DESIGN AND CONSTRUCTION OF AUTOMATIC CAR PARKING SYSTEM USING MICROCONTROLLER

BY

JOSEPH GODWIN

2006/24405EE

A THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE.

NOVEMBER, **2011.**

DEDICATION

This project is dedicated to God Almighty, whom through his son Jesus Christ has given me the wisdom and grace to execute this project. I also dedicate this project to my Mother Mrs. Comfort Udom for her love, encouragement and support through out the period of this project.

DECLARATION

I Joseph Godwin, declare that this work is the product of my intellect done in the pursuit of my B. ENG without contravention to any law relating to copyright, hence all books, materials and quotations in this thesis have been fully acknowledge by reference. I also hereby relinquish the copyright to the Federal University of Technology Minna, Niger State.

JOSEPH GODWIN
(Name of Student)

DR. E.N. ONWUKA
(Name of Supervisor)

(Signature and Date)

(Signature and Date)

ENGR. A. G. RAJI.
(Name of H.O.D)

(Name of External Examiner)

(Signature and Date)

(Signature and Date)

ACKNOWLEDGEMENT

My profound gratitude to God Almighty for his love, care, protection, provisions, wisdom and strength through out the period of this project. May His name by exalted. To my supervisor, Dr. E.N. Onwuka for her constructive criticism, encouragement, technical assistance and guidance in the actualization of this project I want to say thank you. To Mallam Isa Mohammed Doko (chief technologist), for all his technical assistance and encouragement.

I want to say a big thank you to all my lecturers and staffs of electrical and computer engineering department for their love and tutorship.

To my lovely mother Mrs. comfort Udom, for her love, encouragement and financial support, I want to say thank you.

Also to all members of Chapel of Grace F.U.T Minna especially to Pastor Onimole,Mr. Olaniye and all members of the choir for their love, prayer and support. And to all my colleagues and my friends especially to Lawrence Emmanuel, I want to say God bless you all.

ABSTRACT

This project "automatic car parking system" is a design that will automatically order the arrangement of cars in the garage. It as well regulate car entry and exit, thus find application in the arrangement of cars within our offices, schools, homes etc. The system carries out this function by using Microcontroller (AT89C52) and incorporating simple traffic signs using LED screen. Programs written in Assembly language control every event that goes on and around the garage and no manual intervention is need.

Information on the status of the of the garage is provided using 7segment displays (A & B) while the execution of program by Microcontroller is dependent on the interrupt signals received from the sensors.

TABLE OF CONTENT

CONTENT **PAGE**

Chapter three: Design and construction

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE

GENERAL INTRODUCTION

1.0 INTRODUCTION

The break through in land transportation via cars, motorbikes, Lorries etc has brought comfort to man in such a way that can not be quantified. However, it has generated some challenges that challenge this comfort. These challenges range from minor quarrels and car users to even fatal issues of destroying lives and properties. From research it has been found that some causes of these problems are due to poor space management, illiteracy, reckless driving lack of car parks and poor parking pattern or arrangement

Notwithstanding, as technology improves by the day, new car patterns are developed and the number of potential car owners increases too. This increase to a large extent enhances easy transportation of goods and persons from one place to another. However, this increase in the number of cars simultaneously lead to littering and over crowding of cars within our offices, churches, schools, business premises etc. this scenario often portray an unattractive, disorganized and totally un pleasant image of our society and the consequences of such neglect is often very disastrous.

Several approaches have been adopted in the past to help solve this problems and one major approach used for solving the problem was the construction of traditional car parks. The approach has quite provided the solution but as the day go by and technology and the needs of people continue to vary, this technique for solving this problem of car storage and organization in a community becomes inefficient and obsolete. Hence to provide a more precise and recent solution to the highlighted problems, the DESIGN AND CONSTRUCTION OF AN AUTOMATIC CAR PARKING SYSTEM, becomes inevitable.

1.1 AIMS AND OBJECTIVES

This project is aimed at achieving the following:

1. Offer convenience for vehicle users and efficiently use the available space.
2. Save time, money, space and simplify the often tedious task of parking.
3. Provide Safety and security: No property and vehicle damage.
4. Automate the car parks systematically: i.e. Car parks can be customized to accommodate any building style and environment.
5. Valuable Investment: Generate more revenue with lower operation cost and overhead and as well create employment opportunity for young and skillful engineers.

The objectives of this project is to

I. Use microcontroller, sensors and motors to regulate car entry and exit

II. Use LEDs to provide visible traffic sign conventions that will aid orderly arrangement of cars within the Garage.

III. Also use 7segment ICs to give information on the status of the park per operation time.

1.2 METHODOLOGY

This project utilizes a combination of traditional and automated technique in the design and construction of the car park. Embedded systems, digital units, motors and sensors are integrated in the construction. However, research study, literature reviews and practical lectures were also part of the methods used in the course of the project. In addition, simulations were carried out on the virtual simulators: Protuse, Multism and Keil as well as on real time simulators or panel (Bread board and Vero board).

Furthermore, since the functionality of the entire system is dependent on written algorithm, programming this algorithm (software) and wiring the hardware on which this programs will run on was part of the techniques used to ensure the success of the project.

1.3 SCOPE OF WORK

This project is designed to be used for cars, motorcycle, vans and buses with weight ranging from 500N to 1500N and having a height less than 10ft. however, the prototype is designed for cars, motorbikes and buses weighing between 15N and 30N and having width space of not more than 10cm between tires and a height not more than 50cm.

1.4 LIMITATIONS

Despite the tremendous advantages that these project offers and its relevance to the society, it however cannot be used for all types and weight of cars. In addition it cannot be used were car lift or Rolling is require and does not guarantee full safety for cars within the Garage.

1.5 SOURCES OF INFORMATION

Information that aided the success of this project was sourced from a number of sources. Some of these sources include; lecture notes especially on courses such as ECE 521 (System programming), ECE519 (power electronics), ECE527 (Embedded system), Textbook on counters and programming of microchips, Data sheet on integrated circuits and microcontroller and the internet. Other vital source of information was consultation from park managers, my supervisor, lab technician, group mates and colleagues.

1.6 PROJECT LAYOUT

This project reports the processes and steps taken to actualize the design and construction of an **automatic car parking system** using microcontroller.

Chapter one provides a general introduction, discuss the objectives and aims, and outline the scope, limitation and the sources of information that aided the design.

Chapter two presents the literature review, past and recent development in line with principles upon which the operation of the project is based and gives the theoretical background which includes description of basic components.

Chapter three presents the design analysis, component selection and design calculations. Chapter four outline the test and measurement of hardware component and debugging of software components.

Chapter five presents the conclusion, recommendation for improvement on the project and the problems encountered during the design and construction of the project.

CHAPTER TWO

2.0 LITERATURE REVIEW/THEORETICAL BACKGROUND

According to the Oxford advance learner's dictionary, Automation simply means the use of machines to do the work that was previously done by people. More so, a car park is an area of land carved or set aside for keeping cars [1]. These parks are designed with the aim of providing security, ease of access and preventing any form of inconvenience or discomfort. In the years past this was done traditionally. This method has however not been very effective and instead of accomplishing its aims and objective it has posed some form of disadvantages which are so detrimental to man kind. As often said that necessity is the mother of invention, engineers and technologist taught of possible ways of solving the problems posed by the use of traditionally operated car parks. This led to the adoption of the automated parking system as a model for the 21st century car storage system. This recent technology has a lot of advantages over the traditional method. Some of these unique advantages include:

- ✓ Offer convenience for vehicle users and efficient use of space
- ✓ Save time, money, space and simplify the often tedious task of parking
- ✓ Safety and security: No property and vehicle damage.
- ✓ Environmental friendly: Minimize pollution.
- ✓ Systematic: Can be customized to accommodate any building style and environment.
- ✓ Valuable Investment: Generate more revenue with lower operation cost and over head.

2.1 HISTORICAL BACKGROUND

Although the precise time and place where automation began cannot be traced or pin point to a particular place or time or people, history have it that, automation began even earlier than civilization. [2] Similarly, car parking has been in existence almost since the era when cars were invented. However, car parks came into existence in the early 20th century in response to the need for storage space for vehicles [3]. Different traditional methods were used and the approach varied from one location or community to another. For instance, in Toronto not until late 1950s simple parking lots were used to manage vehicles.

In the 1920s, forerunners of automated parking system surfaced in some cities of U.S like Los Angeles, Chicago, New York and Cincinnati. [4] This marked the beginning of what led to a glorious beginning for the world of automation in the car park market economy.

In 1923 the Ferris wheel or Paternoster system of car park automation was developed by the Westing house cooperation. This system was later adopted by Japan for car storage.

Also, during the progress Exhibition in1933 the first glass enclosed version of automated car park system was designed for exhibition in Chicago Century. This great breakthrough in 1983, led to the design and construction of Kent Automatic parking Garage in New York. [5]

Different forms and modes of automation were employed in car parks for example The electric overhead garage door opener invented by C.G. Johnson in 1926 in Hartford City, Indiana.

