PROGRAMMABLE MECHANICALLY DRUM BAND

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DEGREE OF BACHELOR OF MECHATRONIC

2010

"I hereby declared that I have read through this report entitle "Programmable Mechanically Drum Band" found that it has comply the partial fulfillment for awarding the degree of Bachelor of Mechatronic Engineering"

Signature : .....

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Date : 22 April 2010

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This Report is submitted in Partial Fulfillment of Requirements for the Degree of Bachelor in Mechatronic Engineering

FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APRIL 2010

"I hereby declared that this report entitle"Programmable Mechanically Drum Band" is a result of my own work except for the excerpts that have been cited clearly in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree."

Signature : .....

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Date : 22 April 2010

ACKNOWLEDGEMENT

Alhamdulillah, finally the Final Year Project 2 (FYP) is complete. I take a great pleasure in this opportunity to thank many persons who generously advice and assists me while I was doing my Final Year Project 2 which is compulsory to all UTEM students to pass before awarded the degree.

First of all, I would express my deepest thanks and gratitude to my project supervisor, Prof. Madya En Ismadi b Bugis for undivided support morally and physically, assistance, guidance, tolerance, which proved to be invaluable as to the completion of my FYP 2.

I also would like to thank the panel, Mr. Muhammad Herman b Jamaluddin and Mr. Mohd Razali b Mohd Safiee @ Alia, whose give me a good comment during my presentation. I also would like to take this opportunity to express my appreciation to my family and friends for their patients, understanding and also for their undivided support that they had gave me throughout the completion of my project.

Last, but not least I also would like to thank all those helping and supporting me directly and indirectly during my Final Year Project 2.

ABSTRACT

This project is about to design and develop of programmable mechanically drum band. This project contains three main parts which are included electric circuit, mechanical design and programming. Programmable mechanically drum band is manual robot that had been enhanced with some automatic function that makes the robot able to play a music device as a human drummer. This robot has two arms stick and two drum. A special knocker will be implemented in this project to make sure there is no damaged during the operation neither the motor nor the drum. Electrical design is included to design a good electrical drives to suit mechanical requirements. Mechanical design is of prime important to develop reliable, flexible, robust and lightweight that suitable to robot task. Software is spirit of the robot that able to make the robot behave closely to human being.

ABSTRAK

Tujuan utama projek ini adalah untuk mencipta mesin drum automatik. Mengandungi tiga bahagian penting termasuklah litar elektrik, rekabentuk, dan program komputer. Robot drum ini dilengkapi fungsi automatic yang menjadikannya boleh melakukan kerja seperti seorang pemain drum. Mempunyai dua tangan yang berfungsi memegang pengetuk drum. Rekabentuk elektrik adalah penting untuk mengawal mekanikal struktur. Bahagian mekanikal pula penting untuk dibina supaya fleksibel, dan ringan. Program software adalah nadi robot ini yang mana membuatkan robot ini bertindak seperti seorang pemain drum.

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PWM - Pulse Width Modulation

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CHAPTER 1

INTRODUCTION

The robot originated from the Czech word Robota, meaning work. Webster dictionary defines robot as "an automation devices that performs functions ordinarily ascribed to human beings". With this definition, washing machine may be considered as robot. A definition used by the robot Institute of America gives a more precise description of industrial robots: "a robot is a reprogrammable multifunctional manipulator designed to more material, part, tools, or specialized devices through variable programmed motion for the performance of a variety of task". In short, a robot is a reprogrammable general-purpose manipulator with external sensor that can perform various assembly tasks. With this definition, a robot must process intelligence, which is normally due to computer algorithms associated with its control and sensing system.

1.1 PROBLEM STATEMENT

There are numerous potential applications for automated music transcription, such as a learning aid for people wishing to learn how to play a piece of music where they only have access to an audio recording and do not have the necessary skills to attempt transcription themselves. Automatic transcription also has further use in the areas of music information retrieval, such as in query-by-humming systems, whereby the user hums or plays a piece of music and the computer attempts to identify the piece. It also has potential use in the generation of metadata for accessing and retrieving multimedia content such as that contained in the MPEG7 standard.

