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Automatic fertigation control system using PIC / Syamsul  
Amri Mohamad.


## **AUTOMATIC FERTIGATION CONTROL SYSTEM USING PIC**

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**Bachelor of Mechatronic Engineering**

**2010**

“I hereby declare that I have read through this report entitle “Automatic Fertigation Control System Using PIC” and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Elrctrical Engineering (Mechatronic)”

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Date : 12 May 2010

**AUTOMATIC FERTIGATION CONTROL SYSTEM USING PIC**

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**This report submitted in partial fulfillment of the requirements for the degree of  
Bachelor in Electrical Engineering (Mechatronic)**

**Faculty of Electrical Engineering**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2010**

“I hereby declared that this report is a result of my own work except for the excerpts that  
has been cited clearly in the references.”

Signature :  \_\_\_\_\_  
Name : Syamsul Amri bin Mohamad  
Date : 12 May 2010

*Dedicated to my beloved mother and father, my siblings  
and all my friends for their sacrifice.*

## ACKNOWLEDGEMENT

Assalamualaikum w.b.t

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I am also grateful to all my family members.

Thank you.

## ABSTRACT

Agricultural technology nowadays keep changing, the product not only can be increased with double, but planting method can be simplified and can avoid from pest enemy attack and in labor cost same time could be reduced. Fertigation system is a method of cultivation system that combines fertilization in irrigation systems, this means that fertilization carried out simultaneously with irrigation. Fertigation system using this system because the complete flow of fertilizers to agricultural crops because the medium of planting do not have the nutrients because do not use soil, instead using media cocopeat, rice husk, rootwool and others as a soil substitute. This fertigation system is also using fertilizing method that required by the root zone of trees effectively and without waste. Fertigation system is also a branch of hydroponics. "**Automatic Fertigation Control System Using PIC**" is a project that improved from the original system so that the process becomes more efficient. This project use microcontroller to operate and mixture of fertilizer also automatically done. Whereas current product only use the system timer to operate, and mixture of fertilizers is manually done. This project is doing automatic irrigation according to time, usually between 3 to 6 times a day for 5-10 minutes with the PIC control. The projects that using this fully automated control can be expected to increase the production of agricultural products and hope it can help farmers in the agricultural.

## ABSTRAK

Teknologi pertanian masa kini terus berubah, hasil pengeluaran bukan sahaja dapat ditingkatkan dengan berganda tetapi kaedah penanaman dapat dipermudahkan dan dapat mengelak dari serangan musuh perosak dan dalam masa yang sama kos buruh dapat dikurangkan. Sistem fertigasi adalah satu kaedah penanaman yang menggabungkan sistem pembajaan dalam sistem pengairan, ini bermakna pembajaan dijalankan serentak dengan penyiraman. Sistem fertigasi ini menggunakan sistem pengaliran baja sepenuhnya kerana medium tanaman untuk pertanian jenis ini tidak mempunyai nutrien kerana tidak menggunakan tanah, sebaliknya tanaman jenis ini menggunakan media tanaman seperti cocopeat, sekam padi, rootwool dan lain-lain lagi sebagai menggantikan tanah. Sistem fertigasi ini juga menggunakan kaedah pemberian larutan baja kepada zon akar yang diperlukan oleh pokok secara berkesan dan tanpa pembaziran. Sistem fertigasi juga adalah satu daripada cabang hidroponik. “**Automatic Fertigation Control System Using PIC**” adalah satu projek yang ditambahbaik dari sistem yang asal supaya prosesnya menjadi lebih cekap. Projek ini menggunakan kawalan *microcontroller* untuk beroperasi dan campuran baja juga dilakukan secara automatik. Manakala sistem sebelum ini hanya menggunakan timer biasa untuk beroperasi, dan campuran baja dilakukan secara manual. Projek ini melakukan penyiraman secara automatik mengikut masa iaitu antara 3 hingga 6 kali sehari selama 5-10 minit dengan kawalan PIC. Projek yang menggunakan kawalan automatik sepenuhnya ini diharap akan dapat meningkatkan hasil pengeluaran produk pertanian dan dapat membantu kerja-kerja petani dalam pertanian jenis fertigasi.



