AIR-CONDITIONING CONTROL SYSTEM FOR ENERGY SAVING APPLICATION

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"I hereby acknowledge that the scope and quality of this thesis is qualified for the award of the Bachelor Degree of Electrical Engineering (Control and Instrumentation)"

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Date : 27 APRIL 2009

Specially dedicated to

My beloved parents,

and all of my friends.

BEC still in memories..

"Most surely in the creation of heavens and the earth and the alternation of the night and the day there are signs for men to understand. Those who remember Allah standing and sitting and lying on their sides and reflect on the creation of the heaven and the earth: Our Lord! Thou hast not created this in vain! Glory be to Thee; save us then from the chastisement of the fire."

(Ali'imran:190-191)

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In the name of Allah, the Most Gracious, the Ever Merciful. All praise is due to Allah. May salawat and salam be granted to our beloved Prophet Muhammad s.a.w, to his family and to all his noble companions

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ABSTRACT

The usage of antenna is widely developed almost everyday and it has become one of human's need. In today's world, the receiving parabolic antenna is almost commonly use in the world including this region. The purpose of this project is to design an Antenna Movement Controller by using stepper motor with PIC as the controller algorithm. The objective is to control maneuver the parabolic antenna with various and elevation angle. As a result, the antenna able to receive the signal that transmit by satellite from various position or direction. The methodology of implementation of this project could be categorized into software development and hardware design. The software development are base on PIC programming as the controller of the stepper motor. The hardware involves three stages which are keypad, PIC16F84A circuit and stepper motor. The operation of this project starting from the keypad enter the angle value. Then, the PIC receive the data to execute the program. The stepper motor maneuver to the desire direction. This project can be applied to the moving vehicle, portable antenna and etc.

ABSTRAK

Pembangunan teknologi antenna boleh dikatakan bergerak setiap hari dan ianya telah menjadi satu keperluan dlm teknologi manusia. Dalam dunia hari ini, antenna parabola kebiasaannya digunakan sebagai medium penerimaan isyarat di seluruh dunia terutamanya di benua Asia ini. Tujuan utama projek ini ialah untuk mereka bentuk 'Kawalan Pegerakan Antena' dengan menggunakan 'Stepper Motor' sebagai penggerak antenna dan kawalan PIC sebagai medium utk menggerakkan motor. Manakala, objektif projek ini ialah untuk mengawal pergerakkan antenna dalam dua arah; sudut azimuth dan sudut dongakan. Maka, piring antenna mampu untuk menerima isyarat yang telah dihantar oleh satelit dalam pelbagai arah atau kedudukan. Kaedah yang diguna pakai dalam penghasilan projek ini boleh dikategorikan dalam dua kategori; pembangunan perisian dan pembangunan perkakasan. Pembangunan perisian adalah berdasarkan pengaturcaraan PIC sebagai medium kawalan utk motor. Manakala pembangunan perkakasan merangkumi tiga peringkat iaitu peringkat papan kekunci, litar PIC16F84A dan motor stepper. Cara projek ini beroperasi dimulakan dengan memasukkan data sudut yg dikehendaki, data sudut dianalisa oleh aturcara yg telah dibuat dan motor stepper akan bergerak mengikut sudut yg dikehendaki. Projek ini boleh diguna pakai utk kenderaan yang bergerak, antenna mudah alih dan sebagainya.

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LIST OF ABBREVIATIONS

PIC	Programmable Interface Controller
MHz	Mega Hertz
IC	Integrated Circuit
VDC	Volt Direct Current
AC	Alternate Current
GUI	Graphical User Interface
kWh	Kilo Watts per Hour
PC	Personal Computer
LED	Light Emitting Diode

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CHAPTER 1

INTRODUCTION

1.1 Overview

Antennas have practical uses for the transmission and reception of radio frequency signals (radio, TV, etc.). In air, those signals travel very quickly and with a very low transmission loss. The signals are absorbed when moving through more conducting materials, such as concrete walls, rock, etc. When encountering an interface, the waves are partially reflected and partially transmitted through. A common antenna is a vertical rod a quarter of a wavelength long. Such antennas are simple in construction, usually inexpensive, and both radiate in and receive from all horizontal directions (omnidirectional). One limitation of this antenna is that it does not radiate or receive in the direction in which the rod points. This region is called the antenna blind cone or null.

The usage of antenna is widely developed almost everyday and it has become one of human's need. In today's world, the receiving parabolic antenna is almost commonly use in the world including this region. The purpose of this project is to design an Antenna Movement Controller by using stepper motor with PIC as the controller algorithm. The objective is to control maneuver the parabolic antenna with various and elevation angle.

1.2 Objectives of the project

The general objectives of the system is to control maneuver the antenna parabolic dish with the precise azimuth angle and elevation angle. :

(i) To control maneuver the parabolic antenna dish with precise desire azimuth angle and elevation angle

1.3 Scopes of the project

This project required several components that need to connect together to produce an antenna movement controller. This project applies the from the data entry part by keypad, execution of program by the software part and the stepper motor move precisely to the desire azimuth angle and elevation angle. The scope of this project:

(i) To develop the circuit board for PIC 16F84A.this part is hardware development and the complete circuit will be test in FKEE UMP laboratory.

(ii) The stepper motor able to maneuver from both azimuthal angle and elevation angle refer to the desire output given.

1.4 Thesis Outline

This thesis contains 5 chapter which is every chapter have its own purpose. After viewing the entire chapter in this thesis hopefully viewer can understand the whole system design for this project.

Chapter 1 contains of the introduction or the overview of this project, the problem statement of this project, the objectives of the project, the scopes of the project and the outline of this thesis for every chapter.

Chapter 2 contains all the article review. This chapter will explain the information about the article that related to the project design. Besides that, this chapter will be important references to me when do the project. This chapter also includes the journal and the important information when do the research about the project. The information got from several sources such as websites, journals, books, magazines, handout and others.

Chapter 3 is chapter for the methodology of this project. This chapter will explain about the detail of the project. Its also includes the project progress that have block diagram, flow chart and also the explanation in detail about the project. The project explanation will be explained through block by block that refer to the block diagram.

Chapter 4 is about the result and the analysis for this project. This chapter will explain about the result and analysis of the project. This chapter also explains the theory that adapted into the project.

Chapter 5 is for conclusion chapter. This chapter will explain the conclusion of the project that is simple explanation of the project. Its also includes the application of the project in the real world. Besides that, this chapter also view the further improvement can be done for the project. For the cost and commercialization of this project also will be including in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will explain the information about the article that related to the project design. Besides that, this chapter will be important references to me when do the project. This chapter also includes the journal and the important information when do the research about the project. The information got from several sources such as websites, journals, books, magazines, handout and others.

2.2 A study on Antenna

An antenna is a transducer designed to transmit or receive electromagnetic waves. In other words, antennas convert electromagnetic waves into electrical currents and vice versa. Antennas are used in systems such as radio and television broadcasting, point-to-point radio communication, wireless LAN, radar, and space exploration. Antennas usually work in air or outer space, but can also be operated under water or even through soil and rock at certain frequencies for short distances.

Physically, an antenna is an arrangement of conductors that generate a radiating electromagnetic field in response to an applied alternating voltage and the associated alternating electric current, or can be placed in an electromagnetic field so that the field will induce an alternating current in the antenna and a voltage between its terminals. Some antenna devices (parabolic antenna, Horn Antenna) just adapt the free space to another type of antenna.

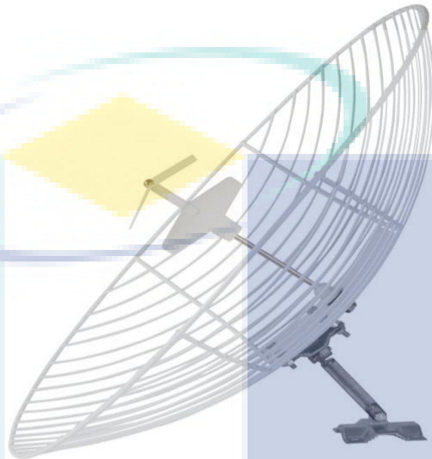

Figure 2.1: Parabolic antenna

The parabolic antenna is a high-gain reflector antenna used for radio, television and data communications, and also for radiolocation (RADAR), on the UHF and SHF parts of the electromagnetic spectrum. The relatively short wavelength of electromagnetic (radio) energy at these frequencies allows reasonably sized reflectors to exhibit the very desirable highly directional response for both receiving and transmitting..

