deployment of cyberphysical systems in production systems gives birth to the intelligent factory (Fig.2.). Intelligent plant products, resources and processes are characterized by cyberphysical systems. Offering significant realtime benefits in terms of quality, time, resources and costs compared to conventional production systems. The Smart Factory is designed according to sustainable, serviceoriented business practices. These insist on adaptability, flexibility, selfadaptability and learning characteristics, fault tolerance and risk management, which shows that the application of the Industry 4.0 concept necessarily implies optimizing the cost and time of production, and thus a large margin of gain that could contribute to industrial development.

4. Industrial Internet of Thing

The Internet of Things (IoT) is a system of interdependent computer peripherals, machines, sensors, objects, animals or people with unique identifiers that can transmit and receive data over a network, without human intervention or computer interaction. It is the network interconnection of objects equipped with ubiquitous intelligence that has evolved from the convergence of wireless technologies, microelectromechanical systems (MEMS), microservices and the Internet. It also analyzed the data generated by unstructured machines to provide information2,4,6.

Practical applications of IoT technology are now found in many industries, including agriculture, chemicals, pharmaceuticals and petroleum, health, energy and transportation. The Industrial Internet of Things (IoT), which is the industrial application of IoT in industry, opens huge opportunities for a large number of new applications that promise to improve productivity in factories, and ensure a better allocation of resources. This revolutionary

technology is attracting increasing attention from researchers and practitioners around the world. The set of protocols in the Internet of Things represents a language common to all connected systems, whatever their brand, operating system or software tools used. Table 1 shows the famous technologies used for IoT

Industry 4.0 draws the intention on an application scenario that consists in building or forming a network of plants distributed geographically by using a flexible adaptation of the production and resource sharing capacities that ensures a wide and secure communication. In this session we are developing our distributed architecture of industrial systems based on NodeRed and Modbus.

The implementation of industry 4.0 requires the adaptation of new methodologies and technologies. The industrial ecosystem is limited to installations wired between all sensors and actuators, based on a set of industrial protocols: Modbus, profibus, valve and others. In our architecture, we opted for the Modbus protocol. This is a dialogue protocol based on a hierarchical structure between a master and several slaves, as shown in the figure 3.