WIRELESS VALVE CONTROL VIA RF REMOTE TERMINATION UNIT (RTU)

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This report in partial fulfilment of the requirements for the award of Bachelor of Electronic Engineering (Industrial Electronic) With Honours

Faculty of Electronic and Computer Engineering

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To my family and friends especially my Father and Mother

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ABSTRACT

This project describes an investigation of the use of Radio Frequency (RF) as the medium in control data communication between plant equipment include Valve as the final control element and sensor as the input device. The main purpose is to investigate the appropriate of the Radio Frequency to be the control data communication medium of Remote Termination Unit (RTU). The RTU is used to convert all the data into signal transmission form. The commonly RTU used the Fiber Optic and Ethernet cable as the transmission medium. In this project the Radio frequency (RF) is used as the transmission medium. Rather the fiber optic is the much better than RF, this project try to reduce the cost and reduce the problem within RF medium. This project is design for the hazardous plant. Therefore, control panel will build out of the plant area. All the automation control, such as the PLC will place in plant area include the instrument sensor, plant equipment and termination device (Valve). Moreover the input and output assemble in auxiliary room. The control panel only receives and transmits command data to auxiliary room. Even though the valve and process plant working automatically, all the operations are important to monitor. The process and operation are monitoring by the operator. Human Machine Interface (HMI) was used by design the graphical interface that represents the operation. Furthermore by the HMI the operation of the process also can be controlled manually especially to shutdown the operation, to bypass the interlocking, forcing the valve and so on. From the HMI, the operator also can know the alarm status and acknowledge it.The final result the valve as the controlled element can remotely and the plant status can controlled by the RF communication medium.

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ABSTRAK

Projek ini melibatkan satu kajian penggunaan Radio Frequency (RF) sebagai midium dalam komunikasi data kawalan antara peralatan loji termasuk injap sebagai unsur kawalan akhir dan penderia sebagai peranti input. Tujuan utama ialah untuk menyiasat kesesuaian Radio Frequency menjadi komunikasi data kawalan sederhana Remote Termination Unit (RTU). RTU digunakan untuk menukar semua data ke dalam bentuk isyarat transmisi. Kebiasaanya RTU menggunakan gentian optik dan kabel Eternet sebagai perantara transmisi. Dalam projek ini frekuensi Radio (RF) digunakan sebagai perantara transmisi. Diketahui bahawa gentian optik ialah pilihan yang lebih baik daripada RF, projek ini cuba kurangkan kos dan mengurangkan masalah dalam pengunaan RF. Projek ini direka untuk kawasan berisiko tinggi. Lantarannya, panel kawalan dibina luar daripada kawasan loji. Semua kawalan automasi, seperti PLC akan ditempatkan dalam kawasan loji termasuk alat penderia, peranti peralatan loji dan injap. Sehubungan dengan itu pula masukan dan keluaran ditempatkan dalam bilik tambahan. Panel kawalan hanya menerima dan menghantar data arahan ke bilik tambahan. Walaupun injap dan proses loji bekerja secara automatik, semua operasi penting untuk dipantau. Proses dan operasi adalah mengawasi oleh pengendali. *Human Machine Interface* (HMI) digunakan oleh dalam reka bentuk antara muka bergambar yang mewakili operasi. Selain itu HMI membolehkan operasi proses boleh dikawal secara manual terutama kepada penutupan operasi, melangkau saling mengunci, memaksa injap dan sebagainya. Dari HMI, pengendali juga dapat mengetahui status penggera dan megambil tindakan sewajarnya. Pada akhir kajian ini Injap sebagai unsur terkawal boleh dan status loji boleh dikawal secara jauh oleh medium komunikasi RF.

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LIST OF ABBREVIATION

BJT	-	Bipolar Junction Transistor
HMI	-	Human Machine Interface
I/O	-	Input/output
LED	-	Light Emitting Diode
PCB	-	Printed Circuit Board
PLC	-	Programmable Logic Controller.
RF	-	Radio Frequency
RTD	-	Resistance Thermal Detector
RTU	-	Remote Termination Unit
RX	-	Receiver
TX	-	Transmitter
WRTU	-	Wireless Remote Termination Unit

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CHAPTER I

INTRODUCTION

1.1 Project Introduction

Valve is a device that regulates the flow of a fluid (gases, liquids, fluidized solids, or slurries) by opening, closing, or partially obstructing various passageways. The traditional valve is manually controlled by hand. In industry now day and also in this project the valve controlled automatically by the microprocessor or microcontroller. The controller collects the input data from the sensor of process parameter to compute and give the output to termination output especially valve. The actuator was used to control the valve regulation. The electrical signal in current and voltage that getting from microcontroller or PLC outputs need to convert mechanical motion. The solenoid valve for digital output and current to pneumatic converter for analog output signal are used for signal conversion. [1]

Even though the valve and process plant working automatically, all the operations are important to monitor. The Human Machine Interface (HMI) was used for represents graphical interface of the operation. Furthermore by the HMI the operation of the process also can be controlled manually especially to shutdown the operation, to bypass the interlocking, forcing the valve and so on.