Electric Garage Door openers did not become popular until Era Meter Company of Chicago offered one after World War II where the overhead garage door could be opened via a key pad located on a post at the end of the driveway or a switch inside the garage. [6]

Contrary to popular belief, the electric door opener does not provide the actual lifting power to open and close a heavy garage door. Instead, most of the actual lifting power comes from the counterbalance springs attached to the door. These springs are under tension to lift the garage door via steel counterbalance cables. The electric opener only controls how far the door opens and closes, as well as the force the garage door exerts. In most cases, the garage door opener also holds the door closed in place of a lock. [7]

Recently another garage door control system called jack shaft opener was invented. It is an advancement on the one invented by C.G Johnson. Furthermore, a remote controlled wireless garage was design by two US inventors at the same time unknown to each other, one in Illinois and the other in Washington state.[8] The first garage door opener remote controls were simple and consisted of a simple transmitter (the remote) and receiver which controlled the opener mechanism. The transmitter would transmit on a designated frequency; the receiver would listen for the radio signal, then open or close the garage, depending on the door position. The basic concept of this can be traced back to World War II. This type of system was used to detonate remote bombs. While novel at the time, the technology ran its course when garage door openers became widely available and used. Then, not only did a person open their garage door, they opened their neighbor's garage door as well. While the garage door remote is low in power and in range, it was powerful enough to interfere with other receivers in the area. [9]

In this light several projects were carried out on door automation, and precisely in 2008 and 2009 projects on door automation were designed by students of Electrical and computer Engineering Department of Federal university of Technology (F.U.T) Minna.

However, most of the automation used in the car parks was not fully engrossed. In order words the control was only to a definite portion or part of the garage and not the entire garage.

Notwithstanding, as technology advanced and computers were invented in the 21st century park automation also experience a tremendous improvement as computers were now used in car park automation. This breakthrough in technology paved the way for full automation of car parks worldwide.

Furthermore, the application of computers or micro computing devices in car park automation gave rise to yet different types of car parks based on the designs used. Some of the most recent automated car park designs available in the advanced world include; programmable Logic control car parks puzzle elevator, TDR, TD, TD-L, TOR, ROLL, and the Lift system Park.[10]In Nigeria however, the traditional system of car park is still predominant. Hence the need to embark on this project MICROCONTROLLER BASED AUTOMATIC CAR PARK SYSTEM.

This car parking system simply uses micro computing devices AT89C52 microcontroller, LEDs and 7segments to control car storage based on simple predefined programmed algorithm. It has certain advantages and peculiarity. Amongst this are

I. It is easy to design
II. Inco-operate indigenous or locally made components
III. Provide full automation
IV. Cost effective and efficient. It serves morepurpose than other existing ones at a considerable amount.

2.1.1 PRINCIPLE OF OPERATION

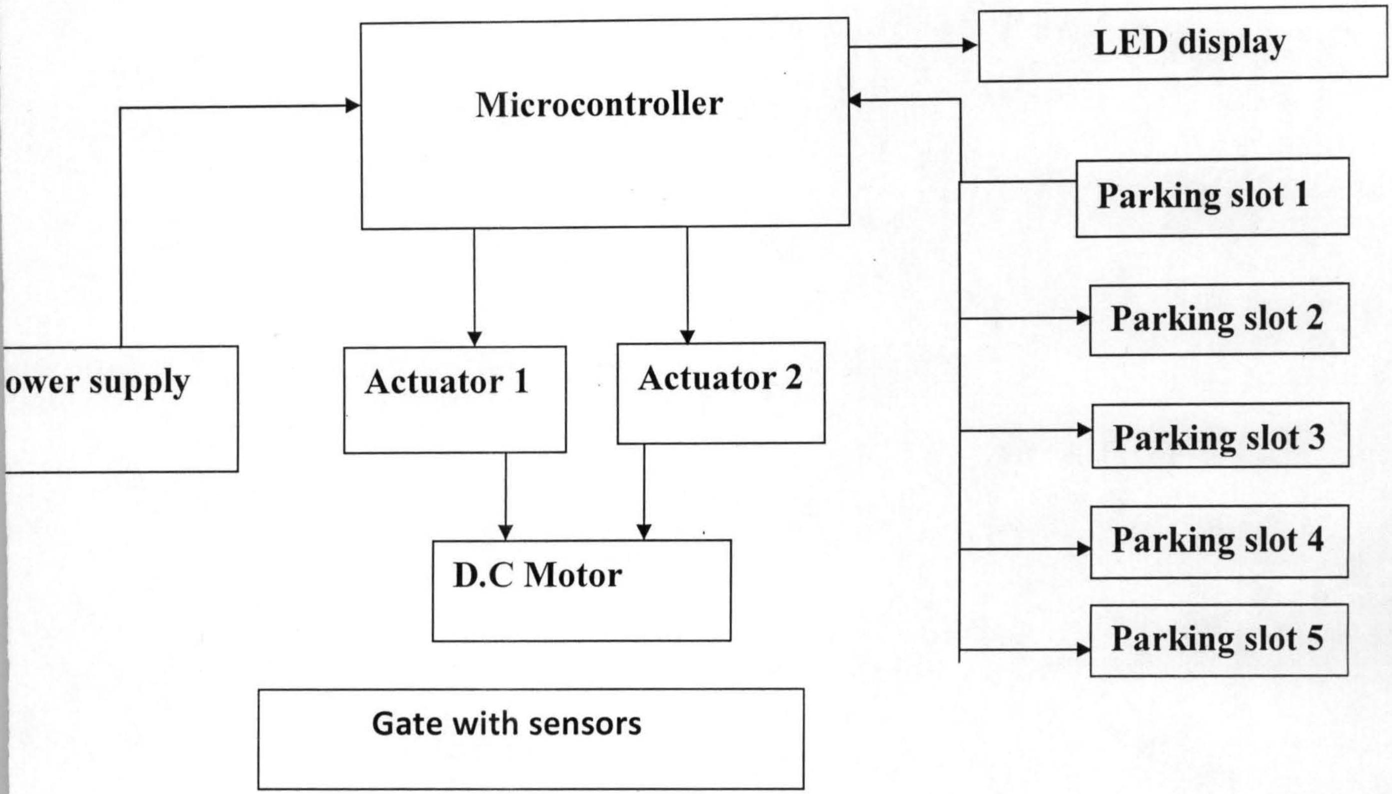


Fig 2.1: Block Diagram Showing the Operation Principle of the Project

As shown in the block diagram above, this system uses the microcontroller to order car arrangement at the different available parking slots. The LED display board provide the visible means of communication between the microcontroller and the park users. Program written to the microcontrollers also control the gate opening and closing through the action of actuators (Relays) and sensors positioned at strategic locations. This system uses 7segment display to display where to park as well as the relative number of cars within the garage per operation time.

2.2 THEORETICAL BACKGROUND

The major components used in this project are

- ✓ AT89C52 microcontroller
- ✓ Sensors
- ✓ Motors and relays
- ✓ LEDs and 7segment

2.2.1 THEORETICAL OVER VIEW OF MICROCONTROLLER

A microcontroller is a computer-on-a-chip, or, simply, a single-chip computer. Microsuggests that the device is small, and controllertells one that the device might be used to control objects, processes, or events. Another term to describe a microcontroller is embeddedController,because the microcontroller and its support circuits are often built into, or embedded in, the devices they control. [11]Microcontrollers make it easy to add features such as the ability to store measurements, to create and store user routines, and to display messages and waveforms. It can be manipulated to meet users need hence it is used in wide project applications such as Consumer products cameras, video recorders, compact-disk players, ovens and in car park automation. [12]Plate 2.2 is a pictorial diagram showing a microcontroller.

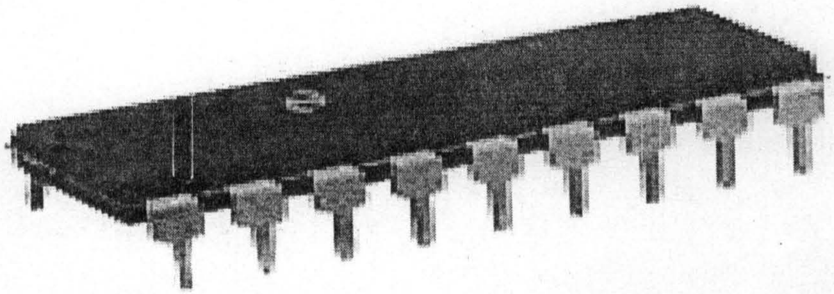


Plate 2.2:the AT89C52 Microcontroller

2.2.2 HISTORY OF MICROCONTROLLER

In January 1975 Popular Electronics magazine featured an article describing theAltair 8800 computer, which was the first microcomputer that hobbyists could build andprogram themselves. The basic Altair included no keyboard, video display, disk drives, orother elements we now think of as essential elements of a personal computer. Its 8080microprocessor was programmed by flipping toggle switches on the front panel. StandardRAM was 256 bytes and a kit version cost $397 ($498 assembled). A breakthrough in theAltair's usability occurred when a small company called Microsoft offered a version of the BASIC programming language for it. This breakthrough led to the design of microprocessors and microcontroller and the commonest and more widely use microcontroller is the 80C52 family produced by Atmel.[13]

Before the microcontroller can be used to carry out any project, certain principle must be followed. These principles are as follows

1. Define the task
2. Design and build the circuits
3. Write the control program
4. Test and debug.

However, this principle may not be followed sequentially but the entire procedure may involve use of a combination of one or all of the principle with some configuration at the discretion of the user.Below is a pictorial diagram showing the inter pins and ports of the microcontroller

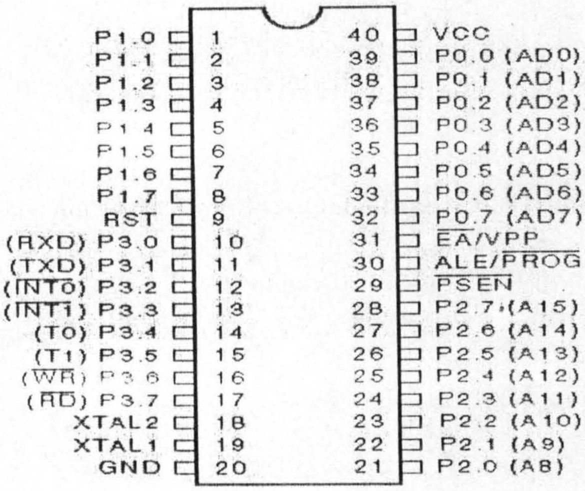


Plate 2.3: Internal Pin Configuration of Microcontroller.

