

**MICROWEB AND COIN SLOT FOR SNACK VENDING  
MACHINE**

**MOHD SYAZWAN BIN MOHD AZLI**

**MAY 2007**

**MICRO-WEB AND COIN SLOT FOR SNACK VENDING MACHINE**

**MOHD SYAZWAN BIN MOHD AZLI**

**This Report is submitted In Partial Fulfillment of requires for the Bachelor Degree  
of Electrical Engineering (Control, Instrumentation and Automation)**

**Faculty of Electrical (FKE)  
Universiti Teknikal Malaysia Melaka (UTeM)**

**MAY 2007**

“I hereby declare that I have read this report and in my opinion this report is sufficient in terms of scope and quality for award of the degree of Bachelor in Electrical Engineering (Control, Instrumentation and Automation)”

Signature :  .....

Supervisor's Name : En. Mohamed Azmi Bin Said

Date : 7/5/2007 .....

“Hereby, I declare that this report is a result of my own research idea except for works that have been cited clearly in the references.”

SIGNATURE : 

NAME : MOHD SYAZWAN BIN MOHD AZLI

DATE : 7<sup>th</sup> MAY 2007

***To My Beloved:***

***Father, Mother, Sisters, Brother and Friends***

***Mohd Azli b. Dahalan, Fadzliah Bt. Salleh***

***Mohd Syahir b. Mohd Azli, Nursuhaili bt. Mohd Azli***

***Nursabihah bt Mohd Azli***

***Thanks For The Support***

***May Allah Bless You All***

## ACKNOWLEDGEMENT

Firstly I would like to express my deep gratitude to Allah SWT who granted me strength to wade difficulties in finishing my project. A lot of thanks to my supervisor, Mr. Mohamed Azmi bin Said for providing full attention, knowledge, guidance and patience throughout the year to the development of my project. Even though there were only some enhancements in my project but still I really appreciate all the precious time spent and guidance for me to overcome all the obstacles occurred in completing this project.

During the time completion, I had collaborated with many colleagues for whom I have great regards and I wish to extend my warmest thanks to all those who helped me with my work especially the technicians, En Omar and En Jasmadi who had offered great advices and time for me to complete this project.

Also, cordial thanks dedicated to my family and my friends under En Azmi supervision for the faithful encouragement and moral support. Thanks again for everything that you all gave to me.

## ABSTRACT

This project, 'Microweb and Coin Slot for Snack Vending Machine' is to create and design microweb and coin slot for snack vending machine that can allow consumer to use this machine with two methods instead of one. First using the internet from microweb so that the vending machine can interface with the internet. Second, the coin slot is used so that the vending machine can interface with coins. The snack vending machine is controlled by using MCS-51 microcontroller. This project consists of two parts, hardware and software. The hardware involved constructing circuit for the coin slot and microcontroller circuit. Microweb and coin detector are treated as input interface consists of spiral ring snack holder, LCD and 12V motor dc to rotate the spiral ring. The LCD will display procedures that consumer should do when purchasing the snack, the amount of coin inserted and the type of snack including with price. For the software, programming will be done in assembly language to interface all the peripherals to the MCS-51 microcontroller including for the coin slot and microweb. This program will help the functional of the vending machine system cycle.

