

AUTOMATED JUICE MIXER

ASNIZA BINTI MUHIDIN

This report is submitted in partial fulfillment of requirements for the award of Bachelor of Electronic Engineering (Computer Engineering) with honours

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka

April 2007



UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : AUTOMATED JUICE MIXER

Sesi Pengajian : 06/07

Saya ASNIZA BINTI MUHIDIN mengaku 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 keselamatan 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: Tali Air 6, Kampung Belt,
36600 Cenderong Balai, Perak.

(COP DAN TANDATANGAN PENYELIA)

SITI KHADIJAH BT IDRIS @ OTHMAN

Pensyarah

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer (FKEKK)

Universiti Teknikal Malaysia Melaka (UTeM),

Karung Berkunci 1200,

Ayer Keroh, 75450 Melaka

Tarikh:

03/05/07

Tarikh:


3/5/07

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

Signature :
Author :
Date :

Asmiza
ASMIZA BT MUHIBIN
03/05/07

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

Signature : 

Supervisor's Name : SITI KHADIJAH BINTI IDRIS

Date : 3/5/07

Special dedicates to my beloved parents, family and fellow friends, who had strongly encouraged and supported in my entire journey of learning

ACKNOWLEDGEMENT

This study could never have been completed without the help and support of many individuals. I wish to express my most sincere gratitude to all of the people who helped me to take this project successful especially to my supervisor, Puan Siti Khadijah Binti Idris@Othman for providing the excellent guidance, concern and informative discussions regarding to my project. Finally to my beloved family members for their unconditional love, support and patience and at last to my friends who gave me support and opinion to make my project successful.

ABSTRACT

This Automated Juice Mixer is a juice mixing device that allows user to create desired drinks with up to four different ingredients through a user friendly interface. RS232 serial port is used to connect the computer to the juice mixer which allows user to dispense or blend their desired recipe easily. The connection also allows uploading or downloading recipes to the EEPROM embedded in microcontroller. By used EEPROM the program can easily be downloading into PIC(Peripheral Interface Controller) and it can be electrically erased when new program is needed to replace the original program. The IC used is chip PIC16F877 where C programming software is used to program the IC. The software controls whether to dispense the liquids or load recipes to or from EEPROM. The graphical user interface software is designed in Visual Basic which allows user to send recipe data through the RS232 port. The design of the juice mixer is build by a bottles which supported by valve and DC motor. The tube will be used together to allow liquid to flow through it based on the time set on timer.

ABSTRAK

Pembancuh Jus Automatik ini adalah sejenis alat pembancuh jus yang membenarkan pengguna membancuh air minuman yang dikehendaki dengan menggunakan empat bahan yang berlainan melalui perantaramuka mesra pengguna. Terminal sesiri RS232 digunakan untuk membenarkan komputer berkomunikasi atau bersambung dengan alat pembancuh jus di mana ia akan membenarkan pengguna untuk mengagihkan atau mencampurkan bahan resepi yang dikehendaki dengan mudah. Penyambungan tersebut juga membenarkan penyimpanan atau muat turun data resepi ke dalam EEPROM(Electrically Erasable Programmable Read-Only Memory) yang terdapat di dalam pengawal mikro. Dengan menggunakan EEPROM, program lebih mudah untuk dimuat turun ke PIC(Peripheral Interface Controller) dan mudah untuk dipadam secara elektrik apabila program baru hendak ditulis bagi menggantikan program yang sedia ada. Untuk projek ini, jenis kawalan mikro yang digunakan ialah dari keluaran Microchip jenis PIC16F877 di mana ia diprogram menggunakan perisian aturcara bahasa C. Perisian tersebut akan mengawal sama ada perlu mencampurkan bahan-bahan resepi atau memuat turun resepi kepada atau daripada EEPROM. Perantamuka mesra pengguna yang digunakan dibina menggunakan perisian Visual Basic di mana aturcara akan membenarkan pengguna untuk menghantar data resepi melalui terminal RS232. Rekabentuk pembancuh jus ini adalah terdiri daripada empat botol yang disambung pada injap dan motor berarus terus. Tiub juga digunakan untuk membenarkan pengaliran bahan-bahan tersebut melaluinya berdasarkan masa yang telah ditetapkan.