2.2.3 SENSORS

A sensor is any tool that allows one to measure a change in an object or thing. That object could be movement or change in air pressure or a combination of the two. Sensors can be made of virtually anything. Plastic, aluminum and other thin conductors are common material types. For sensors to work effectively, they usually are mounted on a fixed object or source. There are, however, wireless options available too. [14]

A parking sensor is safety devices that can help people recognize various roadway dangers. People often attached them behind their rear vehicle tail lights. They generally work by sending out or receiving radio waves, much like a radio or radar gun. A mini-computer inside a sensor box registers electromagnetic waves that bounce off the surface of that given object. Some parking sensors can determine how far away an object is by looking at the length or frequency of the wave emitted by the object. Certain waves along the electromagnetic spectrum have certain lengths and sizes. A parking sensor can measure those wave types and tell how large, small or fast an object is moving. Large objects essentially emit different sizes of energy wavelengths. Large objects that move very fast reflect a totally different carrier wave signature. The same is true of smaller objects, as well. Different types of sensors are in use, of the ones commonly used are ultrasonic sensors, infrared pressures sensors etc. this sensor are very important as these provides the interrupt signals needed by the microcontroller. Switch sensors in the form of floor mats were used in this project.

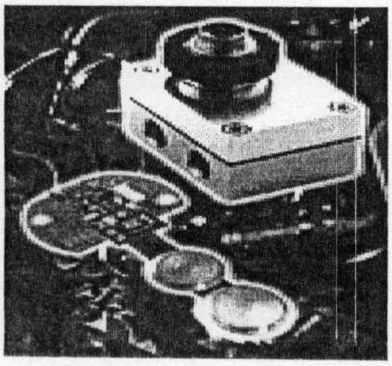


Plate 2.4: Switch Sensors used.

2.2.4 PRINCIPLE OF OPERATION OF DC MOTOR

A DC motor is an electric motor that runs on direct current electricity. It operates on the principle of electromagnetism. It is a machine that converts electric energy into mechanical energy. Its action is based on the principle of magnetism.

When current carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Flemings Left hand Rule and the magnitude is given as $F = BIl$

By construction, a motor shows no difference with an electric generator. As a matter of fact the same DC machine can be used interchangeably as a motor and a generator [15]. A single phase dc motor was used in this project.

2.2.5 THEORY OF OPERATION OF LEDS AND 7SEGMENT DISPLAYS

LEDs are forward bias PN junction which emits visible light when energized. This emission is as a result of the action of recombination. At recombination i.e. when negative electrons N and holes P combine at the junction, energy is emitted in the form of heat or light depending on the type of semi-conductor devices used. When Gallium, Arsenide and Phosphate combinations are used the energy emitted is a visible light whose colour depends on the combination of semiconductor devices used. LEDs only function in the forward bias regions. For this project LED made of Gallium and Phosphate (green colour) were used. [16]

7segments are semiconductor devices which are made up of 7LEDs arranged in either the common anode mode or the common cathode mode. Most times common anode configuration is used especially when it is to be inter phased with a microcontroller. This is because the current flowing through the LED is small and if the common anode is used the limiting resistor inhibit the flow of current through the LED. [17]

CHAPTER THREE

3.1 DESIGN AND ANALYSIS

The design and implementation stage is the most important and technically inclined aspect of the entire project. It involves the assembling and arrangements of various components used in the design and building of the final project circuitry.

The major tools used in the construction of this project are:

I. Vero board
II. Bread board
III. Connecting wires or jumpers
IV. Soldering iron
V. Lead (de-soldering)
VI. Cutter
VII. Multi-meter
VIII. Laptop computer

The automatic car parking system is implemented in modules or subsystems as highlighted below

I. The power supply module
II. The micro-controller module
III. The display module
IV. The buzzer
V. The electromechanical module

Below is a diagrammatic representation of the different modules for the design and construction of the project.

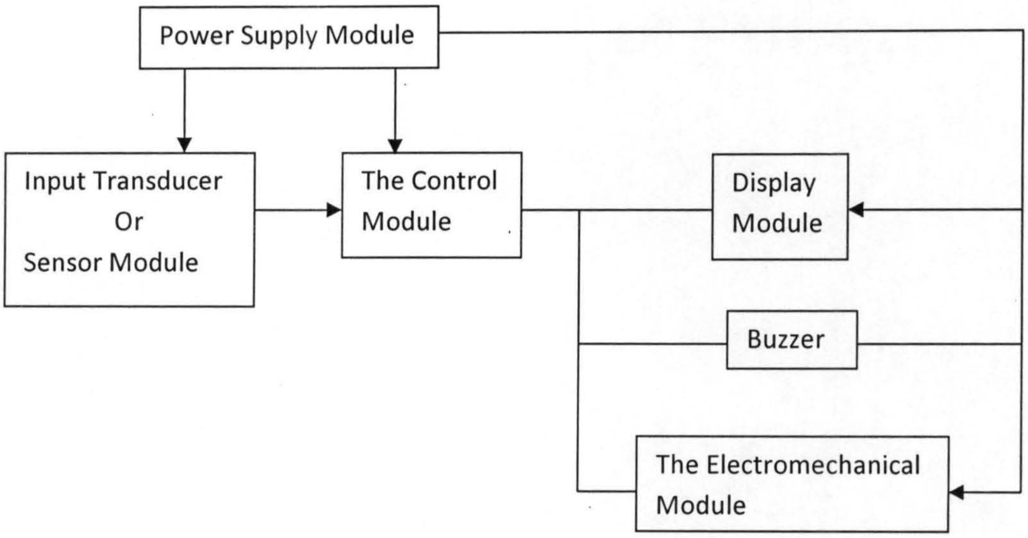


Fig 3.0: Block diagram of an Automatic Car Parking System

3.1.1 THE POWER MODULE

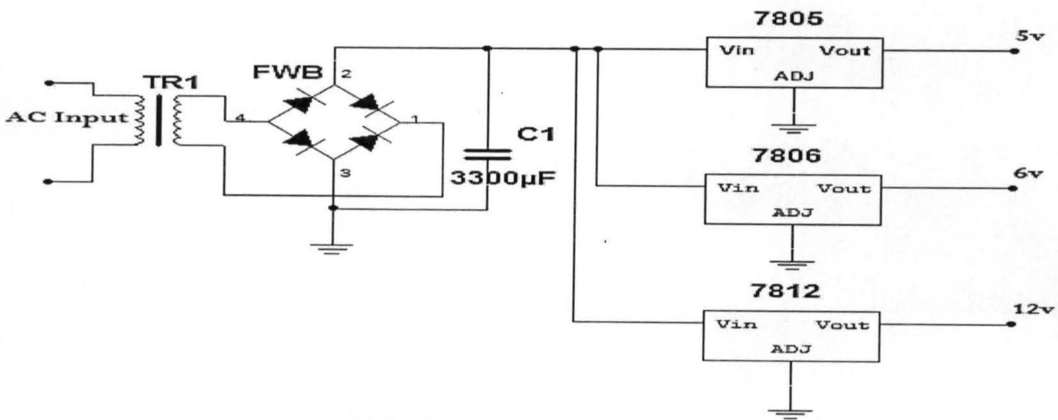


Fig 3.1 Circuit Diagram of the Power Module

The circuit above shows the implementation of the power module. The project power demands are as follows:

1. +5 volts for microcontroller
2. +12 volts for motor control system

3. +6 volts for LED display, Relays and 7 segment display

The power supply unit was designed to supply three D.C voltages 5V, 6V and 12V respectively.

The power module consists of three major units:

1. The voltage transformation unit
2. The rectification and filtering unit
3. The voltage regulation unit

3.1.2 VOLTAGE TRANSFORMATION UNIT

At this unit a 240V-24V step down transformer was used to transform the AC power supplied by PHCN to an equivalent low voltage as gotten from the secondary output terminal.

Transformer specification for this project was 220V-24V, 1A centre tap transformer. This was chosen to compensate for any low voltage supply since the transformation ratio was calculated to be 9. The output supply from the secondary terminal will always be enough to supply the needed rectified voltage.

3.1.3 THE RECTIFICATION UNIT

This unit converts the ripple filled AC voltage to an equivalent ripple free DC voltage. The circuit consists of a block ridge rectifier and a filtering capacitor as shown in the circuit above.

The bridge rectifierdiodes (block diode) convert AC to a pulsating DC. For typical low current rectifiers, the diode drops about 0.7V, this value is used for the analysis. Full wave rectification was used in the project.

For full wave rectification, only two of the diodes conduct at a time while the other two will be in off state.

D_2 and D_4 conduct during the periods $t = 0$ to $t = \frac{T}{2}$ while D_1 and D_3 are in off state during the periods $t - \frac{T}{2}$to T, D_1 and D_4 conduct while D_3 and D_2 are in off state.