## ABSTRAK

Projek *Microweb and Coin Slot for Snack Vending Machine* ini adalah untuk menghasilkan dan mereka mikroweb dan slot syiling untuk *Snack Vending Machine* yang membolehkan pengguna untuk menggunakan mesin ini melalui dua kaedah berbanding satu kaedah sahaja sebelum ini. Pertama dengan menggunakan akses internet melalui penggunaan mikroweb. Mikroweb akan membenarkan *Snack Vending Machine* untuk berhubung dengan internet. Kedua, dengan menggunakan slot syiling di mana duit syiling akan dikenalpasti oleh mikropengawal seterusnya akan menghantar isyarat ke *Snack Vending Machine* bagi membenarkan penggunaan melalui duit syiling. Projek *Microweb and Coin Slot for Snack Vending Machine* ini dikawal oleh mikropengawal MCS-51. Projek ini melibatkan dua bahagian iaitu perkakasan dan perisian. Untuk bahagian perkakasan ia melibatkan pembinaan litar untuk slot syiling dan juga litar mikropengawal. Mikroweb dan slot syiling disifatkan sebagai masukan antara muka untuk *Microweb and Coin Slot for Snack Vending Machine* untuk pengoperasian manakala keluaran antara muka melibatkan pemegang snek lingkaran berpusar, LCD dan 12V motor DC untuk memutar pemegang snek lingkaran berpusar. LCD akan memaparkan prosedur yang diperlukan oleh pengguna semasa membeli snek, jumlah duit syiling yang dimasukkan ke dalam slot syiling dan juga jenis snek termasuk harga. Untuk bahagian perisian, aturcara dijalankan dalam bahasa pengumpul untuk menghubungkan mikroweb dan slot syiling dengan litar mikropengawal. Program ini akan membantu kefungsi litar.



## TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	ACKNOWLEDGEMENTS	v
	ABSTRACT	vi
	TABLE OF CONTENT	viii
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
	LIST OF ABBREVIATIONS	xii
<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
	1.1 Overview	1
	1.2 Project Objective	1
	1.3 Scope of the Project	2
	1.4 Problem Statement	3
<b>2</b>	<b>MICRO-WEB AND COIN SLOT FOR SNACK VENDING MACHINE</b>	<b>4</b>
	2.1 Introduction of the Snack Vending Machine	4
	2.2 Snack Vending Machine Controllers	10
	2.2.1 Vending Machine Using the PIC 16F84	11
	2.2.2 Design and Implementation of a Vending Machine Using SLC500 PLC	12

	2.2.3 Vending Machine Control Using Bluetooth	14
	2.3 The Micro-Web	
	(@Web Software evaluation kit)	16
	2.3.1 Internet Connection via Ethernet	17
	2.3.2 Direct and PSTN Dial-Up Connectivity	17
	2.3.3 CAN Connectivity	18
	2.3.4 Microweb Server Using @Web Library	18
	2.4 Coin Slot Applications	21
<b>3</b>	<b>THE 8051 MICROCONTROLLER</b>	25
	3.1 History of 8051 Microcontroller	25
	3.2 8051 HARDWARE ARCHITECTURE	28
	3.3 OVERVIEW OF THE 8051 FAMILY	29
<b>4</b>	<b>INTERFACING THE MICROCONTROLLER</b>	32
	4.1 Project Background	32
	4.2 Project Methodology	33
	4.3 Project Activity	35
	4.3.1 PSM 1	35
	4.3.2 PSM 2	36
	4.4 Testing the Microcontroller unit circuit	38
	4.5 LCD (Liquid Crystal Display) Programming	39
	4.5.1 LCD Backgrounds	39

		x
	4.5.2 44780 Background	40
	4.5.3 Writing Text to The LCD	41
	4.5.4 A "hello world" Program	44
	4.5 Installing the EEPROM	45
	4.5.1 The Steps to Installing the EEPROM	45
<b>5</b>	<b>RESULTS AND DISCUSSION</b>	46
	5.1 Results	46
	5.2 Discussion	49
<b>6</b>	<b>CONCLUSION AND FUTURE WORK</b>	50
	6.1 Conclusion	50
	6.2 Future Work	51
	<b>REFERENCES</b>	52
	<b>APPENDIX A-B</b>	