The reflector is a metallic surface formed into a paraboloid of revolution and (usually) truncated in a circular rim that forms the diameter of the antenna. This paraboloid possesses a distinct focal point by virtue of having the reflective property of parabolas in that a point light source at this focus produces a parallel light beam aligned with the axis of revolution.

2.3 Maneuver Properties

2.3.1 Azimuth Angle.

The horizontal angular distance from a reference direction, usually the northern point of the horizon, to the point where a vertical circle through a celestial body intersects the horizon, usually measured clockwise. Sometimes the southern point is used as the reference direction, and the measurement is made clockwise through 360°.

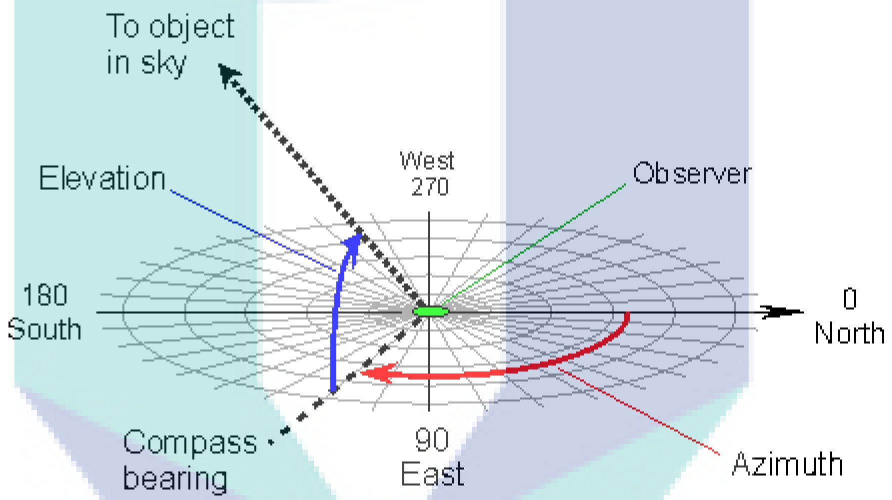

Figure 2.2: Azimuth and Elevation angle

2.3.2 Elevation Angle.

The elevation of a geographic location is its height above a fixed reference point, often the mean sea level. Elevation, or geometric height, is mainly used when referring to points on the Earth's surface, while altitude or geo potential height is used for points above the surface, such as an aircraft in flight or a spacecraft in orbit.

2.4 Microcontroller PIC16F84

PIC (Peripheral Interface Controller) is the IC which was developed to control peripheral devices, alleviating the load from the main CPU. Compared to a human being, the brain is the main CPU and the PIC is equivalent to the autonomic nervous system. PIC16F84 belongs to a class of 8-bit microcontrollers of RISC architecture. Its general structure is shown on the following map representing basic blocks.

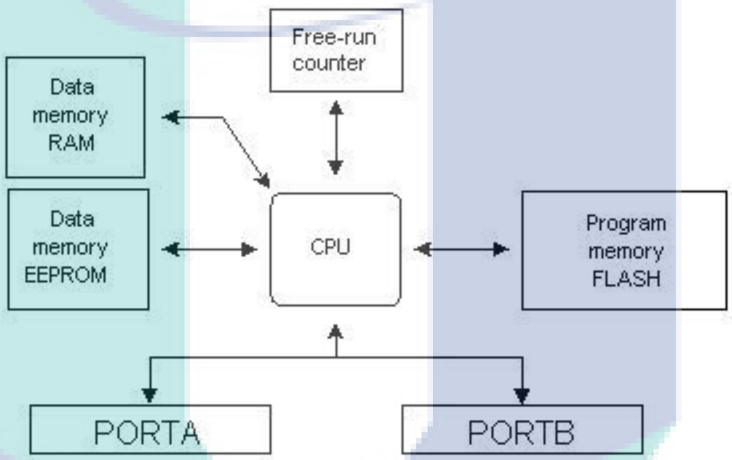

Figure 2.3: PIC16F84 block diagram

Program memory (FLASH) is for storing a written program. Since memory made in FLASH technology can be programmed and cleared more than once, it makes this microcontroller suitable for device development. The program memory contains the program you have written. The program is a set of instruction that the microcontroller will perform for you. The software (instructions) will be written in a computer and then programmed (burned) into the "program memory". This memory is an EEPROM memory which can be rewritten thousands times [3].

RAM is a data memory used by a program during its execution. In RAM are stored all inter-results or temporary data during run-time. RAM contains all the internal registers and a small RAM memory where we can store data temporary. There are several register with different functions. The RAM memory is not large about 64-128 byte. Example: If we make a program loop, then we need a variable to change value each time the loop runs and then we will use a variable defined in the RAM address to hold the counter value. The content in the Register and RAM-info will disappear when the power is off.

EEPROM is data memory that needs to be saved when there is no supply. It is usually used for storing important data that must not be lost if power supply suddenly stops. For instance, one such data is an assigned temperature in temperature regulators. If during a loss of power supply this data was lost, we would have to make the adjustment once again upon return of supply. Thus our device looses on self-reliance. EEPROM can read and write data as well, but the data will not disappear when the power is off. Next time the power is on we can go into this memory and fetch the data again. Example: If we make a code lock alarm, where we have to push 4 buttons to deactivate the alarm. We can store the right code in the EEPROM and just compare the actual pressed keys with the value in the EEPROM. We can then easy change alarm code by rewriting the key in the EEPROM [4].

PORTA and PORTB are physical connections between the microcontroller and the outside world. Port A has five, and port B has eight pins. The port is the input and output pins of the actual circuit. We can define the pins as input or outputs. By writing or reading to the port we can control each pin as we wish.

Free Run Timer is an 8-bit register inside a microcontroller that works independently of the program. On every fourth clock of the oscillator it increments its value until it reaches the maximum (255), and then it starts counting over again from zero. As we know the exact timing between each two increments of the timer contents, timer can be used for measuring time which is very useful with some devices.

Central Processing Unit has a role of connective element between other blocks in the microcontroller. It coordinates the work of other blocks and executes the user program [5].

PIC16F84 has a total of 18 pins. It is most frequently found in a DIP18 type of case but can also be found in SMD case which is smaller from a DIP. DIP is an abbreviation for Dual In Package. SMD is an abbreviation for Surface Mount Devices suggesting that holes for pins to go through when mounting aren't necessary in soldering this type of a component [6].

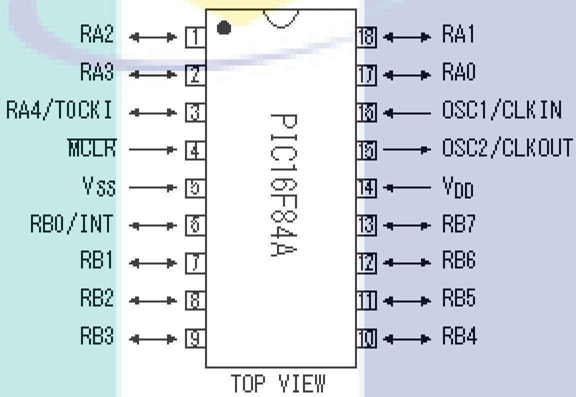

Figure 2.4: PIC16F84 pin diagram

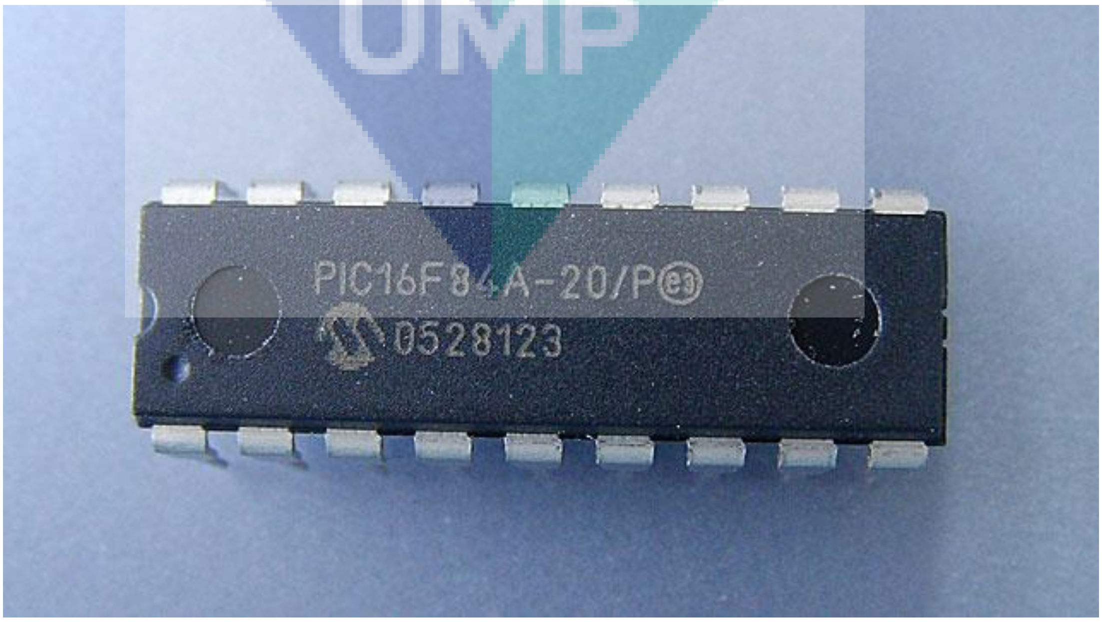

Figure 2.5: PIC16F84A

Pins on PIC16F84 microcontroller have the following meaning:

(i) Pin no.1 RA2 Second pin on port A. Bi-directional I/O port. Has no additional function.

