

CANAL IRRIGATION CONTROL SYSTEM IN PADDY FIELD

NUR RAIHANA BINTI SAMSUDIN

This Report Is Submitted In Partial Fulfillment Of The Requirements For The Award Of
Bachelor Of Electronic Engineering (Computer Engineering)
With Honours

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

May 2011



UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : CANAL IRRIGATION CONTROL SYSTEM IN PADDY FIELD

Sesi : 2010/2011

Pengajian

Saya NUR RAIHANA BINTI SAMSUDIN

mengakui membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan () :

SULIT*

(Mengandungi maklumat yang berdarjah kerahsiaan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

TERHAD*

(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan oleh:

(TANDATANGAN PENULIS)

Alamat Tetap: 37, JALAN ORKID PERMAI
TAMAN ORKID PERMAI
13200 KEPALA BATAS
PULAU PINANG


Tarikh : 29th APRIL 2011

(COP DAN TANDATANGAN PENYELIA)

AHMAD NIZAM BIN MOHD FAHMI @ JIBRANI
Penyarah
Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka (UTeM)
Hang Tuah Jaya
76100 Durian Tunggal, Melaka

Tarikh: 29th APRIL 2011


“I hereby declare that this report is the result of my own work except for quotes as cited
in the references”

Signature : 

Author : NUR RAIHANA BINTI SAMSUDIN

Date : 29th APRIL 2011

“I hereby declare that I have read this report and in my opinion this report is sufficient in terms of the scope and quality for the award of Bachelor of Electronic Engineering (Computer Engineering) With Honours.”

Signature : 

Supervisor's Name : AHMAD NIZAM BIN MOHD JAHARI@ JOHARI

Date : 29th APRIL 2011

Special dedicated to my beloved parents Mr Samsudin bin Hamid and Mrs Rabeah binti Nizam Islah, my lovely siblings, my kindly supervisor Mr Ahmad Nizam bin Jahari@Johari and special greeting to the dear friends.....

ACKNOWLEDGEMENT

First of all, I would like to thank God upon his blessing until I will be able to complete this project, my Projek Sarjana Muda. I would like to take this opportunity to express my deepest appreciations and thanks to those who help me in accomplishing my final year project. Without their help, the completion of project will not be possible. I would like to express my sincere thanks to En Ahmad Nizam Bin Jahari@Johari as my supervisor who give support guidance me during my project was carried out. Besides, I would like to thank to all lectures who are involved for their opinion, information and suggestions in my project.

I also would like to thank all the FKEKK staff and technicians who continuously provided lab facilities and equipment for me to develop this project. Special thanks to all my friends who give supports and encouragement they give throughout the development of my thesis. For my beloved parents, thank you so much for giving your support, understanding and patience along my final project until complete successfully.

ABSTRACT

System of irrigation is an important system for paddy. Although system of irrigation for paddy is available nowadays, but it is a manual system, where farmers need to measure the water level in the field and to ensure that the water level is in the correct level. Therefore, this project is designed to improve the existing irrigation system to more modern system; this is one of the objectives of the project. Besides, another objective of this project is irrigation system is controlled by a Programmable Integrated Circuit (PIC), which it can control the water level more consistent and while LCD Display used to display either a condition level of 5cm or 10cm of water on the appointed day. The aim of this project is to provide facilities to the farmers, where they can monitor water levels. This project is more efficient and systematic, where irrigation of water in and drain at paddy field is controlled automatically. The main contribution of this project is application of the PIC in which it is able to control the main controller for the water level in rice fields.

ABSTRAK

Sistem pengairan merupakan sistem yang penting dalam penanaman padi, untuk menjaga kualiti padi. Sistem pengairan sawah padi sedia yang ada, biasanya adalah secara manual. Dimana pesawah perlu mengukur paras air dalam sawah dan perlu memastikan paras air pada paras yang betul. Oleh itu, projek ini direka untuk mempertingkatkan sistem pengairan yang sedia ada kepada sistem yang lebih canggih; ini adalah salah satu objektif projek ini direka. Disamping itu objektif lain bagi projek ini adalah sistem pengairan ini dikawal oleh *Programmable Integrated Circuit (PIC)*, dimana ia boleh mengawal paras air lebih konsisten dan *LCD Display* digunakan untuk memaparkan kedaan paras air sama ada 5cm atau 10cm berdasarkan hari yang telah ditetapkan. Tujuan projek ini adalah untuk memberi kemudahan kepada para petani, di mana mereka dapat memantau paras air dengan lebih tepat. Projek ini lebih cekap dan sistematik, dimana saluran keluar masuk air di sawah dikawal secara automatik. Sumbangan utama dalam projek ini adalah aplikasi PIC di mana ianya merupakan sistem kawalan yang berkemampuan menjadi pengawal utama kepada paras air di dalam sawah padi.

