MICROCONTROLLER-BASED MECHANICALLY SCANNED LED FLASH DISPLAY

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"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Control Instrumentation and Automation)"

Signature : .....

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Date : 02-05-2008

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

Signature : .....

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Date : 02/09/08

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ABSTRAK

"Microcontroller – Based Mechanically Scanned LED Flash Display", adalah tajuk dan juga projek pilihan bagi projek sarjana muda. Objektif bagi projek ini adalah bagi menghasilkan imbasan paparan LED yang dikawal menggunakan PIC kawalanmikro 8 bit. Projek ini melibatkan rekacipta perkakasan iaitu motor kawalan dan juga program computer menggunakan "Assembly language". Projek ini kombinasi motor a.t, mekanikal, kawalanmikro dan juga beberapa komponen yang diperlukan untuk melengkapkannya. Tujuan bagi projek ini adalah bagi membolehkan 7 LED yang disambung secara siri dan secara menegak memaparkan mesej. Projek ini menggunakan bateri sebagai sumber voltan. Projek ini menggunakan PIC 16F84A sebagai pengatur bagi sistem kawalan, dimana 7 LED dikawal melalui port masuk/keluar pada mikropengawal. Bagi membolehkan mesej dapat dibaca, pergerakkan motor AT haruslah segerak dengan frekuensi imbasan pada LED. Penggunaan "ball bearing sliding contact" diantara bekalan kuasa dan Motor AT membolehkan kelajuan pergerakan berubah tanpa menganggu nilai voltan bagi litar. Sistem ini juga menyediakan suis tekan lepas untuk mengesetkan jam, kelajuan dan system asal.

ABSTRACT

The final year project title is "Microcontroller-Based Mechanically Scanned LED Flash Display". The objective of the project is to produce the dynamic LED flash display system controlled by 8 bits PIC microcontroller. This project involves designing of the speed motor controller hardware and software. The project is basically combination of the hardware including DC motor, mechanical part, microcontroller LED driver and other supporting devices. The software application is design based on assembly language. Aim of this project is to produce a battery operated dynamic LED display system that capable to display a short message using a single column of seven LED's. This project used the PIC 16F84A microcontroller as a main processor of the control system, where the seven LED's are controlled through I/O ports of the microcontroller. In order to produce a readable message, the speed of the DC motor rotation needs to be control and synchronized with the LED's flashing frequency. The separate power supply between ball bearing sliding contact and DC motor allow rotation speed to be change without effect voltage value on the circuit. The system also provides the button for the purpose of system initialization, clock setting and DC motor speed.

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CHAPTER I

INTRODUCTION

This section will explain the overall description of Microcontroller-Based Mechanically Scanned LED Flash Display such as the project background, objective, scope, project methodology and expected result of the final year project. Other than that, this section will also discuss the problem statement and the survey done before project development and implementation.

1.1 Project Background

This project is basically designed based on a mechanical control of LED display using a DC motor as a scanner and PIC-based microcontroller as a LED controller. It has the PIC16F84A interfacing with the rotating motor. This project consists of circuit design, software design, interfacing and modification on DC motor structure. This mechanically display structure system is controlled using an 8 bits PIC16F84A and EEPROM based and is powered by 5V DC power supply. The output of the clock is shown in LED display that can be used efficiently to accommodate the functionality of PIC. The clock can be manually adjusted by using the input (switches) buttons.

This project is presented an alternative method to display message using LED. This project used 7 LEDs to display a clock time by combining microcontroller control, interfacing, firmware and DC motor based mechanical scanner. This illusion is based on inertia of human eye.

The LEDs are turned on and off, one after another, very rapidly. Due to very high mechanical scanning frequency compare with low response of the human eye scanning capability, the single row LED display the clock time. The width of the character can be adjusted by varying the motor speed.

A microcontroller is used to keep controlling the display of the LEDs in an appropriate pattern to enable the message can be read. It has to be programmed so that it will both keep time and also send the appropriate signals to drive the LEDs and to ensure in the correct sequence.