(ii) Pin no.2 RA3 Third pin on port A. Bi-directional I/O port. Has no additional function.

(iii) Pin no.3 RA4 Fourth pin on port A. Bi-directional I/O port. TOCK1 which functions as a timer is also found on this pin.

(iv) Pin no.4 MCLR Reset input and Vpp programming voltage of a microcontroller. Master clear (reset) input. Programming voltage input. This pin is an active low reset to the device.

(v) Pin no.5 Vss Ground of power supply.

(vi) Pin no.6 RB0 Zero pin on port B. Bi-directional I/O port. Interrupt input is an additional function.

(vii) Pin no.7 RB1 First pin on port B. Bi-directional I/O port. No additional function.

(viii) Pin no.8 RB2 Second pin on port B. Bi-directional I/O port. No additional function.

(ix) Pin no.9 RB3 Third pin on port B. Bi-directional I/O port. No additional function.

(x) Pin no.10 RB4 Fourth pin on port B. Bi-directional I/O port. No additional function.

(xi) Pin no.11 RB5 Fifth pin on port B. Bi-directional I/O port. No additional function.

(xii) Pin no.12 RB6 Sixth pin on port B. Bi-directional I/O port. 'Clock' line in program mode.

(xiii) Pin no.13 RB7 Seventh pin on port B. Bi-directional I/O port. 'Data' line in program mode.

(xiv) Pin no.14 Vdd Positive power supply pole. Positive supply (+2.0V to +5.5V)

(xv) Pin no.15 OSC2/CLKOUT Pin assigned for connecting with an oscillator. Oscillator crystal input. External clock source input.

(xvi) Pin no.16 OSC1/CLKIN Pin assigned for connecting with an oscillator. Oscillator crystal output. Connects to crystal or resonator in crystal oscillator mode.

(xvii) Pin no.17 RA0 Second pin on port A. Bi-directional I/O port. No additional function.

(xviii) Pin no.18 RA1 First pin on port A. Bi-directional I/O port. No additional function.

PIC16F84 perfectly fits many uses, from automotive industries and controlling home appliances to industrial instruments, remote sensors, electrical door locks and safety devices. It is also ideal for smart cards as well as for battery supplied devices because of its low consumption.

EEPROM memory makes it easier to apply microcontrollers to devices where permanent storage of various parameters is needed (codes for transmitters, motor speed, receiver frequencies, etc.). Low cost, low consumption, easy handling and flexibility make PIC16F84 applicable even in areas where microcontrollers had not previously been considered (example: timer functions, interface replacement in larger systems, coprocessor applications, etc.).

In System Programmability of this chip (along with using only two pins in data transfer) makes possible the flexibility of a product, after assembling and testing have been completed. This capability can be used to create assembly-line production, to store calibration data available only after final testing, or it can be used to improve programs on finished products.

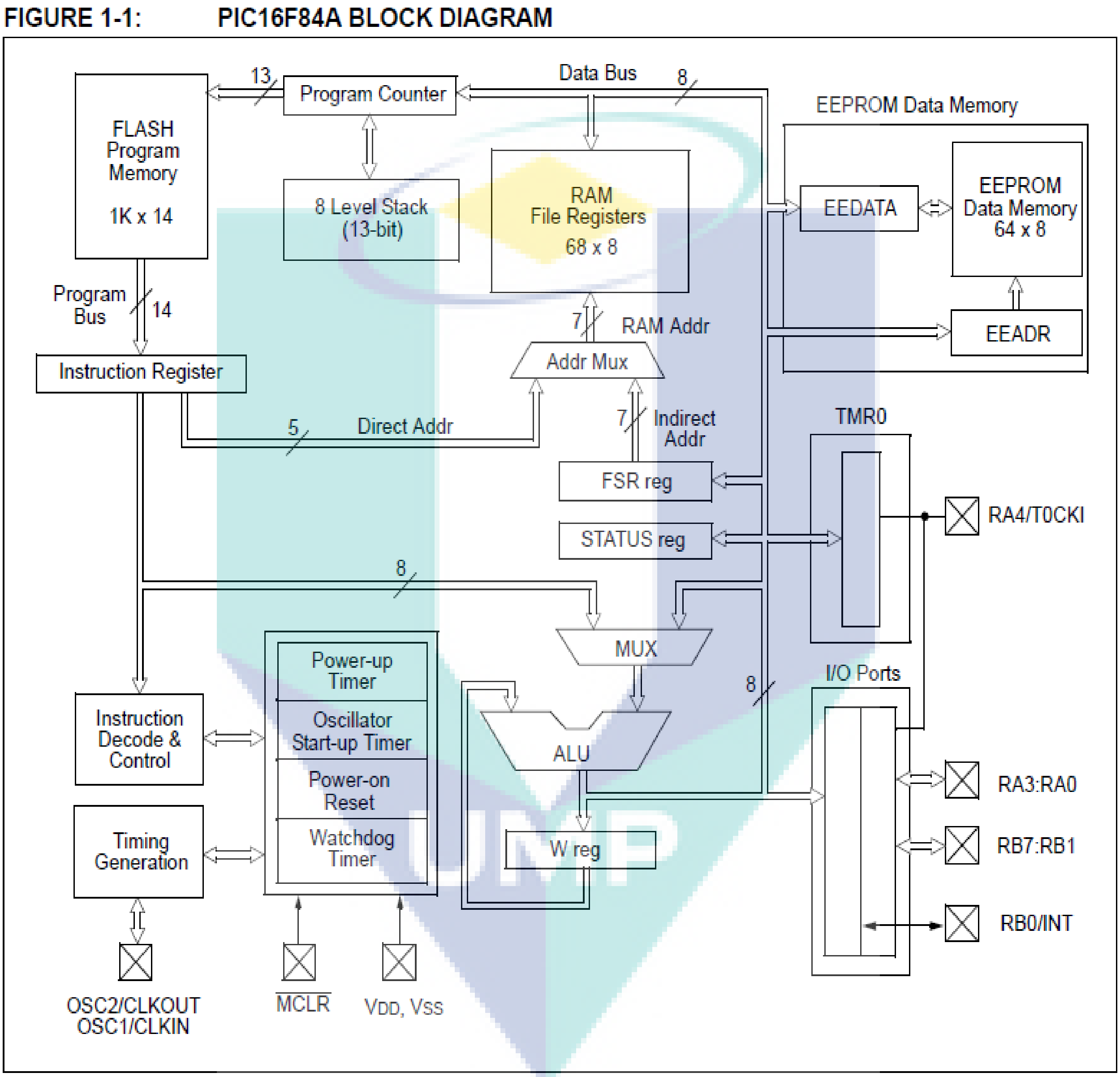

Figure 2.6: PIC16F84A Block Diagram

2.5 Stepper Motor

Stepping motors come in two varieties, *permanent magnet* and *variable reluctance* (there are also *hybrid* motors, which are indistinguishable from permanent magnet motors from the controller's point of view). Lacking a label on the motor, you can generally tell the two apart by feel when no power is applied. Permanent magnet motors tend to "cog" as you twist the rotor with your fingers, while variable reluctance motors almost spin freely (although they may cog slightly because of residual magnetization in the rotor). You can also distinguish between the two varieties with an ohmmeter. Variable reluctance motors usually have three (sometimes four) windings, with a common return, while permanent magnet motors usually have two independent windings, with or without center taps. Center-tapped windings are used in unipolar permanent magnet motors.