CONTENTS

| CHAPTER | CONTENT | PAGE |
|-----------|---------------------------------|----------|
| | PROJECT TITLE | i |
| | DECLARATION | ii |
| | ACKNOWLEDGEMENT | vi |
| | ABSTRACT | vii |
| | ABSTRAK | viii |
| | CONTENTS | ix |
| | LIST OF TABLES | xiii |
| | LIST OF FIGURES | xiv |
| | LIST OF ABBREVIATION | xvii |
| | LIST OF APPENDIX | xviii |
| I | INTRODUCTION | 1 |
| | 1.1 Introduction of the Project | 1 |
| | 1.2 Objectives | 2 |
| | 1.3 Problem Statement | 2 |
| | 1.4 Scope of Projects | 3 |
| | 1.5 Report Structure | 3 |
| II | LITERATURE REVIEW | 5 |
| | 2.1 Introduction | 5 |

| | | |
|------------|---|-----------|
| 2.2 | Economic Assessment of An Irrigation Canal Automation and Control Project | 5 |
| 2.2.1 | The PLC System | 6 |
| 2.3 | Design of Time Control Irrigation System Based on Single-chip Computer | 7 |
| 2.3.1 | System Design | 7 |
| 2.3.2 | Hardware circuit | 8 |
| 2.4 | Research sturdy by Industry | 10 |
| 2.4.1 | MARDI (Malaysia Agriculture Research and Development Institute) | 10 |
| 2.4.2 | Water Management for Paddy Field | 11 |
| 2.5 | Programmable Integrated Circuit (PIC) | 19 |
| 2.5.1 | Why Choose PIC16F877A | 19 |
| 2.5.1.1 | Pin Diagrams of PIC16F877A | 20 |
| 2.6 | LCD Display | 20 |
| 2.7 | Conclusion | 22 |
| III | METHODOLOGY | 23 |
| 3.1 | Introduction | 23 |
| 3.2 | Project Flow Chart | 23 |
| 3.2.1 | Overall of Methodology | 25 |
| 3.2.2 | Hardware Development | 27 |
| 3.2.3 | Software Development | 29 |
| 3.2.4 | Combining Software and Hardware | 30 |
| 3.3 | Chosen Components | 31 |
| 3.3.1 | Resistor | 31 |
| 3.3.2 | LED | 32 |
| 3.3.3 | PIC16F877A | 32 |
| 3.3.4 | Button | 34 |

| | | |
|-----------|-------------------------------------|-----------|
| 3.3.5 | The 78xx Series of Regulators | 34 |
| 3.3.6 | Transistor | 35 |
| 3.3.7 | Relay | 36 |
| 3.3.8 | Diode | 36 |
| 3.3.9 | Capacitor | 37 |
| 3.3.10 | Transformer | 38 |
| 3.3.11 | ULN | 38 |
| 3.3.12 | Relay JZC-6F | 39 |
| 3.4 | Hardware | 40 |
| 3.4.1 | Design Schematic Circuit | 40 |
| 3.4.2 | Design PCB Layout | 43 |
| 3.5 | Software | 45 |
| 3.5.1 | Declaration pins of PIC for project | 45 |
| IV | PROJECT DESIGN | 47 |
| 4.1 | Introduction | 47 |
| 4.2 | Block Diagram | 47 |
| 4.3 | Process of Project | 51 |
| V | RESULT AND DISCUSSION | 53 |
| 5.1 | Introduction | 53 |
| 5.2 | Result of Project | 53 |
| 5.2.1 | Day 5 until Day 14 | 54 |
| 5.2.2 | Day 15 until Day 80 | 57 |
| 5.2.3 | Day 81 until Day 95 | 59 |
| 5.3 | Discussion | 61 |

| | | |
|-----------|--------------------------------------|------------|
| VI | CONCLUSION AND RECOMMENDATION | 62 |
| | 6.1 Conclusion | 62 |
| | 6.2 Recommendation | 63 |
| | REFFERENCES | 64\ |
| | APPENDIX A | 66 |
| | APPENDIX B | 68 |
| | APPENDIX C | 74 |

LIST OF TABLES

| NO | TITLE | PAGE |
|-----------|--|-------------|
| 3.1 | Declaration Pins Input and Output at PIC | 45 |
| 5.1 | Level of Water Depends on Which Day | 54 |