**LIST OF TABLES**

<b>NO</b>	<b>TITLE</b>	<b>PAGE</b>
5.1	Result of Coin Slot in Binary	47

## LIST OF FIGURES

NO	TITLE	PAGE
2.1	A typical drink vending machine	7
2.2	A typical US snack vending machine	7
2.3	Vending Machine Using Bluetooth	15
2.4	@Web PSTN51S evaluation kit	17
2.5	Request from User Using Internet	18
2.6	Web Page Displayed by the Browser	20
2.7	Coin Slot Operator (front view)	22
2.8	Coin Slot Operator (back view)	22
2.9	Coin Slot Operation System	23
3.1	The 8051 Microcontroller Architecture	28
3.2	8051 SFR Memory Map	31
4.1	Block Diagram for Micro-web and Coin Slot for Snack Vending Machine	32
4.2	Flow Chart for PSM 1	36
4.3	Flow Chart for PSM 2	37
4.4	Microcontroller Circuit Unit	38
4.5	Flow Chart of Installing EEPROM	45
5.1	Internal Part of the Coin Slot	47
5.2	Circuit that Indicate the Coin Existence	48
5.3	Coin Slot's Receiver	48
5.4	Coin Slot's Transmitter	48

**LIST OF ABBREVIATIONS**

<b>ABBREVIATION</b>	<b>DEFINITION</b>
ADC	Analog Digital Converter
DC	Direct Current
LAN	Local Area Network
PLC	Programmable Logic Controller
SMS	Short Messaging System
GPRS	General Packet Radio Service
EEPROM	Electrical Erasable Programmable ROM
MCU	Microcontroller unit
LED	Light Emitter Diode
PIC	Personal Interactive Communicators
RAM	Random Access Memory
ROM	Read Only Memory
IC	Integrated Circuit

**LIST OF PROGRAMS**

<b>NO</b>	<b>TITLE</b>	<b>PAGE</b>
4.1	Square Wave Program	29
4.2	LCD Programming to display 'H'	43
4.3	'Hello World' Programming	44

**LIST OF APPENDICES**

<b>APPENDIX</b>	<b>TITLE</b>
A	AT28C64 DATASHEET
B	MICROWEB SERVER USING @WEB LIBRARY
C	VENDING MACHINE CONTROL AND REPLENISHMENT
D	A CAPSTONE PROJECT DESIGN



## CHAPTER 1

### INTRODUCTION

#### 1.1 Overview

The purpose of this project is to build a Micro-web and Coin Slot for snack vending machine using the 8051 microcontroller. The project consists of designing the hardware and software of the system cycle.

For the hardware design, the implementation of the micro-web and coin slot prototype for the input and 12V dc motor for the output will be used to build the snack vending machine. All these appliances were used to interface with the microcontroller unit MCU. This MCU will monitor and process the snack vending machine system cycle.

The microcontroller unit consists of the microcontroller 8051 microcontroller, PPI 8255, EEPROM, 6264RAM, 74LS373 Decoder, 74LS138 Decoder and a crystal 11.0592 Mhz. This microcontroller unit has been successfully constructed and tested from the last year project.

The assembly language is used as the program to initialize the LCD display, the steps of operation and the switching mode for 12V dc motor for the spiral winding rotation (for output)

## 1.2 Project Objective

The objectives of this project are to:

- 1) Build snack vending machine prototype that capable to dispense two outputs using 8051 Microcontroller unit and include Liquid Display unit (LCD) and DC motor that will rotate the spiral ring.
- 2) Build and design coin slot prototype so that snack vending machine can interface with inserted coins..
- 3) Design basic micro-web that can interface with snack vending machine via internet using @Web Software evaluation kit.

## 1.3 Scope of the Project

In order to design snack vending machine that is capable of interfacing with two kinds of inputs that are coin slot and micro-web, a basic operational of snack vending machine is to ensure that the microcontroller will able to interface with input and output operation. Thus, the scope of the project is:

- 1.3.1 To design a program for the microcontroller using assembly language vending machine using the assembly language that can accept coins using coin slot and @Web LAN51S evaluation kit with the steps of operation can be display on LCD display.
- 1.3.2 To design the two spiral rings with the dc motor drive to rotate the spiral that is used to hold and drop snack.

- 1.3.3 To design software for micro-web that reacts as a server to interface with snack vending machine.

#### **1.4 Problem Statement**

Nowadays, consumers usually have to find a shop to buy some food. Sometimes the shops are located far from their residence. They need a solution to make their life easier. For sellers, they have to require a space to sell their goods despite that they have to hire workers to help him. This method will waste a lot of money. So the solution to this problem is to have a snack vending machine that capable to receiving currency credit from multiple sources.

