INDUSTRIAL MONITORING VIA TEXT MESSAGING WITH EMBEDDED PROGRAMMING

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Dedicated to my beloved family

To my father and mother

To my respected lecturer/supervisor

And to all my coursemates

For their support, advice, patience and understanding.

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ABSTRACT

This project will present the use of Embedded Programming in embedded language to perform industrial monitoring works remotely via text messaging service. Conventional industrial monitoring systems are tedious, inefficient and the at times integrity of the data is unreliable. The objective of this system is to monitor industrial processes specifically the fluid level which will measures the instantaneous fluid level parameter and respond by text messaging the exact value of the parameter to the user when being enquired by a privileged access user. In order to achieve the objective of this project, embedded programming is used to program the Nokia12i module device to perform arithmetic calculations and also to integrate it to establish a Global System for Mobile Communication (GSM) connection with the telecommunication network provider. This system ensures data integrity and efficiency of monitoring industrial processes in a more direct manner. This project will begin with a general introduction the project including the problem statements and objectives then moving on to the understanding of embedded java programming and text messaging as well as the principles of distances measuring using ultrasonic sensor. The development of the embedded program code and the circuit for fluid level measuring will be discussed as well. Finally, suggestions for future implementations and efficient remote monitoring works will be included.

ABSTRAK

Projek ini akan menjelaskan kegunaan Pengaturcaraan Terbenam untuk melakukan pemantauan proses industri secara kawalan jauh menerusi hantaran mesej teks dari telefon bimbit. Sistem pemantauan industri konvensional adalah membebankan, tidak cekap dan kadang-kadang integriti data tidak boleh dipercayai. Tujuan sistem ini adalah untuk memantau proses industri khususnya tahap cecair yang akan mengukur tahap cecair dalam parameter dan membalas dengan tepat nilai parameter tersebut dengan mesej teks bagi pengguna yang berhak. Untuk mencapai matlamat projek ini, pengaturcaraan terbenam adalah program yang digunakan untuk modul Nokia12i peranti untuk melakukan operasi kiraan dan juga untuk menyepadukan dengan sambungan Sistem Global untuk Komunikasi mudah alih (GSM) dengan rangkaian telekomunikasi yang sedia ada. Sistem ini menjamin integriti data dan kecekapan proses industri pemantauan secara langsung. Laporan ini akan bermula dengan pengenalan umum projek termasuk pernyataan masalah dan objektif dan juga pemahaman tentang pegaturcaraan terbenam dan teks mesej serta prinsip pengukuran jarak dengan menggunakan sensor ultrasonik. Di samping itu, kod program dalam pegaturaan terbenam dan litar skema untuk mengukur tahap bendalir akan termasuk dalam bab juga. Akhirnya, cadangan untuk implementasi masa depan dan pemantauan secara kawalan jauh akan disertakan.

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LIST OF ABBREVIATION

API	-	Application Programming Interface
CHAP	-	Challenge Handshake Authentication Protocol
CORBA	-	Common Object Request Broker Architecture
EDGE	-	Enhanced Data Rate for GSM Evolution
ET	-	Embedded Terminal
GPRS	-	General Packet Radio Services
GPS	-	Global Positioning System
GSM	-	Global System for Mobile Communication
HSCSD	-	High Speed Circuit-switched Data
ORB	-	Object Request Broker
SMS	-	Short Messaging Services
TCP/IP	-	Transmission Control Protocol/Internet Protocol
UDP/IP	-	User Datagram Protocol/Internet Protocol

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CHAPTER I

INTRODUCTION

1.0 Introduction

During the past decade, the world has seen the paradigm shift into mobile computing and communications. Much of the business and educational work is now heavily relying on the fast access to information and easy communication channels, irrespective of terrain and climate conditions. Remote Industrial Automation is the proof-of-concept for controlling electronic devices based on wireless messaging. Using the existing system, it is possible to monitor industrial processes remotely. Moreover, it can offer other services such as image scanning and status updates. All these features can be accessed via hand-held devices that are used for attending and making calls.

Having that said, text messaging has come a long way and adapted into a more powerful form of professional applications. In our case, remote monitoring. Messages can transport information about the state of remote devices. For instance, system administrators can be notified by a short message that a server is running low of resources or that a fault has been detected on a remote computer [1].

This project uses embedded JAVA programming to program a GSM module that will measure and monitor fluid levels in an industrial process. A user is able to interact or query the current status of the monitoring parameters via text messaging

and the module will respond with the current status of the monitored sensor. In this remote monitoring application, the embedded GSM module is programmed to constantly monitors the parameters of the system and is able to perform calculations to measure the analog state of the parameter and respond in text format understood by the user and at the same time also functions as an alert monitor and will send out a notification to a pre-programmed user's phone number whenever a fault has occurred.

1.1 Problem Statement

Monitoring on industrial waste water discharge had been implemented across the country since decades but is usually confine to site. Monitoring and controlling industrial process maybe a tedious task where a person must be employed on site in order to monitor an industrial process which is a waste of money and time should there be no problem on site. Environmental Quality Act, 1974 and the Environmental Quality (Sewage and Industrial Effluents) Regulations, 1979 [3], requires all industries with known point source of waste water discharge to install, monitor and report flow measurement of wastewater discharges from an industrial outlet.

Such method of monitoring is a time-consuming task, inefficient, subjected to fraudulence and centralize monitoring is almost impossible at times due to the site locality and limited resources of personnel present. Higher officials are unable to acquire first hand data but rather have to go through numerous unreliable intermediate channels.