1.2 Project Objective

Objective of this project is to design control circuit using microcontroller that able to produce a readable message based on single column 7 LEDs. The project involves embedded controller, I/O control, motor control and some mechanical work. The project comprises of four main parts which are hardware design, software design, motor modification and system integration.

First part of this project is design and development of the PIC-based embedded controller board to control the LED through I/O ports. High speed DC motor is selected to provide high-frequency mechanical scanner so that the LED display will be readable. Due to the high motor speed rotation, the motor is mounted on the strong casing that will protect the moving parts which is mounted on rotor of the motor from strong vibration.

The second part of this project is design and implement of application firmware. The firmware is compiled and downloaded into the EEPROM of PIC microcontroller; the message is displaying and also sends the appropriate I/O signals to the LEDs to light them in the correct sequence.

Third part is DC motor modification processes that taking power from the ball bearing which is mounted on shaft of the motor. The ball bearing acts as sliding contact that allows 12 Volts DC is transferred to the 5V voltage regulator.

The final objective need to achieve is integration of hardware and software to this project. After that, the analysis and experiment will be assigning in order to get the result.

1.3 Scope of Project

The project is mounted on top of rotating DC motor. A proper DC motor should be choose to make the display is proper shown. The display consists of 7 LEDs was arranged in horizontal which show sequence numbers from hours, minutes and seconds.

For mechanical part, it uses a 12V Brushes DC motor as a motor to spin the LEDs. The separate power supply between ball bearing sliding contact and DC motor allow rotation speed to be change without effect voltage value on the circuit. The microcontroller circuit supply to 5V fixed by adding voltage regulator LM7805. Other than that, to synchronous and timing to ensure the correct numbers is displayed is most critical in this project. The project should have grid to display numbers and also to on and off the display. A proper set up timing for LED to the display sequence number and angular speed of the spinning must be synchronous to make sure the display is constant and clearly.

LEDs, is an important things realized first and then lighting them at the correct intervals.

PIC 16F84A is used as the controller for the project utilizing assembly language programming. The features of microcontroller as below:

- Use 35 RISC (Reduced Instruction Set Computer)
- Block Diagram of Memory divided:
  1. Flash Program(1K x 14 bits)

- Used to store the program

2. RAM(160 bytes)
    - SFR: used to record the operating states of the PIC, the input/output (I/0) port conditions and other conditions
    - GPR: used to temporarily store results and conditions while the program is running.
3. EEPROM (64 bytes)
    - Used to store data which will not change frequently.

1.4 Problem Statement

Based on surveyed done through the magazine not forgettable in internet, there is no such this project has been sold at market. So, that makes it become interesting to study more about this project, including the motors, mechanical and electronic things.

Firstly, LED display system still very expensive because numbers of LED's, drivers, high speed processor in example 16-bits Microprocessor running at 20MHz in order to maintain scanning time. So, this project is the solution of those problems. Only using just seven LED's in a row and it will make a display same with those LED display system.

Secondly, this project are combination of the hardware and software, so have to study about the programming for the PIC 16F84A. The programming is to control the seven LED that display the clock. The flow of the programming should be the same as what been setting to the circuit and address must be correct due to the input/output connection on the circuit.

About the motor, DC motor modification processes that taking power from the ball bearing mounted on shaft of the rotor. The ball bearing acts as sliding contact that allows 12 VDC and passes it to the 5V voltage regulator. The motor must be setting cycling constant and rotate smoothly to make sure get the clear illusion of number.