This project is about to design and develop a mechanical robot drum band. It is expected that this robot can be used in many functions and well program movement such as in film, advertisement or some art exhibition. This robot can beat drum amiable occur appropriately by installing the program to the controller. By doing so, this robot can also be used in musical orchestra that can mimicking human drummer.

1.2 OBJECTIVE

The main objective of this project is to build a mechanical music drum band. In order to make this project successful, the objectives have been declared that are:

1) Design a mechanical robot
2) Test the performance of mechanical robot.
3) Identify design of mechanical robot that can be improved.
4) Test performance of the robot.
5) Improve design of robot.

1.3 SCOPE

The scope of this project is to build a robot structure that will function properly referring to the objective where the need of the design must be build in good shape to make sure it suitable with the motor and other stuff.

Next, to create a computer program that will process the whole data from input to the output. The program must be formulated after the mechanical part completed to make sure the robot will function properly.

Lastly, perform an experiment that is including testing and commissioning the product to make sure the product well function as stated in the objective.

CHAPTER 2

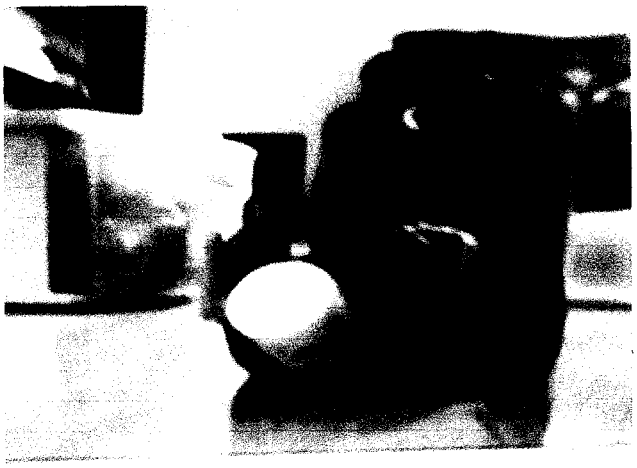
LITERATURE REVIEW

In this chapter, there are several informations about the stuff that need in this project. The information about the controller, motor and other information are described in this chapter. Currently, literature about robot drummer is very hardly to found. Instead, author will explains product or software found in the market.

2.1 Other Automatic Drum

There are several auto drum that have been search in the internet. The information will be discussed below.

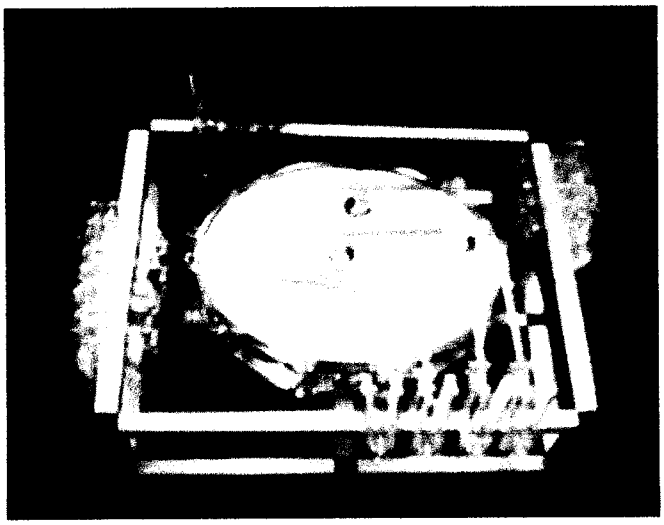
Toy Drum



This is a toy robot where two knockers are use to knock the drum. The difference of the sound is made by the difference of knocker speed. This robot uses the sample drum that made by