There was an effort that designs a snack vending machine from previous project. The prototype does not include coin slot. The project also stands alone and not interfaces with other network such as internet and phone system. The previous project only dispenses one output only and cannot dispense different type of output. So the vending machine that is capable of handling many kinds of new peripherals would be an advantage and useful for the consumers.

## CHAPTER 2

### MICRO-WEB AND COIN SLOT FOR SNACK VENDING MACHINE

A literature survey on Micro-Web and Coin Slot for Snack Vending Machine was done in the early stages of the project. The main objective of doing this particular work is to gain knowledge of the different types of method and application used in snack vending machine.

#### 2.1 Introduction of the Snack Vending Machine

A vending machine is a machine that dispenses merchandise when a customer deposits money, validated by a currency detector, sufficient to purchase the desired item (as opposed to a shop, where the presence of personnel is required for every purchase). It is believed to have been first invented by Hero of Alexandria, a 1<sup>st</sup> century inventor. His machine accepted coins and then dispensed a fixed amount of “holy water” [7].

The first commercial coin-operated vending machines were introduced in London, England, in early 1880s. They dispensed post cards. Richard Caliste, an English publisher and bookshop owner, invented a vending machine for selling books around the same time. In 1888, the Thomas Adams Gum Company introduced the very first vending machines to the United States. The machines were installed on the elevated subway platforms in the New York City and sold Tutti-Fruiti gum. In 1897, the Pulver Manufacturing Company added animated figures to its gum machines as an added

attraction. The round candy coated gumball and gumball (vending) machines were introduced in 1907 [7].

Vending machines soon offered everything including; cigars, postcards, stamps, etc. In Philadelphia, a completely coin-operated restaurant called Horn & Hardart was opened in 1902 and stayed opened until 1962. In the early 1920's, the first automatic vending machines started dispensing sodas into cups. In 1926, an American inventor named William Rowe invented a cigarette-vending machine [7].

Snack vending machine come in a number of different formats and styles. Most snack vending machines are see-through or glass-front merchandisers. This is because the customer likes to see what he or she is getting, and likes to be able to browse. Soda machines are usually solid because most people know what a can soda looks like and exactly how big it is. However, even that is changing as more manufacturers realize that most consumers think with their desire. This is true for vending machines where almost every purchase is an impulse purchase. On the other hand, some employees of companies that have vending machines on – site rely on those vending machines every day for a lunch break. Some snack vending machines have closed-face interfaces but it is very rare [7].

Most modern vending machines have been extensively tested and designed to inhibit theft. Many of these machines are designed essentially as large safes. Every year, a few people are killed when machines topple over on them, either while trying to steal from them, or venting frustration on them, especially when a malfunction causes the machine to fail to dispense the purchased item or the proper change (leading to the humorous saying, "change is inevitable, except from a vending machine"). An article in the Journal of the American Medical Association (Nov. 11, 1988, p. 2697) documents 15 cases in which men trying to get a can out of the machine were crushed. Three died, the other 12 required hospitalization for injuries such as fractures of the skull, toe, ankle, tibia, femur, and pelvis; intercerebral bleeding; knee contusion; and one punctured bladder. The article states that because the soft drinks are located in the upper half of the machine (so that they can fall into the dispensing slot), the center of gravity of the

machine is abnormally high, and the machine will fall after it has been tipped only 20 degrees, a deceptively small angle. A large, fully loaded soft drink machine can weigh over 400 kg (1000 lbs.) It can be easy to "hack" into soda machines by pressing the correct pattern of buttons. Doing so opens a menu used by distributors to record data from sales, or set the machine at "not in service" or "sold out"[8].