CONTENT

CHAPTER	ITEM	PAGE
	PROJECT TITLE	i
	DECLARATION STATUS OF REPORT FORM	ii
	DECLARATION	iii
	DEDICATION	v
	ACKNOWLEDGEMENT	vi
	ABSTRACT	vii
	ABSTRAK	viii
	CONTENT	xi
	LIST OF TABLE	xii
	LIST OF FIGURE	xiv
	ABBREVIATIONS	xv
	LIST OF APPENDICES	xvi
I	INTRODUCTION	
	1.1 Introduction	1
	1.2 Objective	2
	1.3 Problem Statement	3
	1.4 Scope of the Project	4
	1.5 Outline of the Thesis	4

II LITERATURE REVIEW

2.1	Introduction	6
2.2	History of Peripheral Interface Controller	6
2.3	Software	8
2.3.1	EEPROM Programming	8
2.3.2	Graphical User Interface	9
2.3.3	Command Line Interface	10
2.4	Hardware	12
2.4.1	Theory of DC Motor	12
2.4.1.1	Direction Motor	14
2.4.1.2	Speed	15
2.4.2	RS232 Serial Port	17
2.4.3	Solenoid Valve	22

III METHODOLOGY

3.1	Introduction	26
3.1.1	Literature Review	28
3.1.2	Design the Programming	28
3.1.3	Simulation	28
3.1.4	Design the Circuit	28
3.1.5	Build	29
3.1.6	Testing	29
3.1.7	Troubleshoot	29
3.1.8	Combine and Apply to the Project	29
3.2	Hardware Overview	29
3.2.1	Circuit Design	30
3.2.2	Simulation	30

3.2.3	Build Circuit	31
3.2.4	Testing	33
3.2.5	Troubleshoot	33
3.3	Software Overview	33
3.3.1	Study of Programming	34
3.3.2	Build a Program	34
3.3.3	Simulation and Testing	34
3.3.4	Troubleshoot	35
IV	RESULT AND ANALYSIS	
4.1	Introduction	38
4.2	Hardware Result and Analysis	38
4.2.1	Analysis of Voltage Regulator Circuit	39
4.2.2	Analysis of PIC and Motor Controller Circuit Combined with MAX 232	39
4.2.3	Analysis of PIC and Valve Circuit	41
4.3	Software Result and Analysis	43
V	DISCUSSION AND CONCLUSION	
5.1	Discussion	48
5.2	Suggestion	49
5.3	Conclusion	50
	REFERENCES	51
	APPENDIXS	53

LIST OF TABLE

NO.	TITLE	PAGE
2.1	The Advantages and Disadvantages of Graphical User Interface	9
2.2	The Advantages and Disadvantages of Command Line Interface	11
2.3	DC Motor versus Stepper Motor	16
2.4	The Advantages of Using Serial Data Transfer Rather Than Parallel	20
2.5	Serial Pinouts	21
2.6	Pin Functions	21
4.1	Coding for Set the Value of Ingredients	44
4.2	Coding for Reduction Value of Ingredients	45
4.3	Coding for Warning Message	46

LIST OF FIGURE

NO.	TITLE	PAGE
2.1	Electric Motors of Various Sizes	12
2.2	A Simple DC Electric Motor	13
2.3	The Armature Continues to Rotate	13
2.4	The Armature Becomes Horizontally Aligned	13
2.5	H Bridge	14
2.6	Microcontroller Switch the Motor	15
2.7	Pulse Widths and the Voltages Simulation	16
2.8	Pulse Widths and the Voltages Simulation	16
2.9	RS232 Serial Port Connector	17
2.10	Pinouts for the MAX 232, RS232 Driver/Receiver	19
2.11	MAX 232 Circuit	19
2.12	Solenoid Valve	22
2.13	90° Solenoid Valve	25
2.14	180° Solenoid Valve	25
3.1	Project Methodology	27
3.2	Voltage Regulator Circuit	31
3.3	PIC Circuit	32
3.4	Max 232 Circuit	32
3.5	Relay Circuit	32
3.6	Process of Machine	36