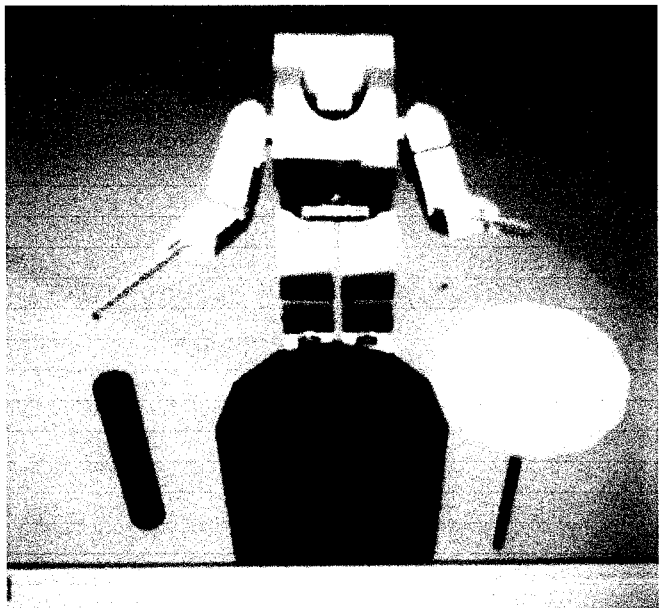
plastic or cup. The speed of the knocker is high but the sounds that come from the drum is always the same because there is no different from the knocker. This kind of auto drum can be describe as a toy robot because the using of motor that can drive the drum anywhere. The advantage of this robot is it can move forward by avoiding the object that come from the front.

Auto Music Drum



Above is the auto drum that more knockers have been used. The difference of sound is made by variety of knockers. It can be seen at the picture where there are so many motor have been used. Each motor is joining with different knocker to make different rhythm of music. Otherwise, the knocker will knock at different part of drum to produce different sound. This drum is kindly the same as my robot but it can be expensive to buy a lot of motor.

Robot Drum Simulation by Fujitsu



This is the simulation of a robot drum by Fujitsu. In this robot, the robot will detect where the drum is by using sensors. This robot is on the developing and do not have the real robot. From the simulation, it can be seen that the drum is moving randomly from its initial position. The task is to detect where the drum is and try to hit it. Several sensors are used in this robot and a camera is used to detect the motion of drum. This auto drum is a high technology machine that will be produce by Fujitsu.

2.2 The PIC16F877A Microcontroller

A microcontroller is a computer-on-a-chip used to control electronic devices. It is a type of microprocessor emphasizing self-sufficiency and cost-effectiveness, in contrast to a general purpose microprocessor (the kind that used in a pc). A typical microcontroller contains all the memory and interface needed for a simple application, whereas a general purpose microprocessor required additional chips to provide these function.

A microcontroller is a single integrated circuit with the following key features:

- Central processing unit – ranging from small and simple 8-bit processor to sophisticated 32 or 64-bit processor.
- Input/output interfaces such as serial port
- Peripheral such as timer and watchdog circuit
- RAM for data storage
- ROM,EEPROM or Flash memory for program storage
- Clock generator – often an oscillator for a quartz timing crystal, resonator or RC circuit

This integration drastically reduces the number of chip and the amount of wiring and PCB space that would be needed to produce equivalent system using separate chip.

2.2.1 PIC16F877A

The PIC16F877A (Programmable Interface Controller) contains a 8192 x 14 Flash EEPROM, 33 I/0 port pins, 8 channels of A/D converters, IC and SPI bus compatible pins, power on reset, watchdog timer, power saving sleep mode, brown-out detection circuitry including external interrupt and various internal interrupt sources.