CHAPTER II

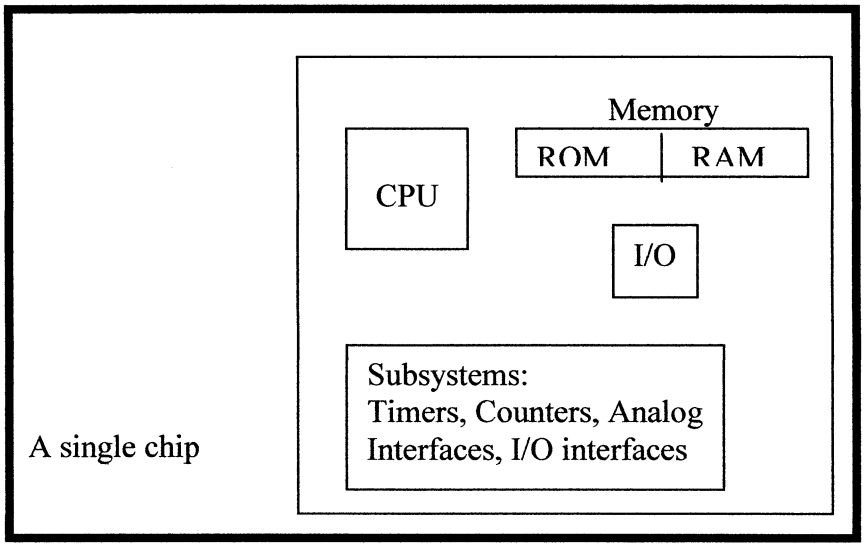
LITERATURE REVIEW

This chapter will discuss about theory and concepts of the project in detail. This discussion is to explain perspective and method that being used in the research before. It survey how far this project interconnected with the research and theory that already have.

Other than that, this chapter also will show the theory and concepts that being used to solve project problem. Understanding about the theory is very important as a guide line through out the research. Final results of the research are not valuable if not compare with theory.

2.1 Microcontroller

A microcontroller (or MCU) is a computer-on-a-chip. It is a type of microprocessor emphasizing self-sufficiency and cost-effectiveness, in contrast to a general-purpose microprocessor (the kind used in a PC). In addition to all arithmetic and logic elements of a general purpose microprocessor, the microcontroller usually also integrates additional elements such as read-only, read-write and flash memory, and input/output interfaces. Microcontroller can be ranging from small and simple 4-bit processors to complex 32- or 64-bit processors according to central processing unit features. [14]



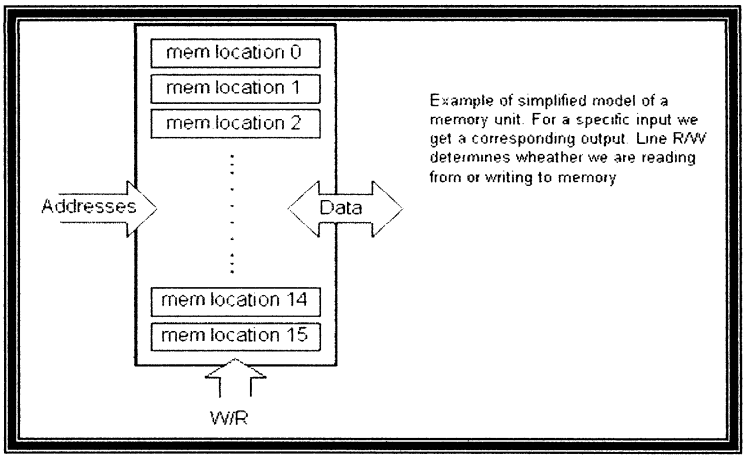
Block Diagram 2.1: Microcontroller Structure System

2.1.1 Microcontroller Features

Microcontroller's features are important while choosing which microcontroller capable to use in projects us wants design. If the performance of the microcontroller that want to use not achieve requirement of the project it will give problem in future, and also will be misspend if it over the requirement.

2.1.1.1 Memory

Memory is part of the microcontroller whose function is to store data. Memory components are exactly like that. For a certain input we get the contents of a certain addressed memory location and that's all. Two new concepts are brought to us: addressing and memory location. Memory consists of all memory locations, and addressing is nothing but selecting one of them. This means that need to select the desired memory location on one hand, and on the other hand have to wait for the contents of that location. Besides reading from a memory location, memory must also provide for writing onto it. This is done by supplying an additional line called control line. We will designate this line as R/W (read/write). Control line is used in the following way: if r/w=1, reading is done, and if opposite is true then writing is done on the memory location.