There is, also, the problem of using a a coin of a foreign currency which has the same size and shape as the coin accepted by the machine to get cheaper merchandise and some times change that might has more value than the originally inserted foreign coin. One remarkable example was the use of Libyan coins of 100 Dirhams and 50 Dirhams denominations in Maltese vending machines in the late 1990s. The 100 Dirham coin was used in place of the 1 Maltese Lira coin which had, back then, a de facto black market value of approximately 10 Libyan Dinars and thus having a staggering value 100 times higher than that of the fraudulent coin. Similarly, the 50 Dirhams coin was used in place of the 25 Maltese Cent which meant 50 folds increase of value accourding to the black market price. However, the machines were quickly replaced with new ones that could detect the difference between the Libyan and the Maltese coins, especially in touristic areas. Most notably, the 2 euro coin is similar in size to the 10 baht coin (worth only €0.25). Thus, many vending machines in the eurozone will not accept €2 coins, such is the extent og the 10-baht scam [8].

The actual causes of vending machine malfunction are usually many-fold. Coin acceptors often jam up, especially if a bill or other foreign object is inserted into the coin slot. Certain vending machines use a spiral kind of mechanism to separate and to hold the products. When the machine vends, the spiral turns, thus pushing the product forward and falling down to be vended. If the products and the spiral are misaligned, the spiral may turn but not fully release the product, leaving the spiral snagged on the product and having it hang there. This may cause repercussions to the alignment of the products behind it if someone knocks the hanging product down, as the spiral must move a fixed distance [8].

Additional sources of failure can include machines not being supplied the proper power (in some cases because they are on the same overloaded circuit with other machines), damage due to vandalism, and insufficient maintenance or upkeep by the operator [8].

Bill validators are also a source of frustration for many customers, especially when they falsely reject a legal tender bill that happens to be crumpled, ripped, or dirty. U.S. vendors, realizing they were losing sales because of validator malfunctions, formed the Coin Coalition to support the United States dollar coin. Their efforts to completely replace the dollar bill with the Sacagawea Dollar have been unsuccessful so far. Also some machines may not accept quarters and other coins on the first pass through the coin slot, causing the customer to have to collect the coins from the change return and reinsert them [8].

Most vending machines have a phone number that users can call to report malfunctions or request assist.

Vending has gone through significant changes over the decades. Many machines are still evolving to take credit cards and monitor machines from afar.

Doug Sanford of Vending Times notes, "many vendors today do not remember the urgency with which industry leaders called on their peers to install coin mechanisms that held the patron's money in escrow until the vend was made; to post a telephone number that a customer could call to report a failure and request a refund; to make sure their drivers were cleaning the machines adequately and replacing burnt-out lamps; and so on and on." More recent innovations include improved coin and bill validation and the rapid adoption of sense-and-feedback systems to verify that the vend was made.

One of the newest vending innovations is telemetry. According to Michael Kasavana, National Automatic Merchandising Association Endowed Professor at The School for Hospitality Business, Michigan State University, the advent of reliable, affordable wireless technology has made telemetry practical and provided the medium through which cashless payments can be authenticated. This is important because

research shows that 50% of consumers will not make a purchase from a vending machine if its "use exact change only" light is on. Machines equipped with telemetry can transmit sales and inventory data to a route truck in the parking lot so that the driver knows exactly what products to bring in for restocking. Or the data can be transmitted to a remote headquarters for use in scheduling a route stop, detecting component failure or verifying collection information. Telemetry could be one of the most significant developments in vending technology since the invention of the bill changer.

With consumers wanting quick and convenient access to competitively priced products, the vending industry has seen a great deal of growth over the last ten years. Vending offers new entrepreneurs a way to start businesses which can grow quickly. Snack, beverage, candy and food vending machines continue to be the most lucrative and stable in the market place. New innovations in service vending machines include internet kiosks and DVD vending. Cashless vending now allows consumers to use debit cards for added convenience. Vending is a multi-billion dollar industry, and growing.

In order to prevent injuries or death from tipping or striking the machine, most modern snack vending machines equipped with spirals to hold products contain lasers near the access door at the bottom. If a purchased item does not break the laser beam when falling, the spirals will automatically turn, usually three times to ensure that a product will fall. If this still does not occur, the customer will be asked to make another selection or will be refunded their money [8].