Output of the bridge rectifier is given as:

$V_{pout} = V_{psec} - 2V_d$ .... (1)

V_{pout} = Peak output voltage

V_{psec} = Peak of the secondary voltage

V_d = Diode voltage drop

But $V_{psec} = V_m\sqrt{2}$.. (2)

V_m = Maximum input voltage.

From the relations given in equations 1 and 2, it can be deduced that

$V_{pout} = V_m\sqrt{2} - 2V_d$..(3)

But$V_m = 24V$, $V_d = 0.7V$

Therefore,

$V_{pout} = 24\sqrt{2} - 2 \times 0.7$

$= 32.54V$

The diodes are rated by the maximum current that can pass throughit and the maximum RMS voltage they can withstand. IN5392 rectifier diode was used for this project.

3.1.4 FILTERING UNIT

After rectification, the rectified voltage is filtered. Electrolytic capacitor was used as the filter capacitor. In selecting the capacitor, the maximum voltage it can handle or the breakdown voltage was considered. The breakdown voltage is that voltage value beyond which the dielectric inside the capacitor begins to conduct. The capacitor was connected in parallel as showed in the fig3.0. The relation below gives the value of the capacitors used as well as their voltage requirement:

$$maximumvoltageofcapacitor(V_m) = \sqrt{2} \times V_{dc}$$

$$= \sqrt{2} \times 24V$$

$$= 33.99V \approx 34V$$

For this project, since there is no 34V in the market, 35V capacitor was selected.

The higher the size of the capacitor the lower the ripples, that is, the better the smoothening. So, 3300UF, 35V capacitor was used.

3.1.5 VOLTAGE REGULATION

In this unit, regulators or electrical devices that provide a constant output voltage regardless of the magnitude of the input voltage were used. Three different regulators providing output voltages of 5V, +6V and +12V respectively were used to provide the required voltages needed by the project. 7805, 7806 and 7812 ICs were used.

Factory specification for the regulators is 40V and 1A and regulators must be grounded before it can function properly.Below is a block diagram summarising the entire power module.

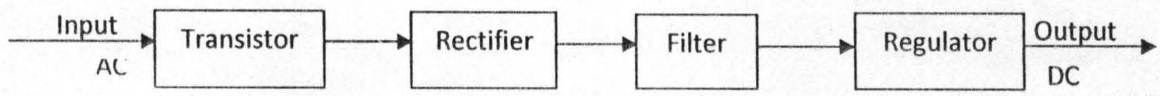


Fig 3.2: block diagram showing power rectification

3.2 THE INPUT TRANSDUCER/SENSOR MODULE

The circuit diagram below shows the configuration of the input transducer or sensor module.

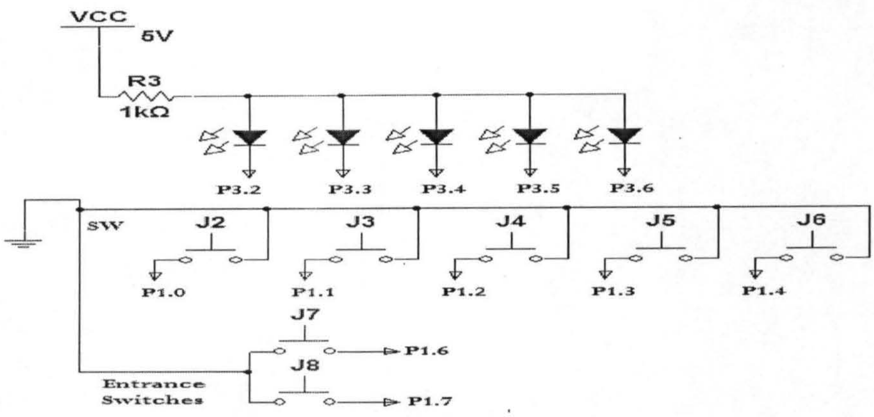


Fig 3.2: Circuit Configuration of the Sensor Module

This module consists of sensors that detect cars, sends out signals to the micro-controller. This signals sent to the micro-controller enables the controller to execute the appropriate instructions. The type of sensor used is the pressure sensor. however switch buttons were used since the car to be used in the prototype are light weighted.

The pressure sensor is a flow mat (mat actuators) which activates opening and closing of the gate as soon as a car steps on it. It is a pressure sensor type of weight detection.

It is a composition of arranged normally open switches connected between the interrupt pins of the micro-controller and the ground. These sensors are placed some distance away from the gates (in/out) and at the parking slots. The connection to ground potential is essentially for the activation of the negative edge triggered interrupt.

3.3 SYSTEM CONTROL MODULE

This module is made up of the hard ware and software design that control the total functionality of the project. Switching and bi-directional operation of the motor in the electrochemical module, sensor actuators, car inventory, display period as well as display mode are all regulated from this module. Hence this module is the core of the project. It is composed of an AT89C52 micro-controller, and functions on the basis of the predefined algorithm programmed onto it using the low-level language (assemble language)

3.3.1 The Micro-controller (AT89C52)

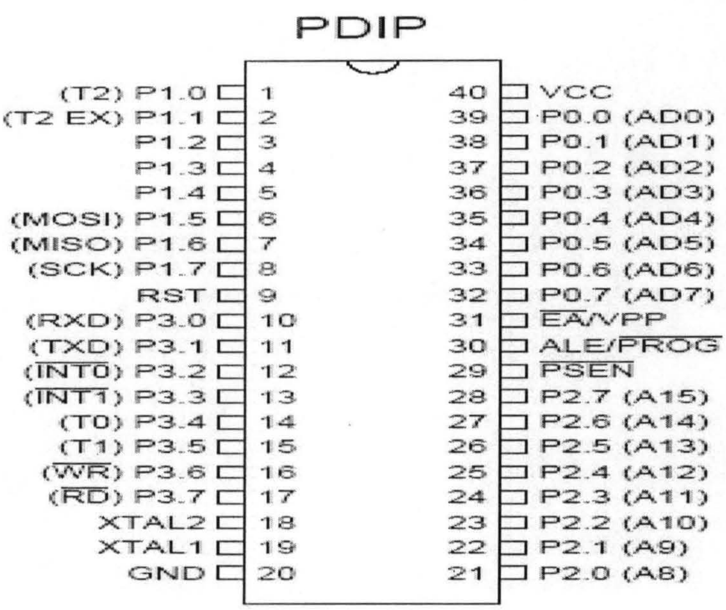


Fig 3.4: Diagram of the AT89C52

The micro-controller (AT89C52) is a low power, high performance 40-pin (DIP), 8-bit controller with 4 kilobytes of In-system reprogrammable flash memory. It has an endurance of 1000 write/erase cycles. It also has a fully static operation of 0Hz to 24MHz, three level program memory lock, 256 and 8-bit internal RAM, 32 programmable (i.e., they are each bit addressable) input/output lines, three 16-bit timer/counters, eight interrupt sources, programmable serial channel, low power idle mode and low power down modes. Table 3.0 shows microcontroller (AT89C52) with its different pin configurations.

Table 3.0: Pin description of the AT89C52

PIN	DESCRIPTION
1-8	$P_{1.0} - P_{1.7}$, Port 1
9	RST, Reset
10-17	$P_{3.0} - P_{3.7}$, Port 3
18	XTAL2 – Crystal
19	XTAL1 – Crystal
20	GND – Ground
21-28	$Port_{2.0} - P_{2.7}$, Port 2
29	PSEN – Program Store Enable
30	program
31	ALE – Address Latch Enable
32-39	$P_{0.1} - P_{0.7}$, Port 0
40	V_{cc} – Positive Power Supply

3.3.2 CONFIGURATION OF THE MICROCONTROLLER MODULE

For this project to function as required the following configuration were made during design

- ✓ **Reset Configuration**

The RST configuration is power ON reset i.e., the system resets itself automatically each time it is powered ON. This is the factory requirement as specified in the data sheet. For the controller to generate internal RESET, Pin 9 must be pulled high for at least 1 machine cycle. In other words, Pin 9 is taken to Vcc.

1 machine cycle = 12 crystal pulses

12 crystal pulses = 1×10^{-6}secs.

Hence, the capacitor change time is 1×10^{-6}secs.

During the charging of the capacitor, Pin 40 is at positive voltage (+5V). After charging to the peak, the capacitor discharges (that is, stops charging). Thus, 10K resistor pulls Pin 9 to ground

(GND). Controller commences executing internal program provided Pin 31 (ALE) is pulled high.

For external RST, the capacitor is short circuited (that is, momentarily discharged by bridging the anode and cathode). The $10\mu f$ capacitor and 10K resistor used in the configuration is so chosen so as to increase the capacitor charge time above 1×10^{-6}secs.

- ✓ **Crystal Configuration**

The crystal is required to generate the required oscillation needed by the micro-controller to function properly. Two 12MHz crystals were used and connected across Pins 18 and 19 to complete the internal oscillation circuit. According to the factory specification, synchronization of both terminals of the crystals is possible by using capacitors with threshold values of$\pm 40\rho f$. For this project, the capacitor value used was$33\rho f$.

- ✓ **Other Configuration**

Since Port 0 has no internal pull up resistor, external pull up resistors were connected in the range of$10K\Omega$. A total of eight resistors were used across $P_{0.0}$ to $P_{0.7}$. Other ports (1-3) has internal resistor in the range of $10K\Omega$ as well. Fig 3.5 shows the configurations highlighted above.

