DESIGN & IMPLEMENTATION OF IOT PIPELINE MONITORING SYSTEM

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

INVESTIGATION AND IMPLEMENTATION OF IOT BASED OIL & GAS PIPELINE MONITORING SYSTEM

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DEDICATION

Special dedication to my lovely parents, Zurkanain bin Malik and Kamariah binti Mahon, my siblings, my kind-hearted supervisor Dr. Zul Atfyi Fauzan bin Mohammed Napiah, all lectures in Faculty of Electronic and Computer Engineering and to my dearest friend.

ABSTRACT

Wireless Sensor Networks (WSNs) engage primary potential technology in an effort to completely change the way of human working and living. Many industrial, scientific, and environmental applications require real time data associated with physical events like, temperature, humidity and pressure. Within the past, the only way to transmit the sensed data to monitoring was through bulky and expensive wires. however recent advancement in wireless networking allows WSNs to communicate the sensed real time event data wirelessly. However recent improvement in wireless networking allows WSNs to communicate the sensed real time event data wirelessly. WSNs have competencies of communicating, processing and sensing which lead them to most suitable for monitoring different on and gas industries midstream, downstream and upstream operations which help to boost up production, decrease the accidents, maintenance price and malfunctioning.

ABSTRAK

Rangkaian Sensor Tanpa Wayar Abstrak (WSN) melibatkan teknologi berpotensi tinggi yang secara dramatik akan mengubah cara hidup manusia dan bekerja. Terdapat banyak aplikasi saintifik, perindustrian dan alam sekitar memerlukan maklumat masa sebenar yang berkaitan dengan peristiwa fizikal seperti tekanan, suhu atau kelembapan. Pada masa lalu, satu-satunya cara untuk memindahkan data yang dikesan untuk mengawal pusat adalah melalui kabel yang rumit dan mahal. Tetapi kemajuan dalam rangkaian tanpa wayar pada masa kini membolehkan WSNs untuk menyampaikan data yang dikesan pada satu masa tanpa wayar. WSN mempunyai keupayaan untuk mengesan, memproses dan berkomunikasi yang menjadikannya paling sesuai untuk memantau keadaan industri gas operasi industri hulu, pertengahan dan hiliran yang berbeza dan membantu meningkatkan pengeluaran, mengurangkan kemalangan, kos penyelenggaraan dan ke-tidak fungsian.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS AND ABBREVIATIONS

DC	:	Direct Current
AC	:	Alternating Current
IoT	:	Internet of Things
WSN	:	Wireless Sensor Network
Wi-Fi	:	Wireless Fidelity
OCC	:	Office of the Comptroller of the Currency
PVC	;	Polyvinyl Chloride
GPRS	:	General Packet Radio Service
SCADA	:	Supervisory Control and Data Acquisition
VSM	:	Virtual System Modelling
H2	:	Hydrogen
LPG	:	Liquid Petroleum Gas
CH4	:	Methane
CO	:	Carbon monoxide
LED	:	Light Emitting Diode
MQ-2	:	Gas Sensor
DHT11	:	Temperature & Humidity sensor
KY-026	:	Flame Sensor
ESP 8266	:	Wi-Fi module

IOX : Ionospheric Occultation Experiment (remote sensing satellite package)

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

This chapter, the overall requirement that needed in the implementing on this project will be explain briefly. It will include overview, objectives, problem statement, scope of work, and how this project will be done.

1.1 Project Overview

Wireless Sensor network (WSN) is a set of restricted resource constrained sensor nodes that are able of communicating, computing and sensing the events of interest. WSNs are among the technology that will completely exchange the world and the way of human working and living with their advanced architecture and extensive style of daily life applications [1-5]. Certainly, modem industry is turning into an increasing number of depending on the need for real-time seamless transmit and manipulation of data for brief collection-making procedure. Safety, strict regulatory, cost reduction and

security are driving businesses in a large variety of industrial fields to be very aware and extraordinarily cautious of these issues and measures.