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**LIST OF SYMBOLS/ABBREVIATIONS**

PIC	-	Programmable Integrated Circuit
DC	-	Direct Current
RC	-	Radio Control
UGT	-	Underground Tank
OHT	-	Overhead Tank
IR	-	Infrared
PCB	-	Printed Circuit Board
DIY	-	Do It Yourself
I2C	-	Inter-Integrated Circuit

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Automatic fertigation control system using PIC is an upgrade project from the existing systems in Malaysia. Systems that used today do not have the system automatically mixes fertilizer. This project using microcontroller to operate and fertilizer mixing is automatically done. The current system only use digital timer to operate and fertilizer mixing process was conducted manually. Usually the fertigation system is used to cultivation such as vegetable, chili, corn and so on.

#### 1.2 Problem Statement

There are the problems statements carried out of this project:-

- a) Fertigation system that provides system automatically mixed fertilizers is not commercialized in Malaysia. Usually, most products fertigation system requires in making fertilizer mixture manually.
- b) Works for manually mixing fertilizer may waste of time.

### 1.3 Objective of Project

There are three objectives of this project:-

- a) To help farmer works in cultivation type fertigation system.
- b) Build software to control automatic fertilizer mixture process.
- c) Build hardware that carried out automatic fertilizer mixture process for fertigation system.