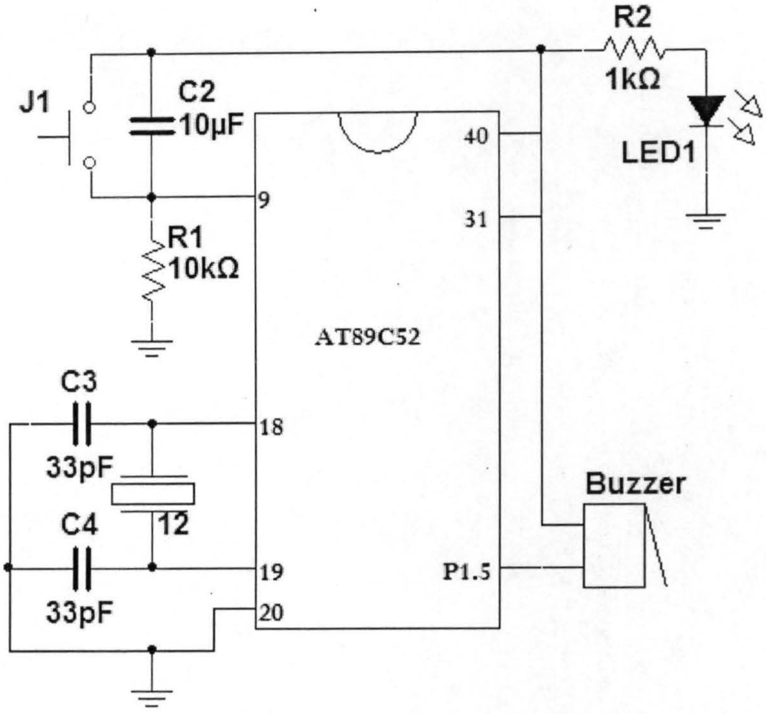


Fig 3.5: Circuit Configuration of the Microcontroller Module

The ports and pins used for this project is as explained below.

- ✓ Port 3 was used to drive the 5 LEDS on the parking slot, the motor relays (R_{L1} and R_{L2}) and Port 3.7 controls "park on SLOT" written on the display board.
- ✓ Port 1 was used to control all the sensors (pressure sensors at the entrance/exit and at the parking slots).
- ✓ Port 2 was used to control 7-segment A and the arrow LEDs.
- ✓ Port 0 is used to control 7-segment B.

3.4 THE DISPLAY MODULE

This module provide the physical visible aid that detects to the user of the garage where and how to park their cars within the garage. The display module has as its major constituent an LED display board with appropriate inscription on it and 2 seven segment displays.

The circuit configuration for this module is as shown in the figure below.

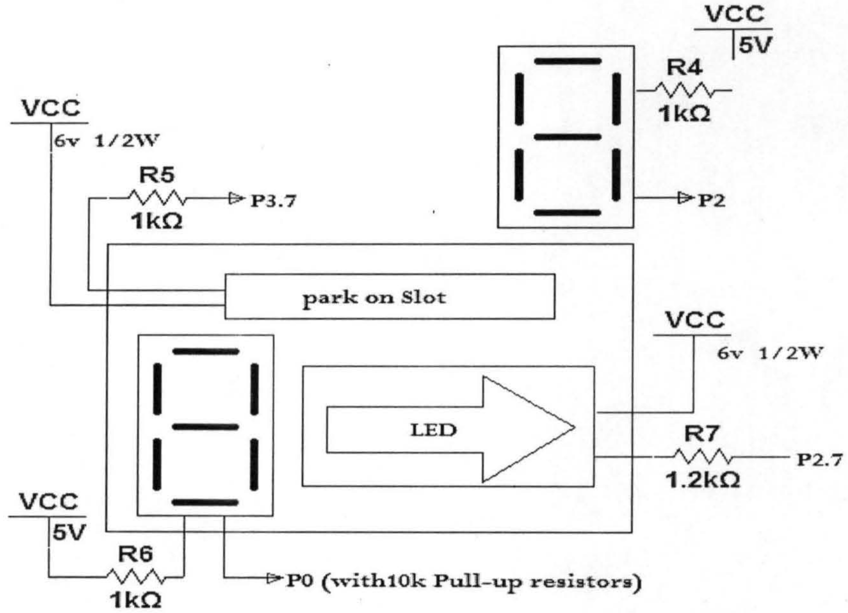


Fig 3.6: Circuit Configuration of the Display Module

3.4.1 SPECIFICATION

Novel shapes, green coloured LEDs, with a common cathode arrangement technique were soldered on the Vero board. The voltage requirement for the LED is 3-5V. Current rating is maximum of 10mA but 5mA was supplied via a $1K\Omega$ resistor.

That is, from Ohms law,

$V = IR$

$I = V/R$

Since,

$V = V_{cc} = 5V$

$R = 1K\Omega$

$I = 5/1 \times 10^3$

$= 0.005A = 5mA.$

3.4.2 FUNCTION OF THE DISPLAYS

The seven-segment displays are connected in common cathode mode. Two seven segment displays were used.

Seven-segment B: displays the position to park car digitally.

Seven-segment A: displays the total number of cars parked in the garage.

The LEDS displays "Park on slot and as well as the direction arrow. This is shown on the picture below

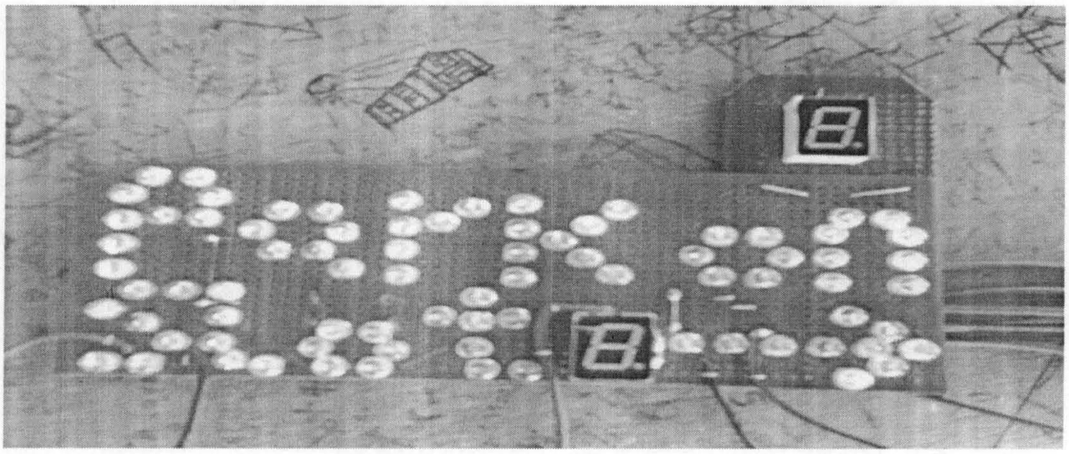


Plate 3.6: Constructed display module

3.5 THE BUZZER SYSTEM

This unit provides an audio alert in the form of a beep indicating that the capacity of the garage is at its maximum and the approaching car is trying to distort the arrangement of the park. Fig.3.5 above shows how the buzzer is connected to the microcontroller.

It is powered with +5V at 5mA. The switching transistor (BC557) is a PNP semi-conductor device. A PNP transistor was chosen because controller can sink more than it can source current. The PNP transistor unlike the NPN operates in the range of milli-amps which is the range of current that the micro-controller uses for sinking.

3.6 THE ELECTROMECHANICAL MODULE

This module is made up of a model of a one-way door with a bi-directional motor controlled by relays. The Figure below shows the circuit configuration for this unit.

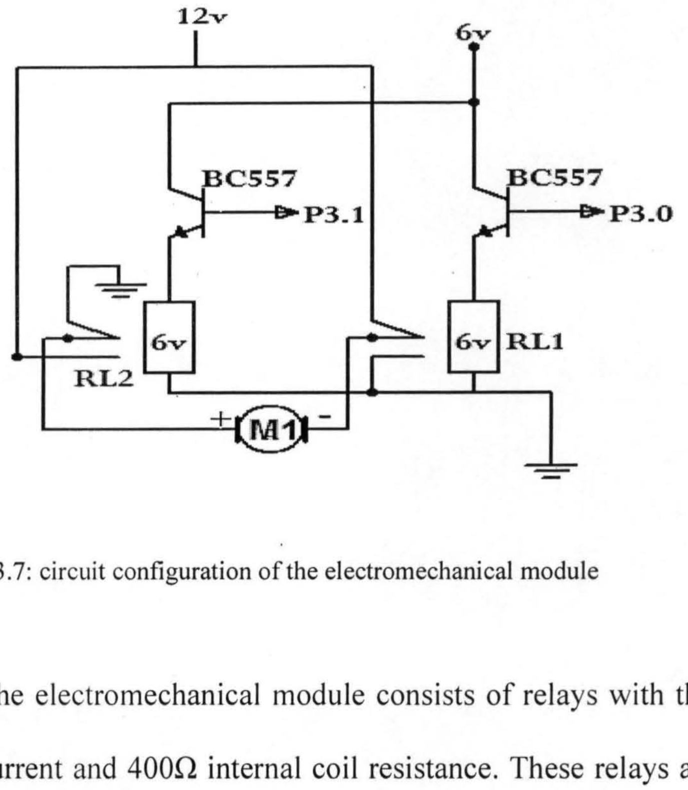


Fig 3.7: circuit configuration of the electromechanical module

As shown in the circuit, the electromechanical module consists of relays with the specification 6V DC, 10A maximum current and 400Ω internal coil resistance. These relays are used to vary the direction of rotation (DOR) of the motor that drives the gate either to open or close.