Stepping motors come in a wide range of angular resolution. The coarsest motors typically turn 90 degrees per step, while high resolution permanent magnet motors are commonly able to handle 1.8 or even 0.72 degrees per step. With an appropriate controller, most permanent magnet and hybrid motors can be run in half-steps, and some controllers can handle smaller fractional steps or microsteps.

For both permanent magnet and variable reluctance stepping motors, if just one winding of the motor is energised, the rotor (under no load) will snap to a fixed angle and then hold that angle until the torque exceeds the holding torque of the motor, at which point, the rotor will turn, trying to hold at each successive equilibrium point.

2.6 Related Stepper Motor Project.

2.6.1 Stepper Motor Controller Using ALLEGRO Microsystem UDN2916

This Project is about how to interfacing a stepper motor to a PIC16F84A and control the stepper motor was quite easily by using ALLEGRO Microsystem UDN2916 stepper motor driver IC. This project show how to control stepper motor movement speed and direction using UDN2916. For the directional controller, it only use push button. Consist with 3 push button, the stepper motor can move from right to left, from left to right and stop.

Compared with my project, I use two stepper motor refer to two directional movement of antenna in azimuthal angle and elevation angle. For

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter will explain about the detail of the project. Its also includes the project progress that have block diagram, flow chart and also the explanation in detail about the project. The project explanation will be explained through block by block that refer to the block diagram.

3.2 Project Development

The process of developing this project starts with the selection of project titles. After all part of the project title are done, all part regarding the hardware and the software will be determine. The process making of the hardware part starts with the design of hardware. . For software part, the process starts with the developing the software. Then the program will be burn in PIC and test the output. If this process is clear and no error for the program, the software part will be integrate with the hardware part to complete the whole system. The integration between them will be test until the system work properly. Then analysis will be made and this project will be end with demo to evaluator and a report about this whole project.

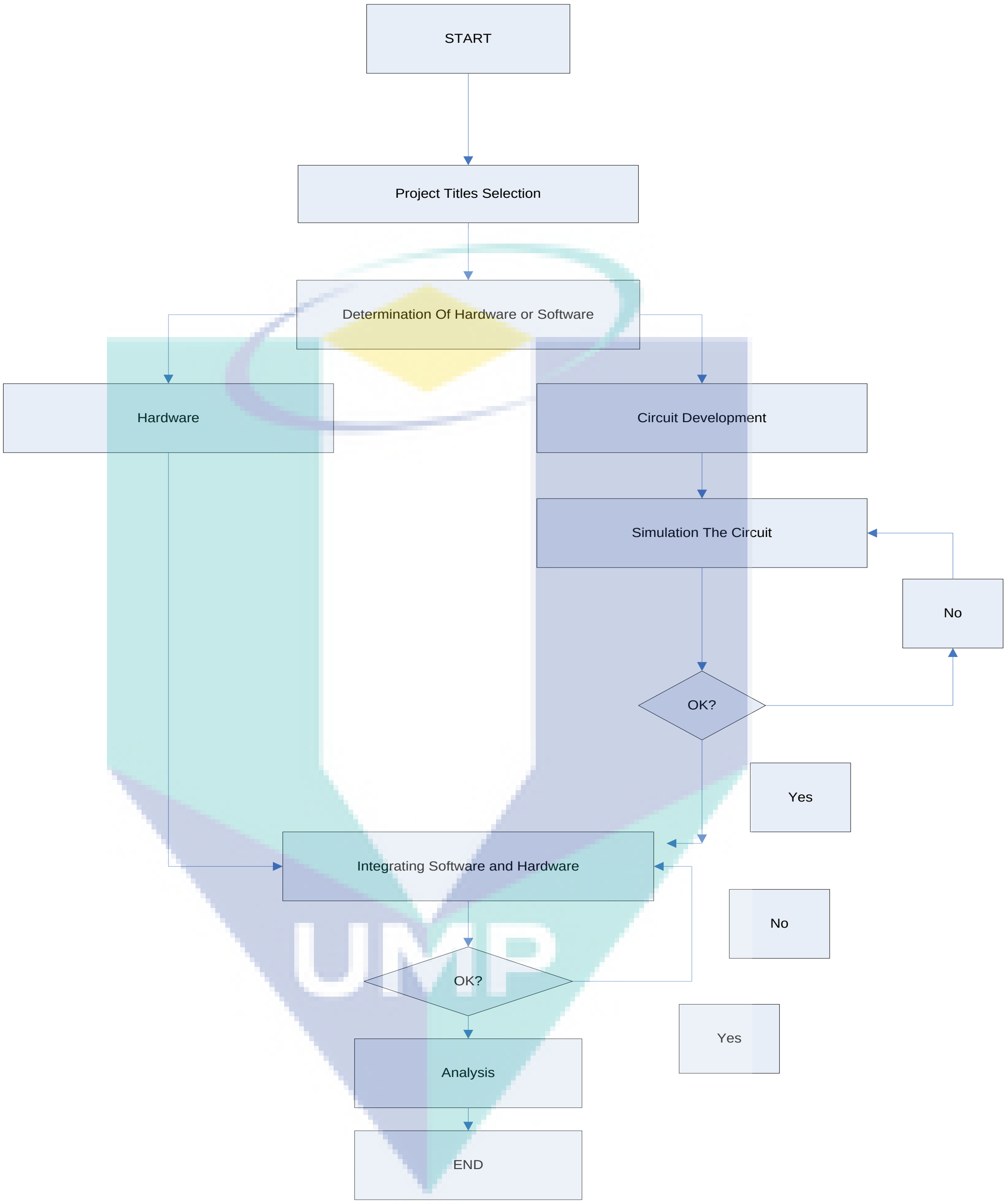

Figure3.1: Project development flow chart

3.3 Project Block Diagram

The whole systems consist of PIC as the controller, signal conditioner as the signal conditioning system, sensor as human detector, internal timer as clock for the PIC, RS 232 communication module for serial communication with computers and lastly relay as the circuit breaker for air conditioning.

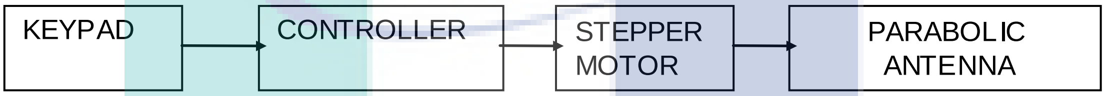

Figure 3.2: Block Diagram for whole system.

This project is about an implementation on how to maneuver the stepper motor that act as driver to drive an antenna dish moving in azimuth angle and elevation angle. This project hardware development consist with three part; data entry part, input processing part and execution part. For the data entry part, keypad was use as component that provide key entry for user to enter the desire data. For the input processing part, the program that have been construct and develop is the main catalyst to processing the input given to execute the data. For the completion of the project, the stepper motor maneuver the antenna .

3.4 Power Supply Interface Circuit

For this project we need 5V power supply. A suitable voltage regulator must be used to provide the supply we need. 5V supply needs by PIC. MC14050 IC also needs 5V supply to power up the IC.

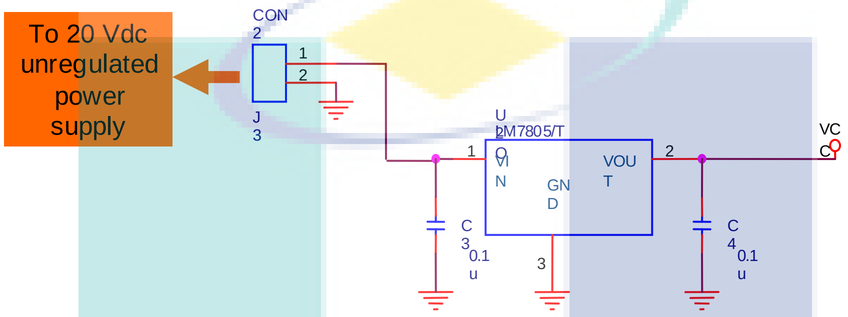

Figure 3.3: Power supply interface circuit.

The function of the capacitor in this is for filter purpose. Although a battery has a essentially a constant or dc output voltage, the dc derived from an ac source signal by rectifying and filtering will have some ac variation (ripple). The smaller the ac variation with respect to the dc level, the better is the filter circuit's operation.