LIST OF FIGURES

| NO | TITLE | PAGE |
|------|--|------|
| 2.1 | System Structure Drawing | 8 |
| 2.2 | Schematic Plan for Paddy Field | 11 |
| 2.3 | Diagram of Plan for Paddy Field | 11 |
| 2.4 | Irrigation Infrastructure | 12 |
| 2.5 | Saturation Level | 13 |
| 2.6 | Inkle Seed Stage | 14 |
| 2.7 | Vegetative Stage | 15 |
| 2.8 | Birth Tree Stage | 16 |
| 2.9 | Rising levels Rice | 17 |
| 2.10 | Stage Band Full Issue | 17 |
| 2.11 | Filling Stage of Rice | 18 |
| 2.12 | Cook Until the Level of Rice Harvest | 18 |
| 2.13 | Pin Diagram of PIC16F877A | 20 |
| 2.14 | LCD Display | 21 |
| 3.1 | Project Flow Chart | 24 |
| 3.2 | Overall of Methodology | 25 |
| 3.3 | Hardware Flow Chart | 27 |
| 3.4 | Software Flow Chart | 29 |
| 3.5 | Combining Software and Hardware Flow Chart | 30 |
| 3.6 | Resistor | 32 |
| 3.7 | LED | 32 |

| | | |
|------|--|----|
| 3.8 | PIC16F877A | 32 |
| 3.9 | Pin Diagram of PIC | 33 |
| 3.10 | Reset Button | 34 |
| 3.11 | Regulator | 34 |
| 3.12 | Transistor | 35 |
| 3.13 | Relay | 36 |
| 3.14 | Diode | 36 |
| 3.15 | Capacitor | 37 |
| 3.16 | Transformer | 38 |
| 3.17 | Pin Diagram of ULN | 38 |
| 3.18 | ULN | 39 |
| 3.19 | Relay JZC-6F | 39 |
| 3.20 | Power Supply Circuit | 40 |
| 3.21 | Water Level Sensor Circuit | 41 |
| 3.22 | PIC Circuit | 42 |
| 3.23 | Output Circuit | 42 |
| 3.24 | PCB Layout for Water Level Circuit | 43 |
| 3.25 | PCB Layout for PIC Circuit | 44 |
| 4.1 | Block Diagram of Project | 47 |
| 4.2 | Design of Project | 48 |
| 4.3 | Combine All Circuits | 48 |
| 4.4 | Input (Circuit Water Level) | 49 |
| 4.5 | System (Circuit PIC) | 50 |
| 4.6 | Pump In | 50 |
| 4.7 | Pump Out | 51 |
| 4.8 | Process of project | 51 |
| 5.1 | Source code that use to control Condition for Day 5 until Day 14 | 55 |
| 5.2 | LCD Display Show Condition during Low Sensor is Off | 56 |
| 5.3 | LCD Display Show Condition during Low Sensor is On | 56 |
| 5.4 | LCD Display Show Condition during High Sensor is On | 57 |

| | | |
|-----|--|----|
| 5.5 | Source Code that Use to Control Condition for Day 15 until Day 80 | 58 |
| 5.6 | LCD Display Show Condition during High Sensor is Off (Hi = 0 is mean that high sensor is off) | 58 |
| 5.7 | LCD Display Show Condition during High Sensor is On (Hi = 1 is mean that high sensor is on) | 59 |
| 5.8 | Source Code that Use to control Condition for Day 81 until Day 95 | 60 |
| 5.9 | LCD Display Show Condition Day 81 until Day 95 | 61 |

LIST OF ABBREVIATION

| | | |
|---------|---|---|
| PIC | - | Programmable Integrated Circuit |
| LabVIEW | - | Laboratory Virtual Instrumentation Engineering Workbench |
| PCB | - | Printed Circuit Board |
| PSM | - | Projek Sarjana Muda |
| LED | - | Light-Emitting Diode |
| LCD | - | Liquid Cristal Display |
| PLC | - | Programmable Logic Circuit |
| MCU | - | Microcontroller Unit |
| LED | - | Light Emitting Diode |
| MARDI | - | Malaysian Agricultural Research and Development Institute |
| JPS | - | Jabatan Pengairan dan Saliran |
| USB | - | Universal Serial Bus |

LIST OF APPENDIX

| NO | TITLE | PAGE |
|-----------|--|-------------|
| A | Flow Chart of the Project | 66 |
| B | Source Code of the Project | 68 |
| C | Buku Panduan Pengurusan Air untuk Tanaman Padi by Jabatan Pengairan dan Saliran | 74 |

CHAPTER I

INTRODUCTION

1.1 Introduction of The Project

This project is about how a system designed to control the drainage of irrigation water into paddy fields. This system will be controlled by PIC16F877. The PIC controller will control the motor pump in order to maintain the level of water in the field and additional of LCD display is to display the condition of system. While motor pump used in this system is to pump water, it has two conditions it will be work; firstly it will pump water into paddy field and second it will pump out water from paddy field. Specific level of water for paddy field is 5cm and 10cm, so if level of water more than specific level or overload so motor pump for pump out of water will be function. Besides level of water is depends on day that state in '*Buku Panduan Pengurusan Air untuk Tanaman Padi*' by JPS which they state that day 5 until day 14 level of water is 5cm while day 15 until day 80 level of water in paddy field will increase from 5cm to 10cm and day 81 until day 95 water pump will pump out water from paddy field. This system is more systematic and user friendly than conventional system, which should be open to drain off irrigation water to paddy fields. In addition, the system can also improve the quality and quantity of rice.