3.6.1 OPERATION OF THE ELECTROMECHANICAL MODULE

The motors terminals are connected across the common (C) of relay one (R_{L1}) and relay two (R_{L2}), when Normally Close (NC) of is R_{L1} positive (+ve), that of R_{L2} is negative (-ve). Hence, Normally Open (NO) of R_{L1} is negative and No of R_{L2} will be positive and motor moves in a clockwise and anticlockwise direction respectively. The motor is powered by +12v from the 7812 IC.

Below is a picture showing the full Vero board construction of the project

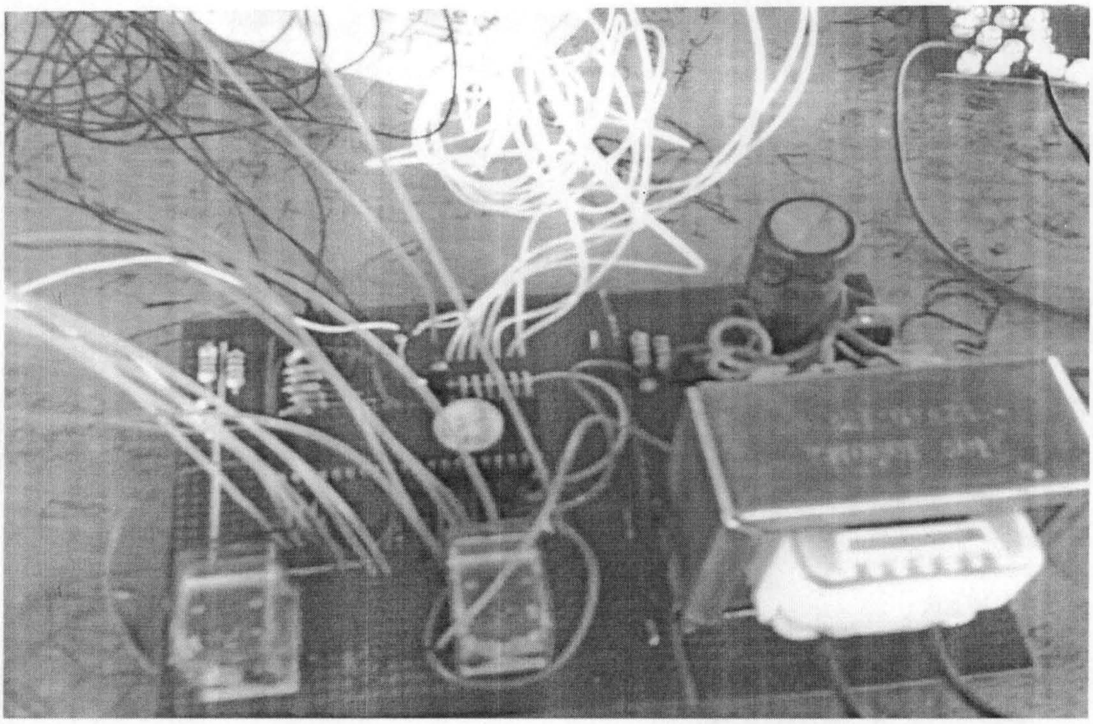


Plate 3.7: Complete project construction on Vero board.

3.7 OPERATION OF PROJECT

On power ON, the controller enables a latch bit which triggers the buzzer ON, thus producing a 20 pulse beep within one twentieth of a second. This indicates the commencement of execution of internal programme. The Display board is ON and seven-segment A displays the digit zero (0) indicating that there is no car parked in the garage. After 3-secs display goes OFF.

The micro-controller begins scanning of entrance and exit sensors once the entrance sensor pulse is low; the controller simultaneously scans the parking slot for free space. If search is positive or positive or valid (i.e., there is free space), controller activates the display and indicates the position to park (i.e., seven segment A is activated as well as the position LED on the parking slot). The gate is automatically open for entrance of car detected by the sensor. This process occurs in micro-seconds. After 15 seconds of entrance, the gate is automatically closed.

When the car is parked at the specified position, a pulse is sent to the micro-controller confirming the status of the car on the slot. The controller thus increment 7-segment A by 1 and the corresponding number is displayed. The process of scanning entrance and exit sensors is repeated.

In the event of exit, i.e., when exit sensors pulse is indicated to be low as confirmed by the micro-controller. Controller immediately opens the gate and decrement 7-segment A by 1 and the corresponding value is displayed. After 8 seconds gate is closed.

The entire process is repeated until the number of cars parked at the garage reaches its maximum. When the garage is fully occupied, i.e., number of cars in garage is five, gate is automatically closed. If any car steps on the entrance sensors at this stage, the buzzer beeps continuously until the car moves away from the sensors.

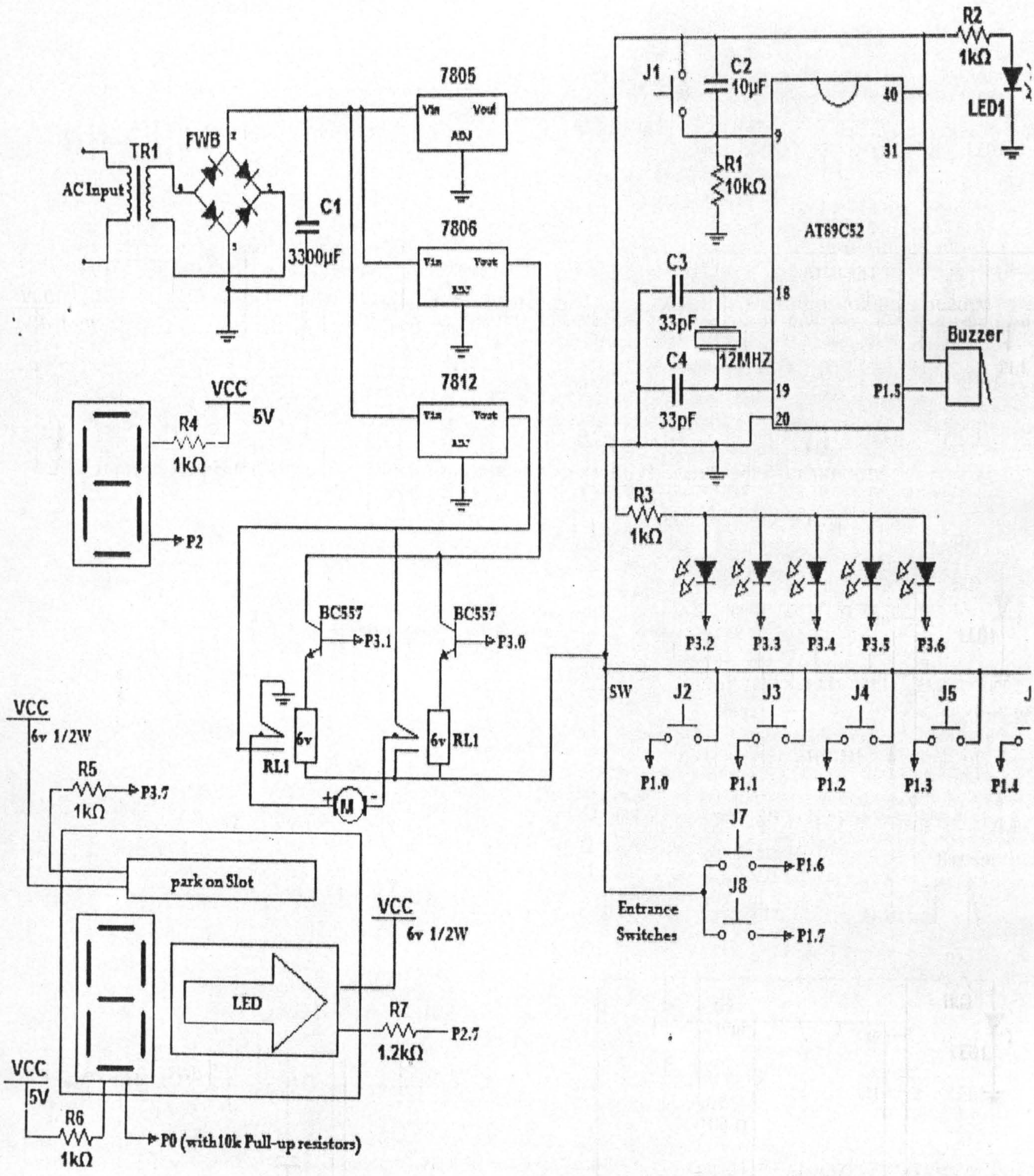


Fig 3.8: Complete project Circuit Diagram

CHAPTER FOUR

TEST, RESULT AND DISCUSSION

4.0 TEST

The purpose of constructing this device is to provide ease of entry and exit into the garage by providing the means with which the cars are properly arranged automatically. Upon completion of the construction, the workability of the constructed device was confirmed by subjecting it to series of test procedures. These procedures help in the test of each of the units and the result tabulated. This chapter gives an overview of the various test procedures and their corresponding tabulated result.