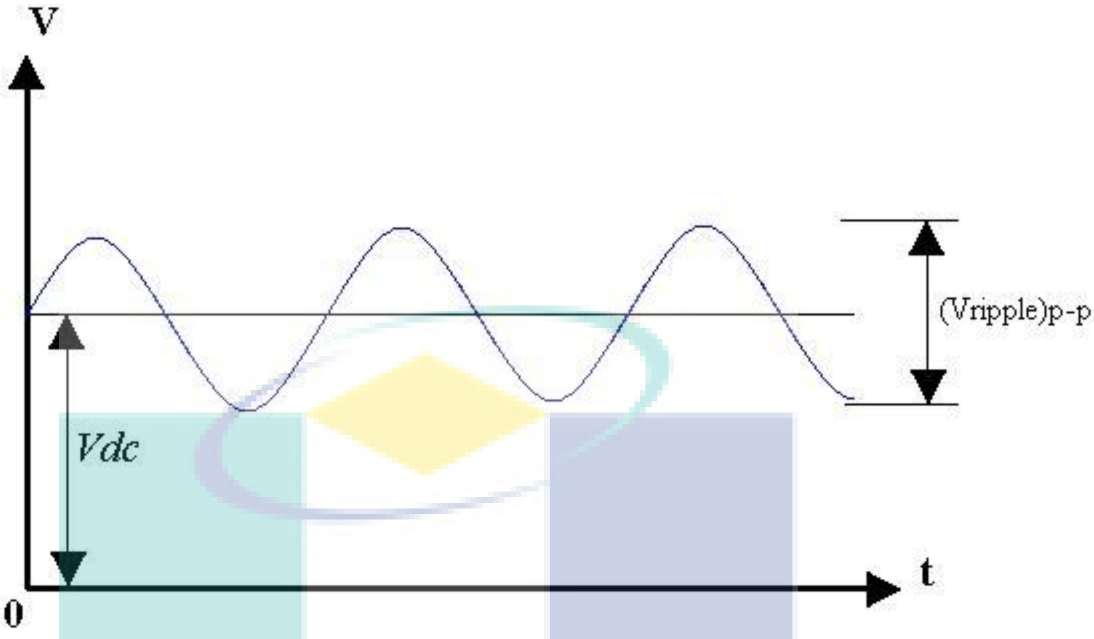

Figure 3.4: Filter waveform showing dc and ripple voltage

Consider measuring the output voltage of a filter circuit using a dc voltmeter and an ac (rms) voltmeter. The dc voltmeter will read only the average or dc level of the output voltage. The ac (rms) meter will read only the rms value of the ac component of the output voltage (assuming the ac signal is coupled through a capacitor to block out the dc level). Ripple is defined as:

$$r = \frac{\text{ripple voltage (rms)}}{\text{dc voltage}} = \frac{\text{Vr (rms)}}{\text{Vdc}} \text{ X } 100\ \%$$

Figure 3.5: Ripple equation

If the voltage regulator circuit did not connect to the capacitor as the filter, the output voltage supply may not smooth enough for power supply purpose. The voltage is not stable to function as the power supply.

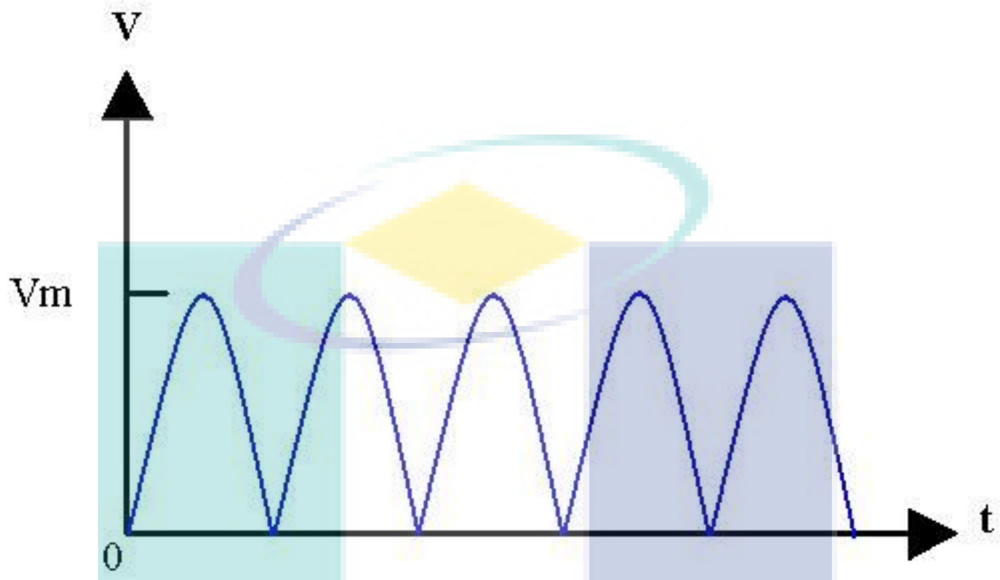

Figure 3.6: Full wave voltage without capacitor filter

When the capacitor is connected to the circuit, a better voltage supply will be created. This voltage supply is suitable to use for various electronics circuit that need a stable voltage supply.

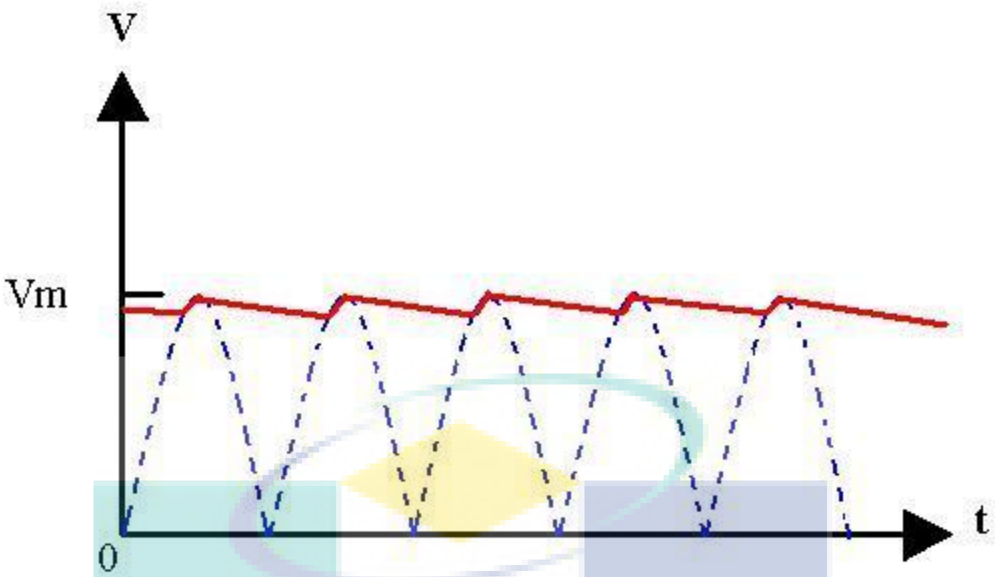

Figure 3.7: Filtered output voltage

Figure 3.17 shows the waveform across a capacitor filter. Time T1 is the time during which diodes of full-wave conduct, charging the capacitor up to the peak rectifier voltage Vm. Time T2 is the time internal during which the rectifier voltage drops below the peak voltage, and the capacitor discharges through the load. Since the charge-discharge cycle occurs for each half-cycle for a full-wave rectifier, the period of the rectified waveform is T/2, one-half the input signal frequency. The filtered voltage, shows the output waveform to have a dc level Vdc and a ripple voltage Vr (rms) as the capacitor charges and discharges.