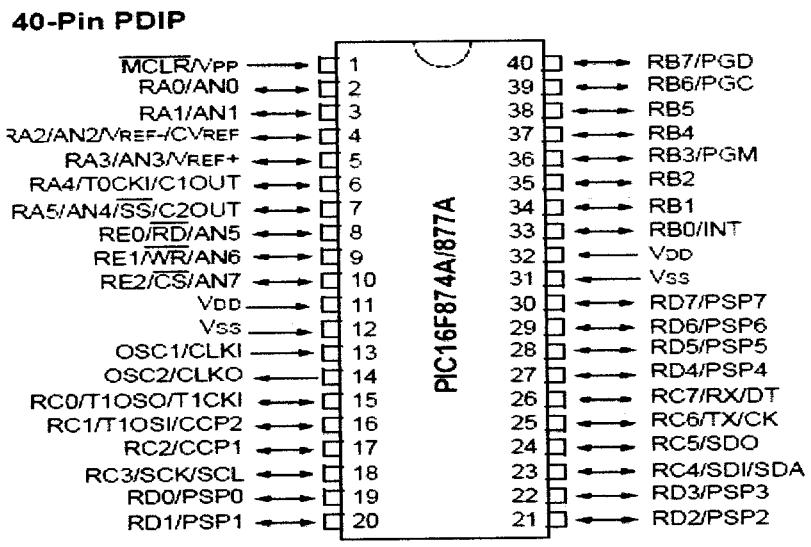


Figure 2.2: The diagram of PIC16F877A and its pin description.

High Performance RISC CPU

- Only 35 single-word instructions to learn
- All single-cycle instructions except for program branches, which are two-cycle
- Operating speed: DC – 20 MHz clock input
  DC – 200 ns instruction cycle

Analog Features

- 10-bit, up to 8-channel Analog-to-Digital Converter (A/D)
- Brown-out Reset (BOR)
- Analog Comparator module with:
  - Two analog comparators
  - Programmable on-chip voltage reference (VREF) module
  - Programmable input multiplexing from device inputs and internal voltage reference
  - Comparator outputs are externally accessible

Special Microcontroller Features

- 100,000 erase/write cycle Enhanced Flash program memory typical
- 1,000,000 erase/write cycle Data EEPROM memory typical
- Data EEPROM Retention > 40 years
- Self-reprogrammable under software control
- In-Circuit Serial Programming™ (ICSP™) via two pins
- Single-supply 5V In-Circuit Serial Programming
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode
- Selectable oscillator options
- In-Circuit Debug (ICD) via two pins

CMOS Technology:

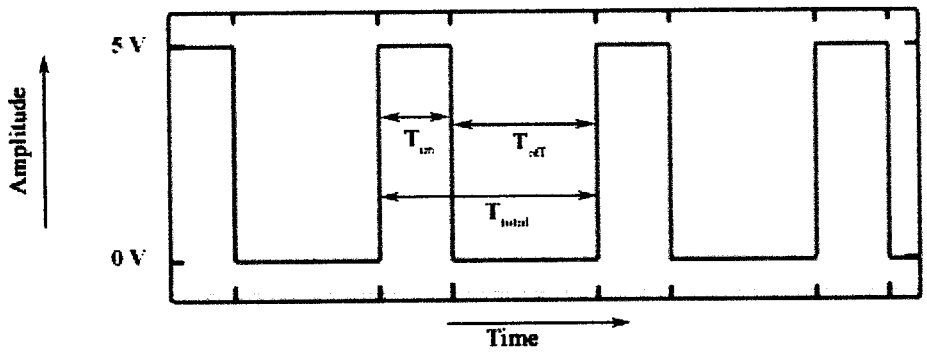
- Low-power, high-speed Flash/EEPROM technology
- Fully static design
- Wide operating voltage range (2.0V to 5.5V)
- Low-power consumption

2.3 Pulse Width Modulation

Pulse width Modulation or PWM is one of the powerful techniques used in control systems today. They are not only employed in wide range of control application which includes: speed control, power control, measurement and communication. In this section, it will explain PWM core and implementation of PWM and PIC microcontroller.

2.3.1 Basic Principle of PWM

Pulse-width Modulation is achieved with the help of a square wave whose duty cycle is changed to get a varying voltage output as a result of average value of waveform. A mathematical explanation of this is given below.