4.1 TESTING OF VARIOUS UNITS

To ease the construction procedure and troubleshooting, the circuitry was segmented Into functional blocks or modules. Each unit of this modules were first simulated using a virtual work bench (Protuse and Multism). Thereafter it was tested on a bread board but due to the complexity of realizing the circuitry, the work was finally transferred to a Vero board. Some of the steps taken in the course of testing include

- ❖ Testing for continuity and proper connection of modules using Multi meter. This was done on power off mode and components were well soldered on board.
- ❖ The construction was tested in modules
- ❖ Capacitance current, resistance and voltage measurement were taken and result was compared with the actual project values.

4.1.1 VOLTAGE REGULATION

In order to verify that the appropriate voltage level is supplied to the system, proper and thorough testing of regulators used was carried out. This was done by inputting the full range of voltage, some of which may contain defect like voltage spikes. The output voltage is measured with a millimeter to ensure that the regulated outputs are accurate and stable. When the voltage regulators were connected into this system circuitry, +5v ,+6v and +12v respectively was obtained. The picture below shows the bread board testing of the project

bread board

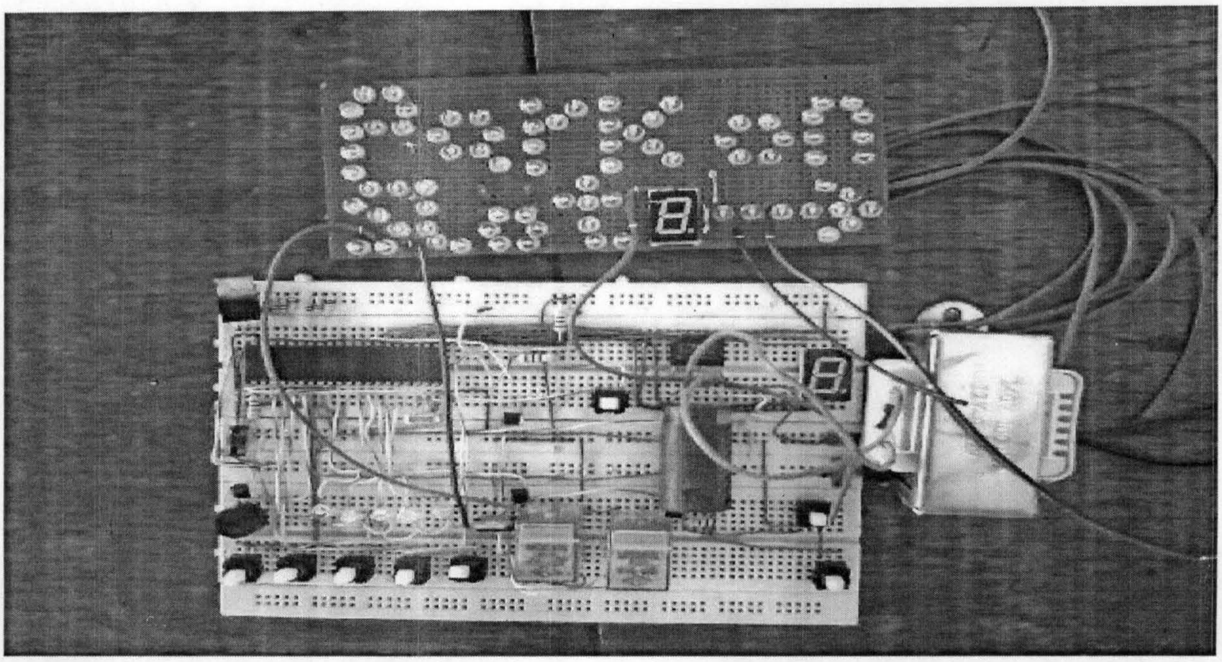


Plate 4.1: Project Testing on Bread Board

4.1.2 MICROCONTROLLER

The programmed microcontroller was not tested with the circuit until at final stage of testing. A simulator (virtual program) Kiel was used to study the program behavior. In this simulator, a lamp was used to indicate the state of the expected output from the microcontroller to the motor programmed drive. The forward motion was observed to work in the exact mode in which it was programmed. In addition, the delay time for each indication signal as well as the display was equally noted and confirms to function as specified by the program.

At power on, the power indication LED glows and the buzzer trigger on, three beep sounds is heard. This indicates that program is working well and the controller begin its scan process. Each result is tabulated based on the initiating interrupt signal.

4.2 RESULTS

The results obtained from the test of the different modules are represented in the tables below

Table 4.1: Results obtained from Power Module Test

	TEST	RESULTS		
VOLTAGE REGULATORS	INPUT VOLTAGE	AC=230VOLT		
		DC=15.5VOLT		
	OUTPUT VOLTAGE	Regulator (7805)	Regulator (7806	Regulator (7812)
		5v	6v	12v

Table 4.2: Result obtained from the Microcontroller Interfaced modules.

INPUT	SIGNAL	DURATION
Power on	10 beeps from the buzzer, power indicator LED glows	10 seconds, one for each beep.
Car on entrance gate	A beep from the Buzzer, entrance gate opens, main display is ON, arrow LED flashes to indicate direction to go Display B increment by one.	2 Seconds and ends after 15 seconds
Car on parking slot	Display A increment by one	Continues until interrupt signal is LOW.
Car on exit sensor	Buzzer beep and gate opens, display A decrement	2seconds and closes after 15 seconds
Car park sensors all LOW	Gate is permanently closed and any encroachment on exit sensors triggers the buzzer	Continuously until car steps off the exit sensor

4.3 DISCUSSION OF RESULTS

At power on, the power on LED indicator is on and the buzzer beeps. The display module indicate the status of the code and each section of the code was monitored. The sensors were activated and the expected duration of the motor motion was noted. The result so obtained correlated with the time span programmed in the control module.

Similarly, the entrance and exit sensors as well as the display board was found to function properly and the result conform to the program duration as well as its necessary action to be execute d. Generally, the programmed values were found to conform to the experimented values with a precise real time clock system.

4.4 COST ANALYSIS

In order to completely realize the project, capital was needed for the purchase of the components . The cost analysis of components used in the project is listed in the table below. This is done so as to give an idea of the "near cost" involvements as regards constructing the device.

Table 4.3: Cost Analysis

COMPONENT	MANUFACTURER	MATERIAL NUMBER	QTY	UNIT PRICE	TOTAL
Microcontroller	Atmel	89C52	1	1000	1000
Transformer		220-24v	1	300	300
Vero board		Big dot	2	150	300
Voltage regulators			3	50	150
Block diode			1	30	30
7segment display			2	100	200
Crystal(12MHZ)			1	200	200
Buzzer			1	200	200
Switch transistors			5	10	50

Relays			2	80	160
LEDs			71	10	710
Gate motor pack	Local		1	600	600
Resistors and capacitors					350
model					4500
Jumper cables					400
total					10230

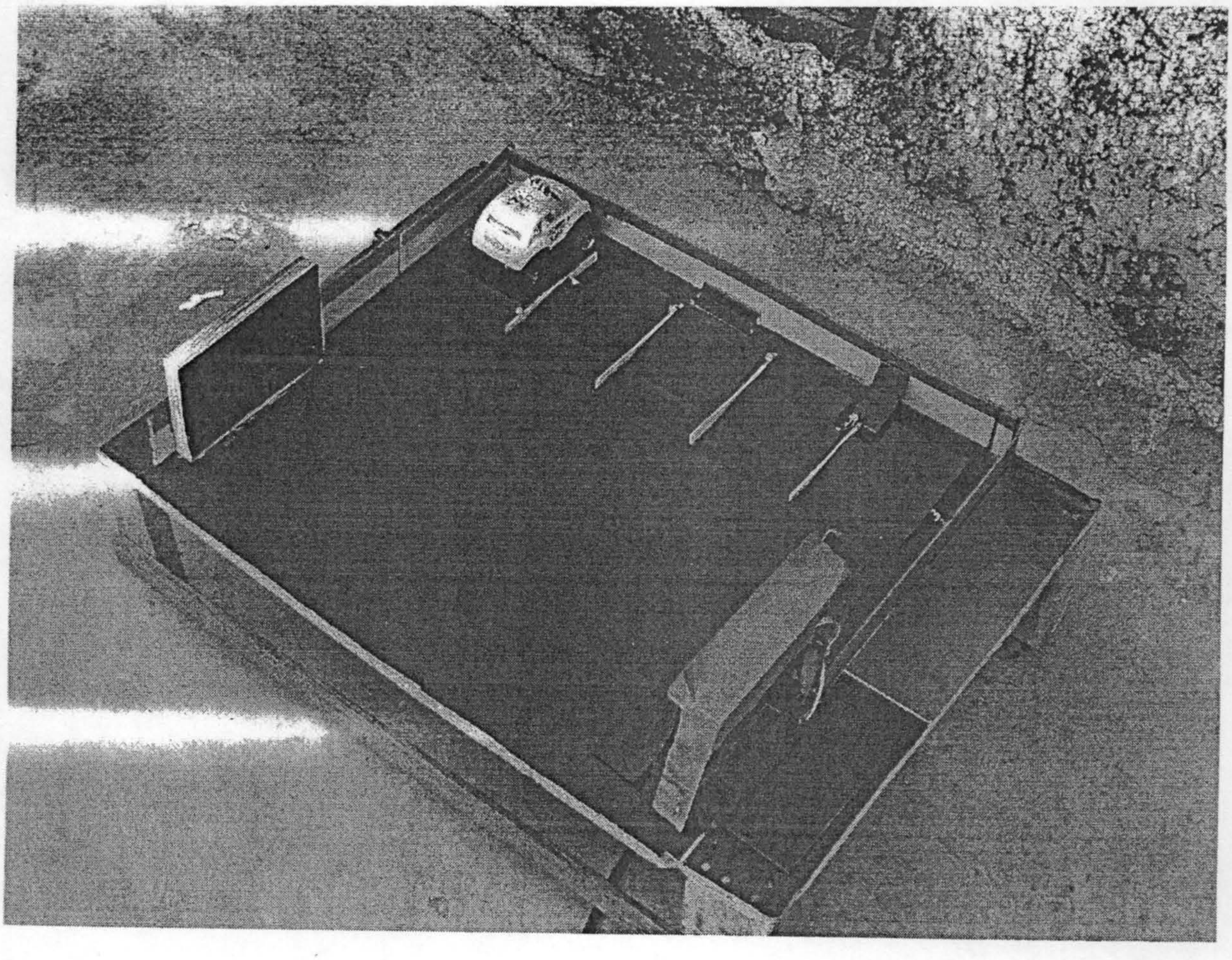
4.5 PROBLEMS ENCOUNTERED

Selecting the right type of sensor was a major problem at first since some of the sensors required were not easy to get around. Finally a switch button acting as a floor mat was used as a pressure sensor. This however, introduced a challenge of communication with the controller which eventually led to increase in cost.