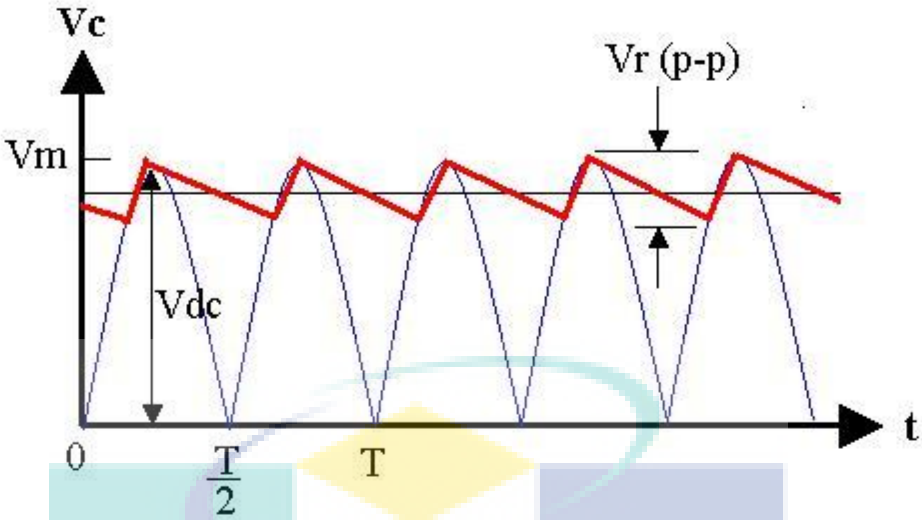

Figure 3.8: Approximate output voltage of capacitor filter circuit

The ripple voltage can be calculated from:

$$Vr\ (rms) = \frac{2.4\ Idc}{C} = \frac{2.4\ Vdc}{R_L C}$$

Where; Idc is in miliamperes, C is in microfarads and R_L is in kilohms

3.5 PIC Microcontroller Selection

The PIC use for this project is PIC 16F84. It has 18 pins. PIC16F84 belongs to a class of 8-bit microcontrollers of RISC architecture. RISC stands for Reduced Instruction Set Computer. This PIC is suitable for this project because the pins provided are enough to interface with other part in this project. A 4MHz crystal oscillator are use to provide sufficient clock to the PIC.

3.6 PIC Microcontroller Interface Circuit

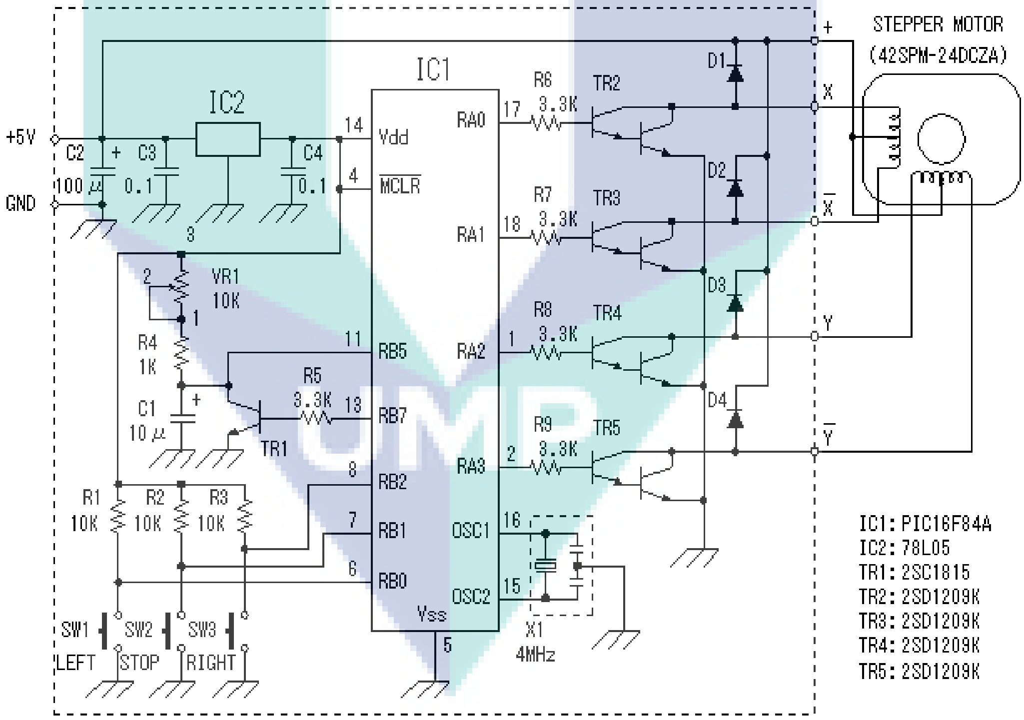

Figure 3.9: PIC 16F84 microcontroller interface circuit

3.7 Software Development

The ability to communicate is of great importance in any field. However, it is only possible if both communication partners know the same language, i.e follow the same rules during communication. Using these principles as a starting point, we can also define communication that occurs between microcontrollers and man. Language that microcontroller and man use to communicate is called "assembly language". The title itself has no deeper meaning, and is analogue to names of other languages, ex. English or French. More precisely, "assembly language" is just a passing solution. Programs written in assembly language must be translated into a "language of zeros and ones" in order for a microcontroller to understand it. "Assembly language" and "assembler" are two different notions. The first represents a set of rules used in writing a program for a microcontroller, and the other is a program on the personal computer which translates assembly language into a language of zeros and ones. A program that is translated into "zeros" and "ones" is also called "machine language".

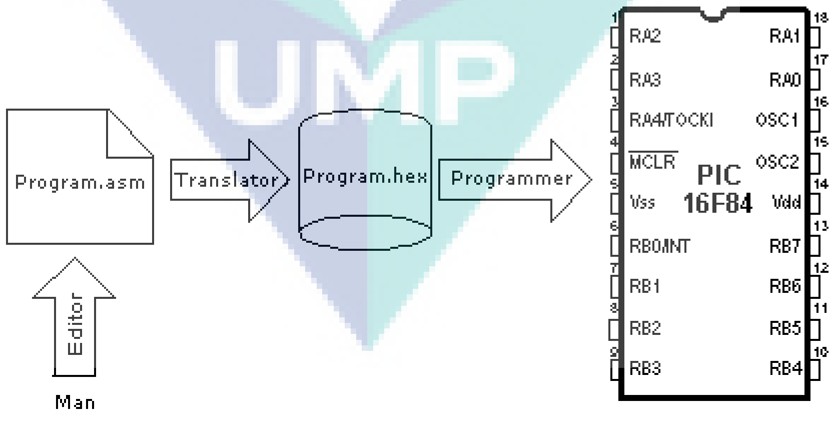

Figure 3.10: The process of communication between a man and a microcontroller

Physically, "Program" represents a file on the computer disc (or in the memory if it is read in a microcontroller), and is written according to the rules of assembler or some other language for microcontroller programming. Man can understand assembler language as it consists of alphabet signs and words. When writing a program, certain rules must be followed in order to reach a desired effect. A “Translator” interprets each instruction written in assembly language as a series of zeros and ones which have a meaning for the internal logic of the microcontroller. Lets take for instance the instruction "RETURN" that a microcontroller uses to return from a sub-program. When the assembler translates it, we get a 14-bit series of zeros and ones which the microcontroller knows how to interpret. For example instruction “RETURN 00 0000 0000 1000”.

Similar to the above instance, each assembler instruction is interpreted as corresponding to a series of zeros and ones. The place where this translation of assembly language is found is called an "execution" file. We will often meet the name "HEX" file. This name comes from a hexadecimal representation of that file, as well as from the suffix "hex" in the title, ex. "test. hex". Once it is generated, the execution file is read in a microcontroller through a programmer. An Assembly Language program is written in a program for text processing (editor) and is capable of producing an ASCII file on the computer disc or in specialized surroundings.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

This chapter will explain about the result and analysis of the project. This chapter also explains the theory that adapted into the project. The analysis includes the measurement at actual value.

4.2 Result And Analysis

This project is develop to control how to maneuver the antenna using stepper motor. While progressing toward this project, there is some difficulties arise . The Solution for the problem also been discuss in this chapter as discussion.

4.3 Power Supply Interface Circuit Analysis

The purpose of this circuit is to keep power supply voltage to PIC to 5V when the power of the stepper motor is more than 5V.

Because the operating voltage of the stepper motor to be using this time is about 5V, the power supply voltage is +5V. In this case, the voltage which is applied to PIC becomes less than 5V because of the voltage drop (about 1V) of the regulator. In case of PIC16F84A, the operation is possible even if the power falls to about 3V because the operating voltage range is from 2V to 5.5V. It is enough in the 100-mA type.