3.7	Prototype of Automated Juice Mixer	37
4.1	Voltage Regulator Circuit	39
4.2	Motor Controller with PIC Connected to Max 232	40
4.3	PIC and Valve Circuit	42
4.4	Graphical User Interface	43
4.5	All Values of Ingredients	44
4.6	Reduction Value of Ingredients	45
4.7	Warning Message to Refill	46

ABBREVIATIONS

PIC	-	Peripheral Interface Controller
TTL	-	Transistor-transistor Logic
DC	-	Direct Current
AC	-	Alternate Current
DTE	-	Data Terminal Equipment
DCE	-	Data Circuit-terminating Equipment
GUI	-	Graphical User Interface
CLI	-	Command Line Interface
USART	-	Universal Synchronous Asynchronous Receiver
CMOS	-	Complementary Metal-Oxide-Semiconductor
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
RAM	-	Random Access Memory
PSTN	-	Public Switched Telephone Network
RISC	-	Reduced Instruction Set Computing

LIST OF APPENDICES

NO.	TITLE	PAGE
A	Source Code of Whole Project	53
B	Source Code of Serial Connection	58
C	Datasheet of PIC16F877	61

CHAPTER I

INTRODUCTION

1.1 Background of Project

The Automated Juice Mixer is a juice mixing device that allows user to create desired drinks with up to four different ingredients through a user friendly interface. RS232 serial port is used to connect the computer to the juice mixer which will allow user to dispense their desired recipe easily. The connection is allowed uploading or downloading recipes to the EEPROM embedded in microcontroller so that the recipes does not lose its contents with the loss of power supply and can be retained in EEPROM without power supply for up to 40 years with up to 1 million cycles of writing can be executed.

The design of the juice mixer is build by a bottles which supported by solenoid valve with tube and DC motor. The tube is used together to allow liquid to flow through it based on the time that is set on timer and the DC motor is used to dispense the liquid smoothly.

The IC used in this project is the PIC16F877. The Harvard architecture is used to implement its function as programmable interface controller. By used EEPROM the

program can easily be downloading into PIC and it can be electrically erased when new program is needed to replace the original program. Visual Basic programming software is used to program the IC used in this project. The software control whether to dispense the liquids or load recipes to or from EEPROM and the graphical user interface software is designed in Visual Basic which allows user to send the recipe data through the RS232 port.

1.2 Objectives

The objectives of the project are:-

- 1) to build a juice mixer which allow user to create desired drinks with up to four different ingredients through a user friendly interface.
- 2) to develop a good system for dispense or blend the juice by used PIC 16F877.
- 3) to build a juice mixer which used RS232 serial port connection between the computer and the EEPROM to allow uploading/downloading recipes process.
- 4) to design the prototype/model of device that can mix the juice automatically.

1.3 Problem Statement

Nowadays, in rapid technology development, human activities increase with the increase of demand. Biologically when human activities increase, human body will dehydrate more and as a result, human body will need a water to recover the losses. In doing so, lots of people prefer to buy water from shop. This will result in misspent their money as we knew the price for need items increases every year.

As a solution of human needs mention above, lots of drinking water maker now available in market and we can also found it at industrial places, office building and event at home. For example the 'vending machine', '3 in 1 instant' and 'coffer maker' can be found in certain home. The disadvantage of this available equipment is the taste of the drinking water is not satisfied for every individual because every person has their uniqueness of taste.

Besides that, some drinking water maker is specified in one type of drinking water only. Indeed there are machine that give a various type of drinking water. That's mean not only one type of drinking water can be made, for example vending machine. Because of the size, it is impossible to place vending machine at home. In fact, it is not portable type machine. Instead of that, it requires more time to be spent to wait for water to mix with ingredients when '3 in 1' is used.

The Automated Juice Mixer is a solution for this problem. It is designed to be user friendly. The machine is automatic mix and dispenses the desire drinks. This machine provides four different ingredients including two flavors, sugar and water. The users only need to press the start button to know all ingredients quantity and then choose and press the flavors button. This will save time compared to the normal method.