### 1.4 Scope of Project

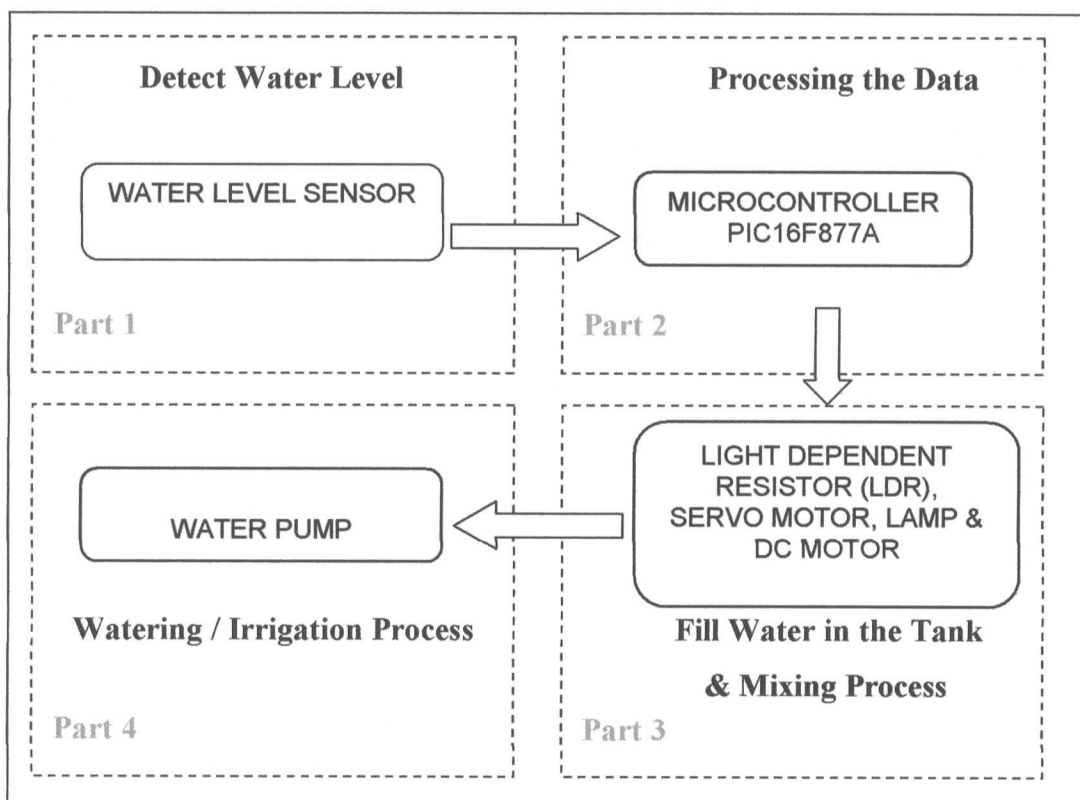


Figure 1.1: System Block Diagram

This project consists of four parts. At the first part, the water level sensor is used to detect the level of water in the tank in Hi condition or Low. The sensor will send the data to microcontroller. The second part, the microcontroller will process the data and send to the servo motor, lamp and DC motor. The third part, light dependent resistor (LDR) is used to measure the content of dissolved fertilizer in the water tank. The servo motor, lamp, LDR and DC motor will operate as it has been programmed in the PIC. Function of servo motor is to open and close the faucet for water and fertilizer, while the lamp is used to LDR detect the light when mixing of fertilizer is carried out and the DC motor will mixing the water and fertilizer. If mixed fertilizer is enough, mixing process stopped. The last part, water pump will work and will carry out the irrigation process according to time set.

### **1.5 Outline of Progress Report**

This progress report contain of five chapters. The first chapter discusses about the project background, problem statement, objective of project and scope of project. The second chapter emphasizes more on the theory and literature review. It is also discuss about the theory on component of software and hardware. In this chapter, it also discuss about the product that is related to this project. Chapter three will explain about the methodology use in this project. Chapter four will present the result that has been done and last is chapter five, it will discuss about the discussion, suggestion and conclusion.



## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

Literature review is a research that should be done before develop a project. The purpose of a literature review is to get knowledge and ideas to about our project. Literature review need to be conduct prior to undertaking this project to obtain the information on the technology available and the methodologies that used by the other researchers on the same topic around the world. From here, comparison of product between present products with our project may observe. This chapter provides the summary of literature review on topics related to the fertigation system.

#### 2.2 Other Fertigation System

There are four types of products related to this project.

- a) Water Fertigation Systems ( Noble Procetech Engineers, India )
- b) Fertigation system
- c) Automatic Yard Watering System
- d) Automatic Sprinkler System Timer (Rain Bird, North America)

### 2.2.1 Water Fertigation Systems ( Noble Procetech Engineers, India )

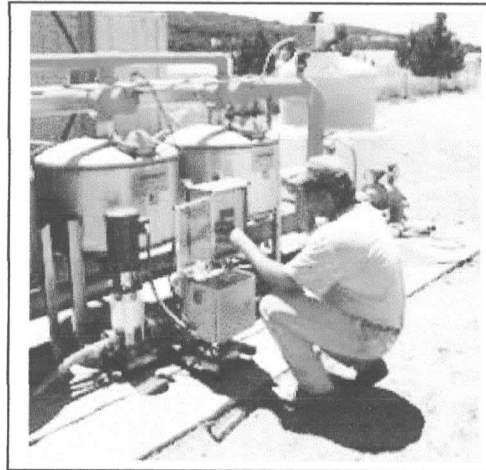


Figure 2.1: Water Fertigation Systems (Noble Procetech Engineers)

This Water Fertigation System was manufactured by Noble Procetech Engineers located in India. This system is offered in semi automatic and fully automatic forms, this Water Fertigation System are provided with the equipment such as:-

- a) Water pump
- b) Sand filter
- c) Fertilizer tank
- d) Agitator/stirrer
- e) Fertilizer pump
- f) Pressure Relief Valve
- g) System Pipeline And Valves
- h) Time Controller Valves
- i) Control Panel
- j) Alarm System

This Water Fertigation System offered in different models as appropriate type of crop, area of plantation, availability of water, quality of soil, and geometrical position of land. The advantages of this product are:-

- a) Automatic
- b) No skills required
- c) The proportion of fertilizer and water are controlled by PLC programming
- d) The work is set by an alarm that helps in automatic power off
- e) More than one fertilizer can be dosed simultaneously
- f) Difference height of the land does not affect the distribution.