Block Diagram 2.2: Memory Location

a) RAM

Random access memory (RAM) is a type of computer data storage. It takes the form of integrated circuits that allow the stored data to be accessed in any order that is, at random and without the physical movement of the storage medium or a physical reading head. RAM is a volatile memory as the information or instructions stored in it will be lost if the power is switched off.

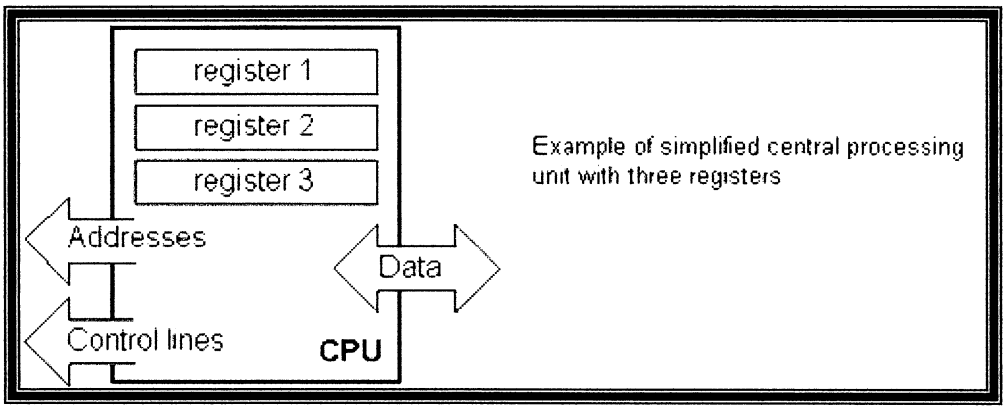
b) FLASH

Flash memory is non-volatile computer memory that can be electrically erased and reprogrammed. It is a specific type of EEPROM that is erased and programmed in large blocks; in early flash the entire chip had to be erased at once. Flash memory costs far less than byte-programmable EEPROM and therefore has become the dominant technology wherever a significant amount of non-volatile, solid-state storage is needed

2.1.1.2 Central Processing Unit

By add 3 more memory locations to a specific block that will have a built in capability to multiply, divide, subtract, and move its contents from one memory location onto another. The part which just added in is called "central processing unit" (CPU). Its memory locations are called registers. Registers are therefore memory

locations whose role is to help with performing various mathematical operations or any other operations with data wherever data can be found.

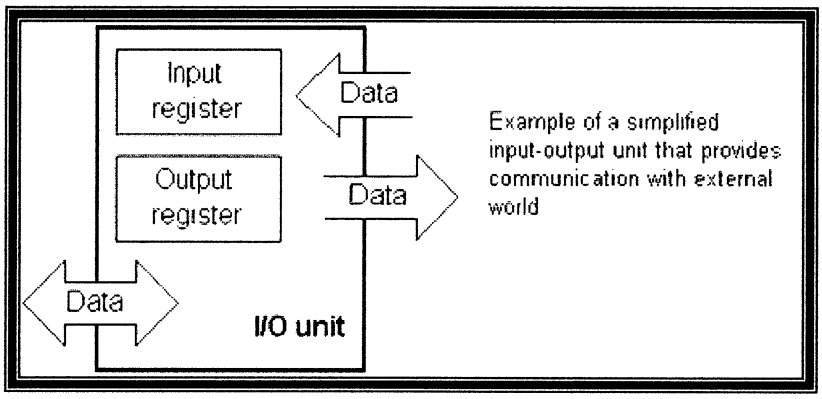


Block Diagram 2.3: CPU

2.1.1.3 Input/Output Port

There are several types of ports: input, output or bidirectional ports. When working with ports, first of all it is necessary to choose which port need to work with, and then to send data to, or take it from the port.

When working with it the port acts like a memory location. Something is simply being written into or read from it, and it could be noticed on the pins of the microcontroller.



Block Diagram 2.4: I/O Location