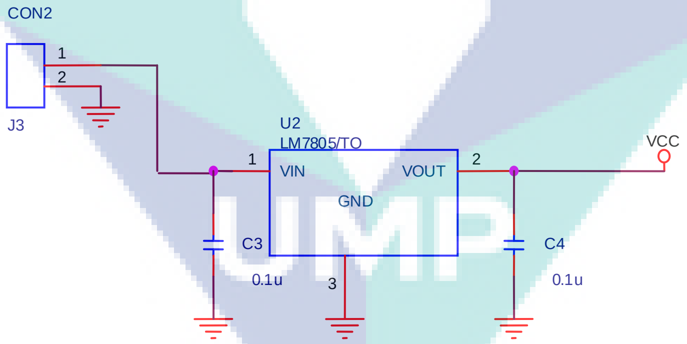

Figure 4.1: Power supply interface circuit

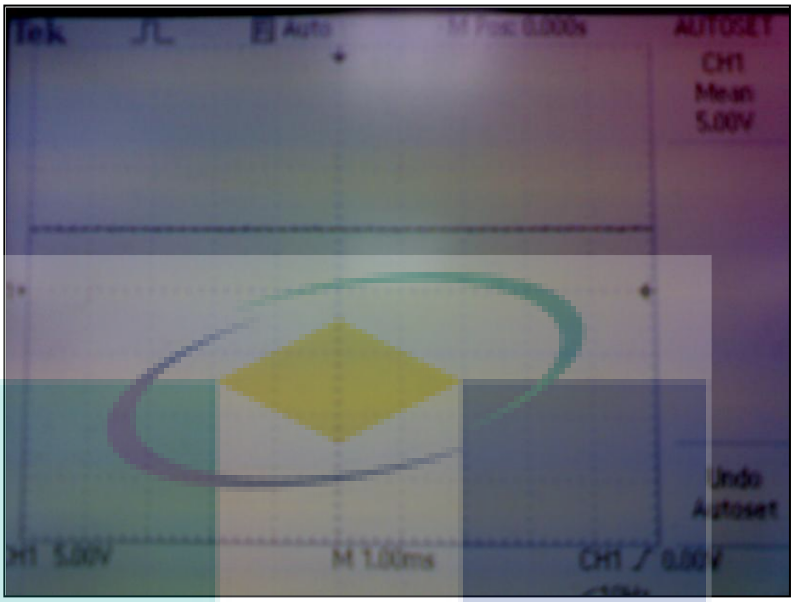

Figure 4.2: Output Waveform of LM7805 using Oscilloscope

To provide 5V regulated signal to the system circuit, LM7805 voltage regulator is used. Figure 4.3 shows that 5V supply without ripple is came out from the LM7805 output.

LM7805 provide 5.626V for the system circuit. LM7805 voltage regulator are connected to the 20Vdc power supply. For the filter purpose, the 0.1µF is used. To calculate the ripple voltage we used below equation:

$$V_r\,(rms) = \frac{2.4\ I_{dc}}{C} = \frac{2.4\ V_{dc}}{R_L C}$$

From the equation, if bigger value of capacitor is used, the smaller ripple voltage that we will get. The smaller ripple value, that's mean the voltage supply is better for the system.

4.4 Stepper motor controller circuit test

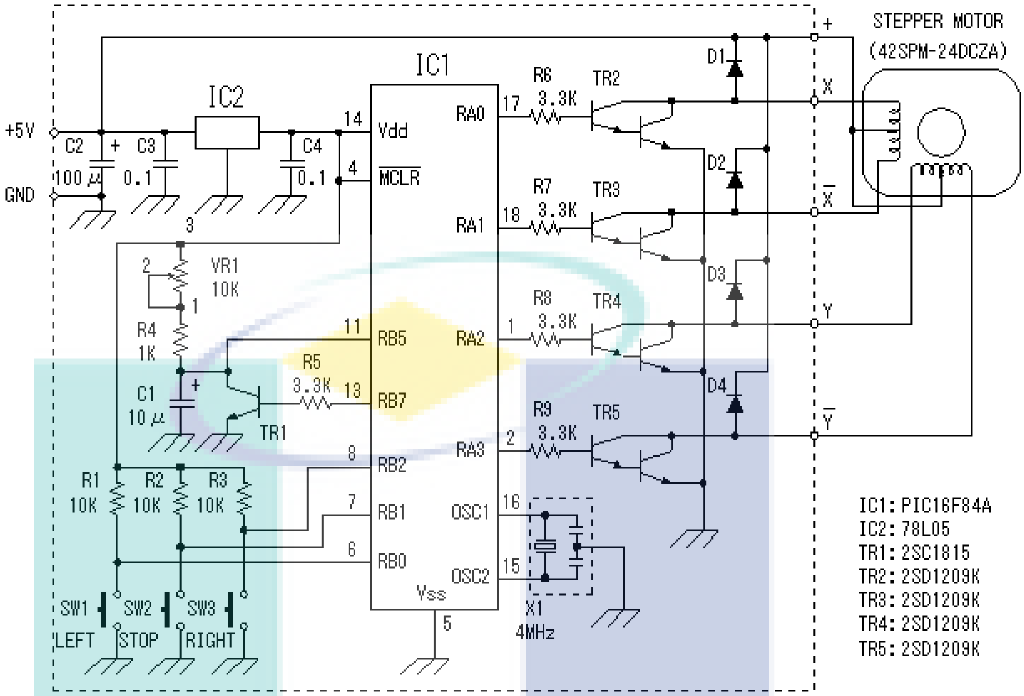

Figure 4.3: Stepper motor controller circuit

Firstly, using the circuit that shown above and one instant circuit is develop exactly as shown as above. The purpose is to test either that circuit shown can drive the single stepper motor or else.

4.5 Antenna Movement Controller Circuit Analysis

4.5.1 Oscillator

4-MHz resonator is used because the circuit this time doesn't need high-speed operation.