### 2.2.2 Fertigation System



Figure 2.2: Fertigation system

Most of this fertigation system was used in Malaysia. This system is offered in semi automatic which only irrigation work automatically. These fertigation systems are provided with the equipment such as:-

- a) Dropper
- b) Mini tube
- c) Mini tube connector
- d) Poly pipe
- e) Filter

- f) Water pump
- g) Digital timer
- h) Tank

The advantage of this product is cheaper than product above (water fertigation system, Nobel Procetech Engineers), and disadvantage of this product was it is not provide the automatic mixture.

### 2.2.3 Automatic Yard Watering System

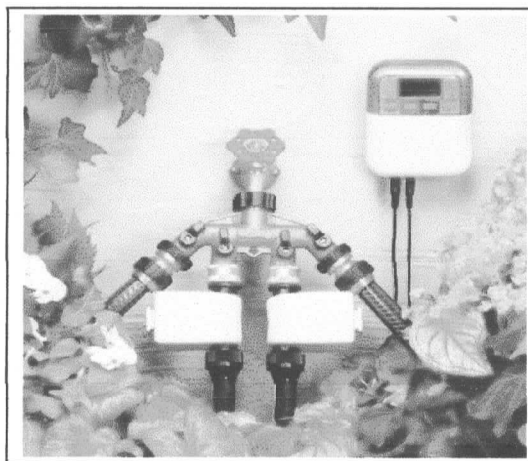


Figure 2.3: Automatic Yard Watering System

The Automatic Yard Watering System is a system that connected to a standard faucet. It is providing four hose outlets with independent controls for convenient and remote operation.

There are the futures of the product:-

- a) Set the timer to water up to 4 separate yard sections on their own schedules
- b) System installs in minutes
- c) No digging required
- d) For outdoor use only
- e) Small size

### 2.2.4 Automatic Sprinkler System Timer (Rain Bird, North America)



Figure 2.4: Automatic Sprinkler System Timer

This product is manufactured by Rain Bird, the number one brand of underground irrigation product located in North America. Automatic sprinkler system timer is remarkably easy to program while offering advanced features for precise watering control. Common schedules can be programmed with one-touch convenience. More sophisticated programming can be done quickly and simply by following on-screen prompts at each point of the dial. Other sprinkler timer advances include:-

- a) Water saving rain sensor
- b) Seasonal Adjust features (easily increase or decrease the amount of water applied by season without changing programs)
- c) Fuse-less surge protection and three independent programs to manage watering needs for multiple planting areas.

### 2.3 Hardware Specification

In hardware specification, there are many components will be used to build up this project, but the main components that used in this project are:-

- a) PIC16F877A
- b) DC Servo Motor

- c) DC Motor
- d) Water Level circuit
- e) Light Detect Resistor Sensor (LDR)
- f) Relay circuit
- g) Water pump
- h) Real Time Clock (RTC) DS1307