In addition, some of the components due to their high degree of sensitivity to temperature change were damaged during the process of soldering and this drastically slow down the progress of the work. Again, programming the chip to the design specification became very difficult. This was because getting the correct programmer was not easy. However, this was overcome by writing codes in assembly language and saving in a compatible mode that will enable synchronization during burning.

4.6 Project casing and model

The casing for this project was done using metal. The metal was perforated so as to provide enough ventilation to the controller and the entire system modules. The project model was however done using wood and modeling paper. This is as shown in fig 4.1



CHAPTER FIVE

5.0 CONCLUSION

The project achieved its aims and objectives as it relates to workability, functionality, efficiency and economy. However, it is pertinent to state that the design and implementation specification used in this project is only a prototype. Specification for the real life commercial or industrial implementation of the project will differ slightly but same procedures will be adhered to.

Finally, with this project, comfort and easy of entry and exit within car parks is ensured. Unnecessary overcrowding, quarrels, accidents, unpleasant site of car littering around our workplaces, homes, schools, worship centers and hospitals etc. is eliminated using simple automation.

5.1 RECOMMENDATION

This project finds application in virtually all sectors of the economy. Some of the recommendations that will make this project meet the changing trend include

1. Inclusion of a security measure that will monitor cars as the enter and leave the garage
2. Inclusion of a timer and real time clock that will give information about time when car entered and leaves the premises.
3. Inclusion of a program that will monitor when users of the garage violate instructions given by controller. For instance, a program can be written to alarm when drivers park at the wrong slot as indicated by display board.

5.2 PRECAUTIONS

Some of the precautions taken during the construction of the project are as listed below

1. During the design, simulations were first carried out on the virtual workbench (Multism) and errors were corrected during the debugging process.
2. During bread boarding, the microcontroller was not connected in the circuit. This was done to prevent damage to the controller.
3. In the process of burning the programme code to the chip, it was ensured that the controller was placed following the direction of the U inscription on the Programmer. This is to avoid error of port mismatch.
4. The Vero board was properly scrapped before any form of soldering was made on it. This is to ensure firm and neat soldering.
5. At every stage (module) of construction, continuity test was carried out on each component before soldering. This is to ascertain the reliability of the component and possible save cost of damaging the entire project.
6. The LEDs were ensured to be all forward biased to prevent any form of damage of the LEDs.

REFERENCES

[1] Oxford Advance Learners dictionary, 6th Edition, pp.65

[2] www.wikipedia.org/car_parking_system/books?id =ms45, Df j&p

[3] Shannon Saunders, Mc Donald, "Automated parking saves space", Proc. of the IPSN track on space management UCC Ireland, pp.7.

[4] M. Piorkowski, M. Grossglauser. "Constrained Tracking on a Road Network," European Workshop on Wireless Sensor Networks (EWSN), Feb. 2006, pp.23

[5] Parking Carma/Acme Innovation Inc. http://www.parkingcarma.com/

[6] http//books.google.com/books?id=NSEDAA,AAMBA,J&Pg=PA137&dq=popular+ science+January+1946&hl.

[7] S. Miura, Y. Zhan, and T. Kuroda, "Evaluation of Parking Search using Sensor Network," IEEE International Symposium on Wireless Pervasive Computing, Jan. 2006.

[8] Jan Axel son, the microcontroller idea book, lake view research, 1997, pp.1-3.

[9] Siemens AG. Intelligent Traffic Systems.http://www.siemens.com/traffic

[10] J.T Benson, T.O.Donovan, carpark management using wireless sensor Network, University college Cork (UCC) Ireland, 1999, pp.3

[11] A.K & B.J Theraja, Electrical Technology,pp.996

[12] "Aids To Modern Living - Garage Doors". *Popular Science*: 137. January 1946. http://books.google.com/books?id=NSEDAAAAMBAJ&pg=PA137&dq=popular+science+January+1946&hl=en&ei=vb7kTIbiC4uQnwfUwpT4BQ&sa=X&oi=book_result&ct=result&resnum=2&sqi=2&ved=0CDQQ6 AEwAQ#v=onepage&q=popular%20science%20January%201946&f=true.

[13] B.D Panda, car automation development, Antariksh Bhavan, new Bell road Bangalore India 1995, pp.1-8[14] Mecklev Nelson N.M(Ed), parking made easy, 1990, pp14-16

[15] Faruqi K.K Khalid, Automation principles and methods, pp2-4

[16] G.M (Ed), car parks of the future research, contribution from the 1990 computers in garage and libraries 1991, pp21-37

[17] Jeremy Landit, history of RFID and its application in automation 1990, pp13

APPENDIX

```
ORG 0H
MOV R0, #0H
MOV R1, #0H
MOV R2, #0H
CPL P1.5 ...ON buzzer
LCALL DELAY;...1/20sec
CPL P1.5 ...OFF buzzer
LCALL DELAY...1sec
CPL P1.5 ...ON buzzer
LCALL DELAY...1sec
CPL P1.5 ...OFF buzzer
LCALL DELAY...1sec
CPL P1.5 ...ON buzzer
LCALL DELAY...1sec
CPL P1.5 ...OFF buzzer
LCALL DELAY...1sec
JMP ENTRANCE_1_SW
;...............................
DELAY: NOP
MOV TMOD, #0...1sec delay
MOV TH0, #3CH
```

```
MOV TL0, #0

SETB TR0

JNB TF0, $

CLR TR0

CLR TF0

INC R0

CJNE R0, #20, DELAY

MOV R0, #0000H

RET

;.................................

; Monitor'sentrance/exit cars

ENTRANCE_1_SW: JB P1.6, ENTRANCE_2_SW

JMP CHECK

ENTRANCE_2_SW: JB P1.7, ENTRANCE_1_SW

LJMP OPEN_GATE

;.................................

CHECK...On what slot to park

SLOT_1: JNB P1.0, SLOT_2

CLR P3.2...ON LED in slot 1

MOV P0, #11111001

JMP OPEN_GATE

;.................................
```

```
SLOT_2: JNB P1.1, SLOT_3

CLR P3.3...ON LED in slot 2

MOV P0, #10100100

JMP OPEN_GATE

;...............................

SLOT_3: JNB P1.2, SLOT_4

CLR P3.4...ON LED in slot 3

MOV P0, #10110000

JMP OPEN_GATE

;...............................

SLOT_4: JNB P1.3, SLOT_5

CLR P3.5...ON LED in slot 4

MOV P0, #10011001

JMP OPEN_GATE

;...............................

SLOT_5: JNB P1.5, BUZZER

CLR P3.5...ON LED in slot 5

MOV P0, #10010010

JMP OPEN_GATE

;.................................

BUZZER: CLRP1.5 ...ON buzzer

JNB P1.6, $...Pause no packing space

SETB P1.5
```

```
JMP ENTRANCE_1_SW

;...............................

OPEN_GATE: CLRP3.7 ...ON MAIN DSPL

CLR P1.5 ...Activate buzzer

LCALL DELAY .1sec

LCALL DELAY .1sec

SETB P1.5 ...OFF buzzer

CLR P3.0 ...Open gate

CLR P3.1 ...Open gate

JNB P1.6, $

MOV R2, #15

GHJ: LCALLDELAY ...Wait for 15sec

   DJNZ R2, GHJ

;...............................

CLOSE_GATE: NOP

SETB P3.0 ...Close gate

SETB P3.1 ...Close gate

MOV P0, #0FFH...Clear display

SETB P3.7; OFF MAIN DSPL

;...............................

; Shows no_ of cars available in slots

S1: JNB P1.0, S2

INC R1
```

```
S2: JNB P1.1, S3
INC R1
S3: JNB P1.2, S4
INC R1
S4: JNB P1.3, S5
INC R1
S5: JNB P1.4, SHOW_1
INC R1
SHOW_1: CJNE R1, #1, SHOW_2
MOV P2, #10011001
SHOW_2: CJNE R1, #2, SHOW_3
MOV P2, #10110000
SHOW_3: CJNE R1, #3, SHOW_4
MOV P2, #10100100
SHOW_4: CJNE R1, #4, SHOW_5
MOV P0, #11111001
SHOW_5: CJNE R1, #5, FINISH
FINISH: MOV P2, #11000000
;...............................
LJMP ENTRANCE_1_SW
END
```