1.2 Objective of Project

The project was to designed and implemented with the purpose of industrial monitoring via text messaging with embedded programming. Thus the objectives as follows should be achieved.

(a) To design and develop an industrial monitoring system with embedded programming using JAVA.

(b) To be able to use JAVA to program the GSM module to convert analog voltage into parameter values.

(c) To enable users to interact or query the GSM module through text messaging to query the current status of the monitored parameter.

(d) To enable the GSM module to be programmed to automatically send out an alerting text message whenever a power failure or the monitored parameter is at fault.

(e) To design a fluid level measuring detector circuit that produces an analog voltage in reference to the fluid level.

1.3 Scope of Project

The scope of work for this project in order to fulfill the objectives is as follows:

(a) Programming in embedded JAVA language.

(b) Using the Nokia 12 Configurator to simulate the programmed program code.

(c) Using the Sun Java Wireless Toolkit 2.5.2 as the compiler for the JAVA program.

(d) Computing measured analog voltage of the monitored parameter into values.

(e) Constructing a fluid level monitoring circuit.

1.4 Report Outline

This report consists of four chapters. The report begins with a general introductory for the project including problem statement, objective and scope of the project.

Chapter two will be the literature review where the concept and theoretical aspects are mentioned such as the understandings of embedded systems, the

versatility of the JAVA language in Embedded JAVA evolution and advancements of text messaging, better known as SMS (Short Messaging Services) as well as the specifications of the Teltonika T-BoxN12R which uses the Nokia 12i GSM Module. The principle of ultrasonic sensor for distance measuring would also be mentioned in this chapter as well.

Chapter three introduces the methodology for this project which involves programming source codes for sending and receiving text messages as well as the various programming syntax alternatives available for Module or API JAVA programming works. It also includes the schematics to be fabricated for an ultrasonic sensor used to measure the depth of the fluid being monitored.

Chapter four includes the results of the software works of this project through Embedded JAVA programming with available APIs in the Teltonika T-Box N12R to send and receive text messages.

Chapter five will be the conclusion for this project and future works that can be implemented with the Teltonika T-Box N12R device for improved remote monitoring works.

CHAPTER II

LITERATURE REVIEW

2.0 Introduction

This chapter will describe the current trend of embedded system applications in the current market and its gradual popularity in terms of its architecture, and computing capabilities including JAVA and its demanding role in embedded systems with embedded JAVA. Also, the advent of short messaging service (SMS) and the role it plays in this system will be mentioned as well as a brief introductory explanation about the features of the Nokia12i and the Teltonika T-Box N12R.

2.1 Embedded Systems

In November 2005, Andrew David Moss [7] developed a program transformation tools in the analysis and compilation of programs for embedded systems to aid the programmer in understanding and controlling the effects towards software precision and timing and therefore reduces the complexity of the problem.

With the advent of system level integration (SLI)—the next level of integration beyond Very Large System Integration (VLSI)—and system-on-chip (SOC) capabilities, the computer industry's focus is shifting from personal to embedded computing. The opportunities, needs, and constraints of this emerging

trend will lead to significantly different computer architectures at both the system and processor levels as well as a rich diversity of off-the-shelf (OTS) and custom designs.

2.1.1 Embedded Computing

Driven by the accelerated pace of semiconductor integration during the past three decades, the computer industry has steadily moved from mainframes and minicomputers to workstations and PCs. In accordance with a corollary of Moore's law, computing power becomes half as expensive every 18 to 24 months. Over a decade, this reduces the cost by a factor of 30 to 100, making computing affordable to an exponentially larger number of users and dramatically changing the key applications of this computing power. [12] Manufacturers have for several years incorporated embedded computers in so-called smart products such as video games, DVD players, televisions, printers, scanners, cellular phones, and robotic vacuum cleaners. Using embedded computers in devices that previously relied on analog circuitry such as digital cameras, digital camcorders, digital personal recorders, Internet radios, and Internet telephones provides revolutionary performance and functionality that analog designs could not achieve. Any computer architecture must balance the latest technological opportunities with product, market, and application requirements that together determine three important features of embedded computing architecture: specialization, customization, and automation. Specialization increases the performance and reduces the manufacturing cost of embedded computer systems. Customization permits specialization when no adequately specialized OTS product is available. Automation reduces the design costs incurred by customization.

2.1.2 Embedded Architecture

The architecture of an embedded system is fairly significant and favourable in resolving challenges faced when dealing with new systems.

The most common of these challenges include:

a) defining and capturing the design of a system
b) cost limitations
c) determining a system's integrity, such as reliability and safety
d) working within the confines of available elemental functionality(i.e., processing power, memory, battery life, etc.)
e) marketability and sellability
f) deterministic requirements

In short, embedded systems architecture can be used to resolve these challenges early in a project. Without defining or knowing any of the internal implementation details, the architecture of an embedded device can be the first tool to be analyzed and used as a high-level blueprint defining the infrastructure of a design, possible design options, and design constraints. What makes the architectural approach so powerful is its ability to informally and quickly communicate a design to a variety of people with or without technical backgrounds, even acting as a foundation in planning the project or actually designing a device. Because it clearly outlines the requirements of the system, an architecture can act as a solid basis for analyzing and testing the quality of a device and its performance under various circumstances. Furthermore, if understood, created, and leveraged correctly, an architecture can be used to accurately estimate and reduce costs through its demonstration of the risks involved in implementing the various elements, allowing for the mitigation of these risks. Finally, the various structures of an architecture can then be leveraged for designing future products with similar characteristics, thus allowing design knowledge to be reused, and leading to a decrease of future design and development costs. [2]