Consider a square wave shown in the figure above.

T_{on} is the time for which the output is high and T_{off} is time for which output is low. Let T_{total} be time period of the wave such that,

$$T_{total} = T_{on} + T_{off}$$

Duty ratio of a square wave is defined as

$$D = \frac{T_{on}}{(T_{on} + T_{off})} = \frac{T_{on}}{T_{total}}$$

The output voltage varies with duty cycle as...

$$V_{out} = D \times V_{in}$$

$$\boxed{V_{out} = \frac{T_{on}}{T_{total}} \times V_{in}}$$

So you can see from the final equation the output voltage can be directly varied by varying the $\mathbf{T_{on}}$ value.

If $\mathbf{T_{on}}$ is 0, $\mathbf{V_{out}}$ is also 0.

If $\mathbf{T_{on}}$ is $\mathbf{T_{total}}$ then $\mathbf{V_{out}}$ is $\mathbf{V_{in}}$ or say maximum.

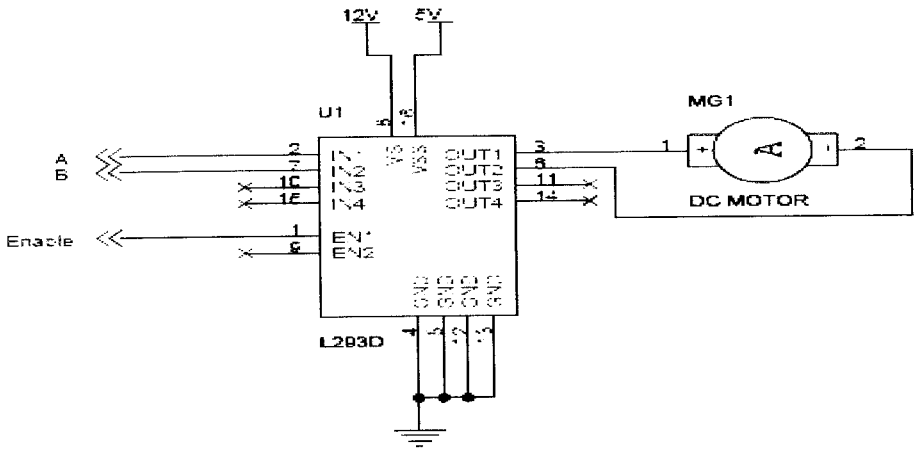
2.4 DC Motor

2.4.1 DC Motor interfacing with Microcontrollers tutorial: L293D H-Bridge interfacing

- L293D Dual H-Bridge Motor Driver

L293D is a dual H-Bridge motor driver, with one IC it can interface two DC motors which can be controlled in both clockwise and counter clockwise direction and it can use all the four I/Os to connect up to four DC motors. L293D has output current of 600mA and peak output current of 1.2A per channel. For protection of circuit from back EMF output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D a best choice for DC motor driver.

A simple schematic for interfacing a DC motor using L293D is shown below.



Truth Table

A	B	Description
0	0	Motor stops or Breaks
0	1	Motor Runs Anti-Clockwise
1	0	Motor Runs Clockwise
1	1	Motor Stops or Breaks

For above truth table, the Enable has to be Set (1). Motor Power is mentioned 12V, but you can connect power according to your motors.

Figure 2.4 : Simple schematic for interfacing a DC motor using L293D

As you can see in the circuit, three pins are needed for interfacing a DC motor (A, B, Enable). If you want the o/p to be enabled completely then you can connect Enable to VCC and only 2 pins needed from controller to make the motor work.

As per the truth mentioned in the image above its fairly simple to program the microcontroller. It's also clear from the truth table of BJT circuit and L293D the programming will be same for both of them, just keeping in mind the allowed combinations of A and B. We will discuss about programming in C as well as assembly for running motor with the help of a microcontroller.