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This project is design for the hazardous plant. Therefore, control panel will build out of the plant area. All the automation control, such as the PLC will place in plant area include the instrument sensor, plant equipment and termination device (valve).moreover the input and output assemble in auxiliary room. The control panel only receives and transmits command data to auxiliary room.

To communicate between control panel and auxiliary room, the Remote Transmission Unit (RTU) is used. The RTU is used to convert all the data into signal transmission form. The commonly RTU used the Fiber Optic as the transmission medium. In this project the Radio frequency (RF) is used as the transmission medium. Rather the fiber optic is the much better than RF, this project try to reduce the cost and reduce the problem within RF medium.

1.2 Project Objectives

To produce the wireless data transmission via RF Remote Transmission Unit (RTU) between Valve at site and Human Mechine Interface (HMI) at control panel, which it can reduce the installation and maintenence cost. In addition it also can siplify the data transmission medium system.

1.3 Problem Statement

By current RTU in industies,that were used the ethernet cable with modbus Module for short distance and fiber optic for long distance of data transmission medium. This project is concernt to the long distance communication.

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For ethernet networking it just for indoor and short distance linking only. It not purpose to the other.

For long distace, the fiber optic may be used. To setup the fiber optic need the big budject and cost. Fur themore for maintenance, preventive and reactivation maintenance also need the much cost budget.

Although, there are a lot of merits in using fiber optic, there are some weakness about it. Some of the examples are.

i. Can lose signal caused by physics and material trouble.
ii. More difficult to be coupled with ordinary conventional cable.
iii. The price which enough expensive in comparison with technological copper cable.
iv. Enough level of investment which needed levying of human resource which expert inside.
v. Level of difficulty of implementation and deployment enough fiber optics are high.
vi. Cumbersome to install, because fibers are damaged if they are bent sharply.

Moreover, the fiber optic cable placed under the ground. It become hardly to find the failure point if the cable breakdown. The changed of environment also will impact to the cable working condition.

1.4 Scope of Work

In this project, the software and hardware will be developed. For hardware, mechanical part such as valve actuator, and other instrument sensor, and also the

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electronic circuit are design and fabricate. The electronic circuits are use as well as, comparator, voltage balanced bride, signal amplifier and so on. In circuit fabrication the circuit designs software use to implement the circuit track and the track will print into the PCB by the PCB fabricating method.

The software development is concert to the PLC programming for hardware operation and the interface programming such as Lab view for the GUI or HMI. The prototypes also design to ensure this project can operate and make this project realistic.

When discussing about control systems, a control element needs to chosen. In this project, two control elements are to be determined. The PLC that will be chosed is the OMRON PLC CJ1G/H. The reason for this choice is that two models are easily found and a lot of document that will help in this project.

The software programming that will be used for the PLC would be the CX-Programmer whereas designs and creation of diagrams are made. The software programming tool for the PIC however is the SourceBoost IDE and the Proteus. SourceBoost IDE will be used to write the programs while

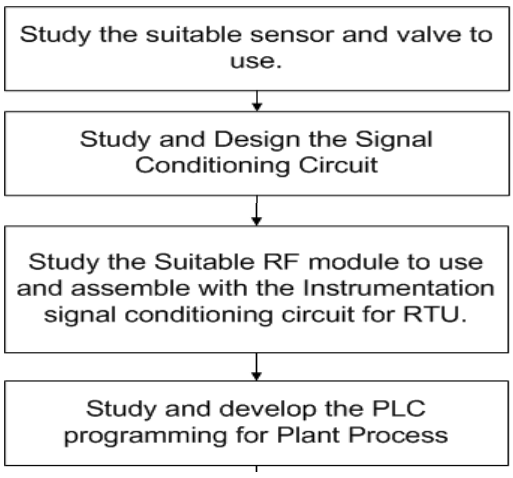

Figure 1.1 project Methodology

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Figure 1.1 was detailed about the flow of the methodology need to proceed. In this project execution the step must be followed one by one.

1.5 Report Structure

This report shall explain the first part of the final year project, which is the research. This report is going to be the reference material in case there is improvement can be done for this project. All contents of this report are useful to bring this project to the next level in fast pace. So it is important that the contents of this report to be thoroughly researched and put into place.

Chapter 1 is introduces the project as a whole. The early and basic explanations are mentioned in this chapter. This chapter consists of the project's objectives, statements of problems, scope of work, and the simplified methodology.

Chapter 2 is literature review. Past projects or researches are taken into consideration when completing this chapter. The ways those projects and researches are done are compared with what this project is all about. These comparisons are done to understand what this project is all about and where it stands.

Chapter 3 is explains how this project came to be. It is the methodology. The ways and procedures in which ensure this project is done. This chapter will enlighten the part most important of all, the flow this project. What is researched and what needs to be done is explained in this chapter.

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Chapter 4 concentrates on the result and discussion of this project. What has been done thus far is explained in diagrams and written programs. Why the results are like so will also be explained. The reasons and setbacks that cause the project to be halted are discussed in this chapter. The expected results will also be mentioned in this chapter.

Chapter 5 is the final chapter in this report. The conclusions and recommendations are placed in this chapter. The conclusion is the final overview of this project. In other words, the conclusion is the summary of what has been done throughout this project.

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