Oil and gas indusial operations hold a lifecycle of processes which can be classified into three main sectors/subdivisions; downstream (refining and marketing), midstream (garage and transportation), and upstream (exploration and manufacturing). For upstream sector the raw materials are extracted and inspected. Inside the midstream area the produced oil and gas is stored and transferred to the downstream area for refining techniques. This area is subjected for distributing, refining and retail of petroleum products. Due to the fact almost all the assets within the oil and gas industries are difficult to reach and reside in remote locations, the processes and equipment involved in these three areas need to be perfectly controlled and monitored remotely and constantly. A high level of attention, resources, significant travel and cost are required to hold production and manage of oil and gas property.

Wired technology in oil and gas industries has been widely used for monitoring purposes. However, these wired technologies are costly and their maintenance and deployment is hard to handle in harsh environment like Oil and gas [6]. Furthermore, in massive plants when cabling is used for interconnecting machines to control and monitor processes, it lacks flexibility and turns into impractical because of the growing fluctuations of wiring costs to excessive values [7].

The progression in wireless technology continues to develop, as a result eliminating the need for cables that in the long run allows to have cost efficient network deployments. Even it is documented that wirelessly connected property are up to IOX

less costly than wired options [8]. As a result, to remotely monitor pipelines, equipment condition, real-time reservoir, natural gas 1eaks, and corrosion status [9], the Oil and gas industry is seemingly looking in the direction of WSN technology.

1.2 Objective

This Project is carried out on the following objectives: -

1. To developed early warning system by adopting IoT technology for monitoring purpose.
2. To develop the complete system of IoT-based pipeline monitoring system.
3. To analyze the performances of various sensor for monitoring purpose.

1.3 Problem Statement

Wired technology in oil and gas industries has been widely used for monitoring purposes. However, these wired technologies are costly and their maintenance and deployment is hard to handle in harsh environment like Oil and gas [6]. Furthermore, in massive plants when cabling is used for interconnecting machines to control and monitor processes, it lacks flexibility and turns into impractical because of the growing fluctuations of wiring costs to excessive values [7].

Many ageing Oil and gas pipelines be afflicted by numerous defects including cracks, corrosion, and many others and might cause failure of pipeline then eventually this can damage to human health and interruption of oil and gas supplies. As an instance, on March 2, 2006, a spill of approximately 1 million liters of oil at around five days inside the area known Alaska's North Slope due to a quarter inch a hole corroded in a pipeline. This situation indicates the significance of the problem in a fast

and ageing decaying pipeline system. Nowadays, sensor network technologies are used to look into pipeline system. As an instance, within the applications of natural gas pipeline inspection and monitoring via acoustic sensors [10-12].

Moreover, environmental regulations are regularly changing and turning into stricter each day. In 2008, The office of the Comptroller of the currency (OCC) authorized a set of rules at the management of surface waste from oil and gas operations that force organizations to haul tremendously infected soil and water to permanent disposal sites instead of spreading it back over the land after closing a well. The OCC also authorized stricter fine to reinforce industry compliance with environmental standards [13]. Oil and gas companies need to expand new methods to abide by new regulations and, emissions without impacting production and cut down accidents. Through the evolution of wireless communications and digital technology, wireless sensor networks can be rapidly prepared and constantly tailored to monitor and control environmental conditions and machinery in response to business drivers and requirements.

1.4 Scope of Project

For this project, it can be divide into two parts, the first is the software part and second is the hardware part. Firstly, Proteus ISIS 7 professional is a VSM (Virtual System Modelling) that combines circuit simulation, animated components and microprocessor models to co-simulate the complete microcontroller-based designs. This is the perfect tool for engineers to test their microcontroller designs before constructing a hardware in real time.

For hardware part, the section that responsible with the designing and constructing the circuit and does troubleshooting to the circuit. This project used an Arduino Uno which is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. A sensor is a device which detect motions or measure physical properties or respond to it. Arduino UNO will connect to flame, gas, temperature and humidity sensor. If there is any interruption or abnormal behavior at the pipeline, the sensor will detect and tower will light up. All the data will send to the cloud for monitoring purposes. This plan permits users to interact with the design using on-screen on mobile and web-based application.