1.2 Objectives

This project is purposely to study about canal irrigation control system in paddy field. It is because to know how to improve irrigation control system that using in paddy field. The system will used software, so before design this system, must to understand how PIC16F877A program works. While another objective is to design a water level circuit, output circuit, power supply circuit and then combine it together with PIC controller that used in this project.

Objectives of the project are:

- i. To improve the conventional paddy field irrigation system to a modern system.
- ii. To design and develop irrigation control system in paddy field using PIC.

1.3 Problem Statement

Malaysia is a country that has a lot of paddy field fields, but farmers are still using manual systems for the irrigation of crops. As we know, the irrigation system is important to paddy plants in which the nature of the paddy itself which it needs water to alive, where level of water are not too many and too few. Besides, the weather in Malaysia is a factor that caused the destruction of rice crops which are sometimes dry, and sometimes floods, so a good irrigation system is necessary to prevent farmers from losses. Based on current technology nowadays, I propose to develop a system of canal irrigation control system in paddy field by using a PIC to control the water pump and motor function and the LCD display will display current result as my final project.

1.4 Scope of Projects

The scope of this project is to study and research several information that related to the project that will be designed. The project is divided into two parts, namely the software and hardware. Hardware design is about looking for the materials and resources on the right track with the project. The main thing that is emphasized in the hardware design is the ability of the circuit, the price and size. Besides that, it need to ensure that the project will be fully functioning when all the circuits needed are combined together in a design. While in software design is focused on find and review software for the project and can be combined with the hardware. The software that used for this project should be suitable, simple program design, and easy to understand functions.

1.5 Report Structure

This final year project consists of six chapters. First part of this paper discusses the concept of canal irrigation control system in paddy field, the factor that initiates the canal irrigation system to be developed and its objectives.

The second part described literature review of canal irrigation system and background study of the irrigation project.

The third part is covered the methodology of project which design and development of canal irrigation control system in paddy field project.

The fourth part which is Chapter IV is covered design of project and how the project functions according to methodology.

The fifth part which is Chapter V consists of results and applications of canal irrigation control system in paddy field project also include the analysis of project and software.

Finally, the last part is part which concludes the overall development project and how to improve it very well.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

Much research in the irrigation system of previous projects has been reviewed. The purpose of the research is to identify technologies have been used and how to improve the system. The project previously many uses of PLCs (Programmable Logic Circuit) as a controller for controlling the irrigation system. Additionally, the research also conducted in the industry, which is to determine how the rice irrigation system used in Malaysia.

2.2 Economic Assessment Of An Irrigation Canal Automation And Control Project

According to M Abu-El Magad, Eman Kamel, and Khaled Kamel [6]. The automation and remote control system improvements comprise electrically powered motorized gate operators with local control (at each regulator) by a programmable logic controller (PLC) actuated by water level limit transmitters. The PLC units are monitored and controlled from a PC sub-master station located at the irrigation manager's office. A computer Simulation model is available to the manager to enable

evaluation of alternative control scenarios prior to carrying them out. In addition, equipment was provided for remote monitoring of gate openings and water levels at 10 of the most important secondary canal turnouts supplying 40% of the total area irrigated below the head-gates. A more detailed description of the system and the improvements implemented was presented.

2.2.1 The PLC System

Each site is equipped with an Allen-Bradley PLC, which is equipped with an adequate number of Input/Output modules, communication modules, and associated panels. The ladder program was implemented using Allen-Bradley 6200 series software. The program logic implemented a downstream water level control which involved the adjustment of upper and lower gates repeatedly. It also calculated the flow rate through the regulator based on the Irrigation Conveyance Simulation System (ICSS).

System control can be provided in local or remote mode. Remote mode can be active only when the system is placed on the Automatic (AUTO) position. If the switch for any of the motors is placed on manual position, only local control mode is available for such motor/gate. Gates are maintained at approximately equal openings by adequate selection of the next gate to be moved and by constraining the movement to only one gate at a time for a small distance. If a motor fails to start or is put on manual position, it does not get included in the control selection and sequencing.

The user interface, graphics, database and communication are implemented using Allen-Bradley Control View software. Water levels, gate openings, upstream level, downstream level, lock gates position, flow conditions and the flow rate are monitored and continuously displayed for each of the regulators. Also motors and operation switches are displayed. A status page is provided for each site with alarm types and possible cause. Remote entries of set points are also provided. Color codes used