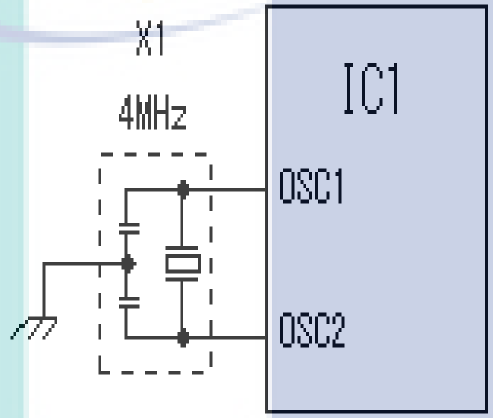

Figure 4.4 : Oscillator circuit

4.6 Circuit Design and Modeling

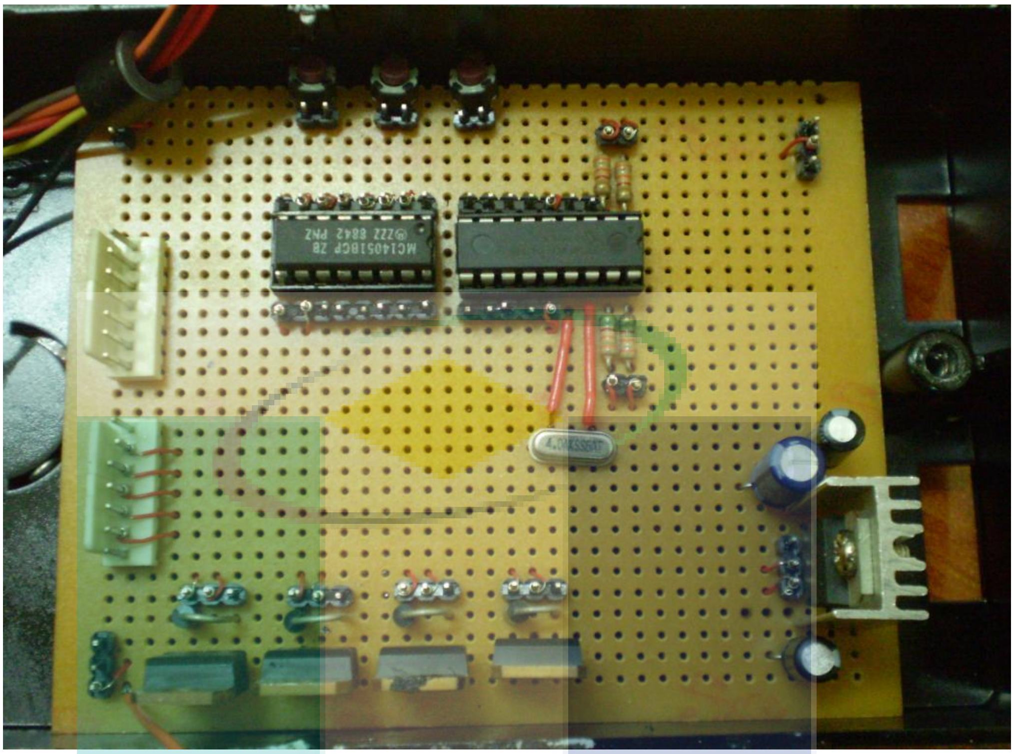

Figure 4.5: Hardware design for circuit

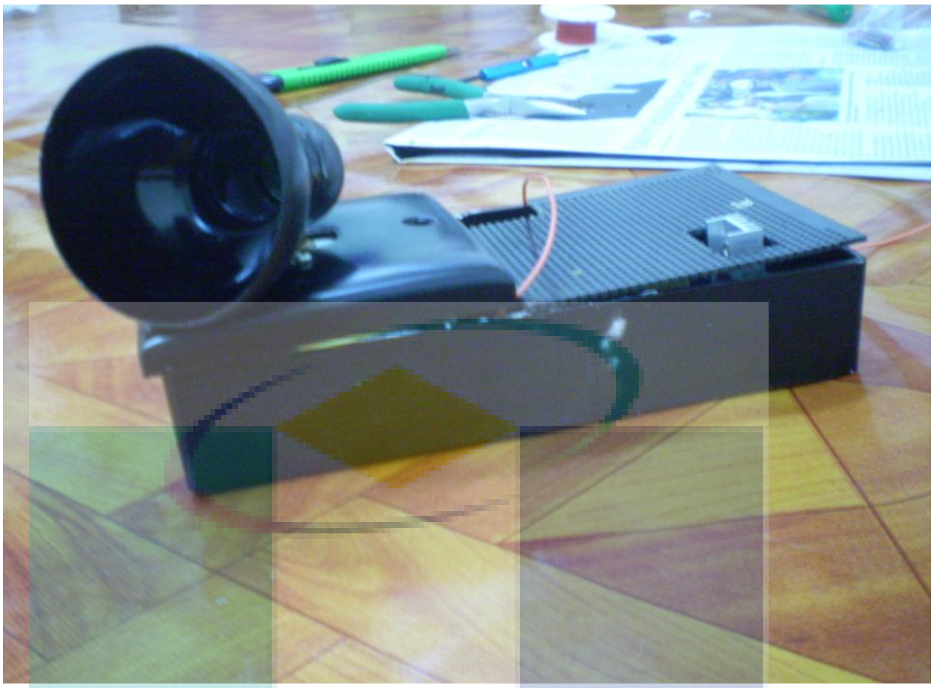

Figure 4.6: Modeling (outside view)

For modeling, the antenna look-a-like is replace by something lighter just for it look exactly like parabolic antenna. This is because the stepper motor for this project is quite small and cannot carry heavy object and it may result the stepper motor cannot move even a single degree.

4.7 Problem Occurs Analysis

After doing troubleshoot about the circuit, the hardware that have been use in this project, there is some problem occurs that make this project cannot achieve its certain scope. The problem is, selection of suitable PIC and the precision of the stepper motor

4.7.1 Selection of suitable PIC microcontroller.

From the beginning of this project, PIC16F84A is been choose as a suitable PIC to be the main controller for this project. There is a mistake in calculating the value of port input or output that must be use to connect two hardware, keypad and stepper motor. For keypad, 8 port of input must be connected to the PIC and the stepper motor need 4 port per stepper motor. In this project, need two stepper motor to accomplish the objective. As a result, 8 port needed to connect the stepper motor as an output. PIC16F84A only consist 4 port A and 8 port B. To solve this problem, using PIC that have more port is better solution.

4.7.2 The precision of the stepper motor

The precision of stepper motor depend on the angle of rotation per phase that can be achieved by certain stepper motor. This project using stepper motor that has 7.5^0 per phase for its angle of rotation. The problem is, the stepper motor failed to deliver the accurate angle. For example, it cannot reach 80^0 of angle. For the solution, this project need more precise stepper motor for the best precision of desire objective.

CHAPTER 5

CONCLUSION AND RECOMMENCATIONS

5.1 Conclusion

As for conclusion, This' project objective to build an Antenna Movement Controller using stepper motor should be successfully achieved. This project implemented successfully with the final part of stepper motor moving with the desire azimuth angle and elevation angle.

5.2 Difficulties

There are some difficulties arise with progressing this project. The major problem is selection of PIC microcontroller that uses in this project. This project use many port for input and output to connect the keypad and the stepper motor. To solve this problem, using the PIC that have many port such as MC68HC11 is the best way to solve this problem.

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5.2.1 Costing and Commercialization

The overall cost for Antenna Movement Controller using PIC16F84A application project are shown in Table 5.1, Table 5.2 and Table 5.3 below:

Table 5.1: Cost for the controller board

Unit name	Component	Qty	Price/ RM	Total price/ RM
Controller Board	PIC 16F84A	1	15.00	15.00
	Push Botton	3	2.00	6.00
	18-pin IC holder	1	1.00	1.00
	4 MHz Crystal	1	6.00	6.00
	Heat sink	1	1.50	1.50
	10µF capacitor	4	0.60	2.40
	0.1µF capacitor	5	0.40	2.00
	Resistor 470 Ω	1	0.30	0.30
	Resistor 1 KΩ	1	0.30	0.30
	Diode 1N4001	1	0.50	0.50
	Diode 1N4148	2	0.80	1.60
	Stepper Motor Connector	2	3.00	6.00
	Stepper Motor	2	18.00	36.00
	Casing box	1	8.00	8.00
	Header	5	0.50	2.50
			Total	RM87.40

Table 5.2: Cost for Hardware Connection

Unit name	Component	Qty	Price/ RM	Total price/ RM
Connection	5 stands rainbow cable	1	2.00	2.00
	8 pin connector	1	2.00	2.00
	Wrapping wire	1	15.00	15.00
			Total	RM 19.00

Table 5.3: Overall Cost of the Project

Unit name	**Total price/ RM**
Controller board	87.40
Connection	19.00
Total cost	RM 106.40

The design also can be improved and developed for commercial used. It also can be develop to be automatically maneuver without using keypad as data entry. Designing a software that could be able to detect the satellite position and it will automatically move the antenna dish to the exact location of satellite position. It also can be develop as portable antenna for communication use.

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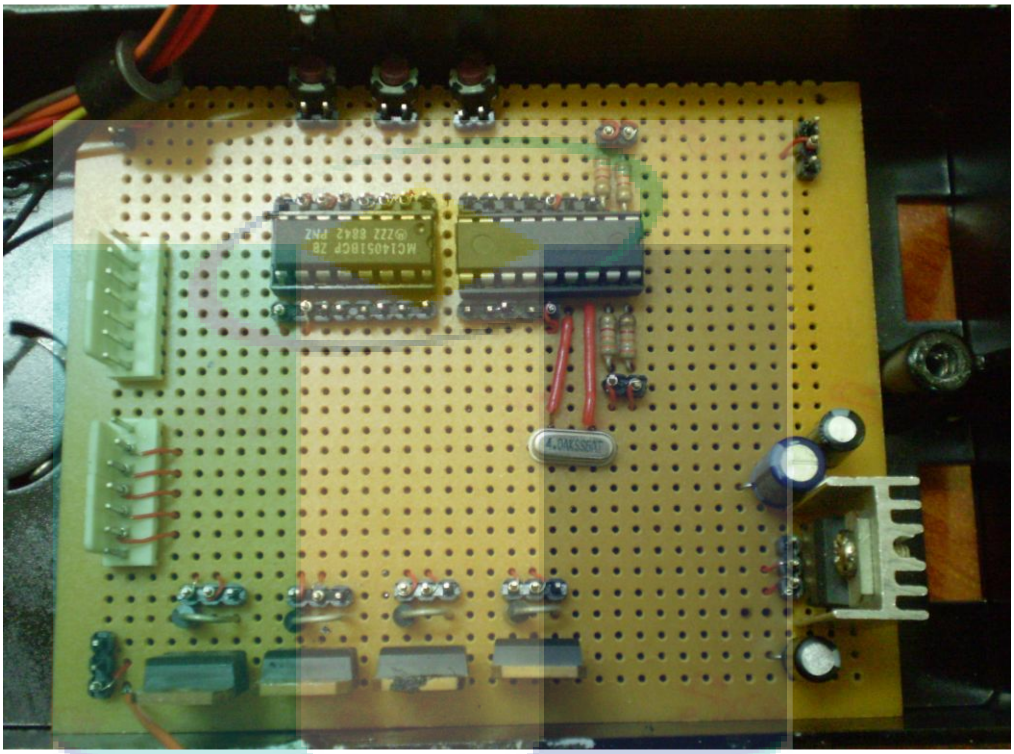
APPENDIX A

Hardware of Antenna Movement Controller



A. Hardware is located between the microcontroller

APPENDIX B

DATASHEET