1.4 Scope of the Project

The scope for this project is to study the PIC(Peripheral Interface Controller) deeply including the C programming to program the PIC for controlled the hardware part. Besides that, the types of motor also need to study for choosing the suitable motor for dispense the juice and suitable valve to allow the flow of all ingredients to the container cup to mix in order to make one glass of juice. Then, the visual basic programming is studied for use as a graphical user interface to interact with a computer which employs graphical images, in addition to represent the information and actions available to the user. And lastly, the serial port connection using RS232 serial port also is studied to know how that data can be transmitted and received and communicate through the hardware and software.

1.5 Outline of the Thesis

This thesis consists of five chapters that describes in detail and clearly about this project. **Chapter one** is an introduction of the entire project. These are included the importance of this project and motivation of the projects. Besides, the problem statement, objectives and scope are discussed in this chapter.

Chapter two will be based on the literature review that is related to this project. Literature review is important to explain or briefly describe the work that has been reported on a topic or field. It will describe the related theory of components or some devices that is chosen in this project. It also explains the main ideas of the approach taken here as well as a frame of conditions and potential problems to which the system will be adapted.

Chapter three explains the project methodology implemented in this project in details. It is use to describe the research perspective at past, present or possible future points of view. This chapter also have been listed the methodologies that could be use and describe why each might be appropriate and feasible. So, it can be reuse as a guide to make some improvement to this project.

Chapter four is focused on the result and analysis of this project. This chapter describes all the results and analysis with some discussion about the testing and verification.

Last chapter in this thesis are conclusion of this project. The performance and limitations of this project from the beginning to the end is discuss including the problems, unachieved objectives and all the matters arise during this project conducted. This chapter also, describes the future recommendation plus the ideas of upgrading that can be add to improve and increase the efficiency and reliability in future.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

In this chapter, all about theory and concept of the entire project is explained. Literature review on past journals is done to understand the operation of project. Before start the project, literature review must be done which is all information about the project can be applied to the product that is going to design.

2.2 History of Peripheral Interface Controller(PIC)

PIC is a family of Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. PIC are popular due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, serial programming and re-programming with flash memory capability.

The PIC architecture is distinctively minimalist. It is characterized by some features such as it has a separate code and data spaces with a small number of fixed length instructions. The most instructions are single cycle execution with a single delay cycles upon branches and skips. Furthermore, it has a single accumulator which the use of source operand is implied.

All RAM locations are functioned as registers as both source and destination of math and other functions. The hardware stack inside the PIC is functioned for stored the return addresses and a fairly small amount of addressable, the data space typically 256 bytes and extended through banking. Then, the PIC is consisting of data space mapped CPU, port and peripheral registers. The program counter is also mapped into the data space and writable used to synthesize indirect jumps.

PIC microcontrollers have a very small set of instructions, leading some to consider them as RISC devices, however many significant features of RISC CPU's are not reflected in the PIC architecture. For example it does not have load-store architecture, as memory is directly submit in arithmetic and logic operations and it has a singleton working register, whereas most modern architectures have significantly more. But PIC microcontrollers are categorized under RISC category due to their features. It is reduced instruction set, fixed size of each instruction and execution of each instruction in single cycle.

PIC has a set of register files that function as general purpose RAM, special purpose control registers for on-chip hardware resources are also mapped into the data space. The addressability of memory varies depending on device series, and all PIC devices have some banking mechanism to extend the addressing to additional memory.

2.3 Software

In order to control a device easily without knowing how everything works. Visual Basic is chosen to write a GUI program rather than using the Common Line Interface because graphical user interface is a particular case of user interface for interacting with a computer which employs graphical images and widgets in addition to text to represent the information and actions available to the user.

2.3.1 EEPROM Programming

The most important characteristics of this memory are that it does not lose its contents with the loss of power supply. Then the data can be retained in EEPROM without power supply for up to 40 years and up to 1 million cycles of writing can be executed. Actually, EEPROM memory also is placed in a special memory space and can be access through special registers. These registers are:

- EEDATA: holds read data or that to be written
- EEADR: contain an address of EEPROM location being access.
- EECON1: contain control bits.
- EECON2: this register does not exist physically and serves to protect EEPROM from accidental wiring.