### 2.3.1 PIC16F877A

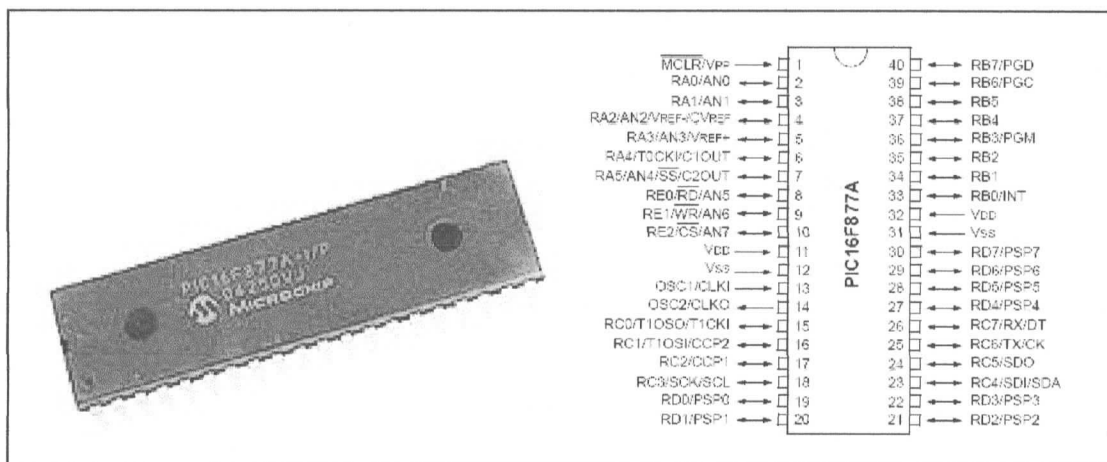


Figure 2.5: PIC16F877A

The 16F877A is one of Microchip powerful easy-to-program FLASH-based 8-bit microcontroller. The PIC16F877A is a 40-pin DIP package that features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I<sup>2</sup>C™) bus and a Universal Asynchronous Receiver Transmitter (USART).

PIN	Pin Name	Description
1	MCLR/VPP	Master Clear (input) or programming voltage (output).
2	RA0 AN0	Digital I/O. Analog input 0.
3	RA1 AN1	Digital I/O. Analog input 1.
4	RA2 AN2 VREF- CVREF	Digital I/O. Analog input 2. A/D reference voltage (Low) input. Comparator VREF output.
5	RA3 AN3 VREF+	Digital I/O. Analog input 3. A/D reference voltage (High) input.
6	RA4 T0CKI C1OUT	Digital I/O – Open-drain when configured as output. Timer0 external clock input. Comparator 1 output.
7	RA5 AN4 SS C2OUT	Digital I/O. Analog input 4. SPI slave select input. Comparator 2 output.
8	RE0 RD AN5	Digital I/O. Read control for Parallel Slave Port. Analog input 5.
9	RE1 WR AN6	Digital I/O. Write control for Parallel Slave Port. Analog input 6.
10	RE2 CS AN7	Digital I/O. Chip select control for Parallel Slave Port. Analog input 7.
11	VDD	Positive supply for logic and I/O pins.
12	VSS	Ground reference for logic and I/O pins.
13	OSC1/CLKI	Oscillator crystal or external clock input.
14	OSC2/CLKO	Oscillator crystal or clock output.
15	RC0 T1OSO	Digital I/O. Timer1 oscillator output.

	T1CKI	Timer1 external clock input.
16	RC1 T1OSI CCP2	Digital I/O. Timer1 oscillator input. Capture2 input, Compare2 output, PWM2 output.
17	RC2/CCP1	Digital I/O. Capture1 input, Compare1 output, PWM1 output.
18	RC3 SCK SCL	Digital I/O. Synchronous serial clock input/output for SPI mode. Synchronous serial clock input/output for I2C mode.
19	RD0 PSP0	Digital I/O. Parallel Slave Port data.
20	RD1 PSP1	Digital I/O. Parallel Slave Port data.
21	RD2 PSP2	Digital I/O. Parallel Slave Port data.
22	RD3 PSP3	Digital I/O. Parallel Slave Port data.
23	RC4 SDI SDA	Digital I/O. SPI data in. I2C data I/O.
24	RC5 SDO	Digital I/O. SPI data out.
25	RC6 TX CK	Digital I/O. USART asynchronous transmit. USART1 synchronous clock.
26	RC7 RX DT	Digital I/O. USART asynchronous receive. USART synchronous data.
27	RD4 PSP4	Digital I/O. Parallel Slave Port data.
28	RD5 PSP5	Digital I/O. Parallel Slave Port data.
29	RD6 PSP6	Digital I/O. Parallel Slave Port data.
30	RD7 PSP7	Digital I/O. Parallel Slave Port data.