DESIGN AND CONSTRUCTION

OF A PARKING LOT

AUTOMATIC GATE

BY

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2004/18782EE

A Thesis submitted to the Department of Electrical and Computer Engineering, Federal University of Technology, Minna, Niger state.

DECEMBER, 2009

DEDICATION

This project is specially dedicated to Almighty God, the one who grants wisdom and for making me to successfully graduate in the Department of Electrical and Computer engineering, Federal University of Technology, Minna.

ATTESTATION/DECLARATION

I, Omolara Monisola Akinyeye, declare that this work was done by me and has never been presented elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

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ACKNOWLEDGEMENT

My utmost appreciation goes to Almighty God for his protection, provision and Loving kindness throughout my stay in the Federal University of Technology, Minna.

I am specially indebted to all the staff in the Department of Electrical and Computer Engineering for the great knowledge imparted into my life during my stay on campus.

I am extremely grateful to my project supervisor, Dr E.N Onwuka for her intellectual supports, advice and critisms. I remain highly indebted to my parents Mr and Mrs F.A Akinyeye, My spiritual father Dr J.K Omoniyi for their financial support, spiritual support and parental care during my stay in the University and always.

Finally, I consider myself very fortunate to have My brother and sister, Wale Akinyeye and Mrs A.O Ajadi, My Dear friend, Adeniyi Oguntunde and My other friends like Anne-Marie Obaitan, Abimbola Ajagun, Afoma Onyemelukwe, Ephraim Michael, Yvonne Achema, Kinsley Ugwu, Shittu Zumu-Ngaih and Samson Akinsanya. They all helped me and gave me the encouragement I needed in my academics. Thank you all very much for being there always.

ABSTRACT

The work presented here outlines the development of a microcontroller based automatic gate. The inconveniences encountered in gate operations have called for an immense search for solutions. The microcontroller based automatic gate offers everything necessary to put an end to these inconveniences as it incorporates an intelligent device (microcontroller).Specifically, the system described in this project monitors two gates, the entrance and exit. The automatic gate senses any vehicle approaching it. It automatically opens, waits for a specified time, and closes after the time has elapsed. As soon as the gate closes, the system counts, registers, and displays the number of vehicles. The system also serves as an automobile parking control unity by periodically checking the number of vehicles that have entered the area and computing the available space limit in the parking area. Once the available space limit is reached, the entrance gate remains inaccessible until another vehicle comes out through the exit gate. The automatic gate developed in this project is unique in that it is controlled by software, which can be modified any time the system demands a change.

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CHAPTER ONE

INTRODUCTION

1.1 General Introduction

The need for automatic gates has been on the increase in recent times. The system described here incorporates the use of a microcontroller as a controller in achieving the aims of this project. It is no exaggeration to say that the microcontroller has revolutionized the electronics industry and has had a remarkable impact on many aspects of our lives.

Almost all areas of technology have started taking advantage of the inexpensive computer control that microcontrollers can provide. Some typical applications include: electronic games, CD players, automatic braking systems, industrial process controls, electronic measuring instruments, automobile emission controls, microwave ovens, traffic controllers, and a rapidly growing number of new products.

The automatic gate described here automates the entrances to parking lots of residential homes, organizations, automobile terminus, and public car parks. It could use a remote control convenience to avoid the stress of manually opening and closing the gate. The technology used eliminates gate monitoring and manning by human beings. The gate uses a state-of-the-art entry system. The gate has to perform gyrations – open, auto-reverse, stop, fully close and fully stop.

The automatic gate is not a security device and is not construed as one. It provides convenient access and intelligent features that makes it distinct from all other gates which bring it so close to a security device.

1.2 Aims and Objectives

At the end of this project, the following objectives should be achieved:

- Automatic gates that are easy to install, of good value and will give years of trouble free use.
- Automatic gates that are relatively cheap.
- Automatic gates that are safe for use.
- Automatic gates with parameters which can be varied.
- Automatic gates which are easy to service regularly.

1.3 Methodology

The research work presented here is the design and development of a microcontroller based automatic gate. As a monitoring and control system, the microcontroller was used to read in data values from the input device and interact with the outside world.

The system senses, opens and closes the gate, counts, registers, and displays the number of vehicles crossing the gate (both entrance and exit) and triggers an alarm once the space limit is reached. Once triggered, the gate remains inaccessible until another vehicle leaves the park. The automatic gate system comprises a sensor unit, a comparator unit, display unit, relay unit, gate control unit and the power supply unit.

The sensor provides an input signal to the system. It is an optical sensor which, when light rays are focused on it, has a low resistance and hence, causes the input to the system circuitry to be held "LOW". But, when a vehicle interrupts the beam, the resistance increases and reaches its dark resistance, thus, the input to the comparator circuitry is held "HIGH". The comparator unit serves as an Analog–to–Digital converter (ADC), which compares and produces a HIGH signal when the beam is interrupted. The comparator circuitry sends a signal to the interface unit, which is made up of Programmable Input/Output Controller (PIO). The software causes the microcontroller to check the input port of the interface unit for the sensor status information (the outputs of the comparator circuitry). A HIGH value causes the microcontroller to send a signal to the output port of the interface unit in order to activate the DC motor to control the gate (open and close). It equally sends a signal to the display unit for counting the number of vehicles. A LOW value will never activate the gate. The power supply unit supplies the required DC voltage needed by the entire microcontroller system.

1.4 Scope of Study

The scope of this project covers and entails the following areas:

- The Aims and Objectives of the project
- The Circuit Description of the project
- The Theoretical Background and Literature Review of the project
- The Design and Implementation of the project
- The Tests, Results, Problems encountered and Remedies to them in the course of the project.

CHAPTER TWO

LITERATURE REVIEW/THEORETICAL BACKGROUND

2.1 Literature Review

Gates in historic districts was considered as one of the factors which contribute to the overall character of a particular neighbourhood, along with buildings, trees and green space. Gates serve to indicate where public or private property meets. In general, the 19th century can be divided into two periods as far as Gate designs are concerned. The first half of the century can be identified with mostly wooden gates used for privacy. The chief problem with wood gates was that they rotted after a few years and had to be replaced frequently. By the 1850s, this problem was solved by the availability of cast-iron gates which will last far longer than wood gates.

Swing gates are the most common type of Cast-iron gate that you can see. This is especially true in residential areas. Though swing gates have traditionally been manually operated, more and more swing gates are being fitted with electric circuitry so as to transform manual swing gates to Electric swing gates. Furthermore, electric swing gates are also being fitted with remote access such that they become Automatic swing gates.

If you ask people, a large majority would probably answer for security purposes. True enough, if you have installed an elegant fence around your property, what better way to cap it off than with an equally elegant electronic swing gate? Then there is the reason of convenience. Think about it. how many times have you arrived home late at night from a hard day's work or a long road trip and you have had to stop the car, get out, open the gate, get back into the car, drive the car inside, get out, and close the gate again? Perhaps one time too many. Now think about another scenario. You arrive home in the dead of the night, bone tired. All you need to do is slow down a bit in front of the gate, push a single button, and voila, the gate opens for you! Once inside your property, you just need to press another button and the gate closes behind you. That is why more and more people are opting for automatic swing gates.

The most recent gate used is the Electric gate motor which is our focus in this project. The backbone of any electric gate —whether automatic or not —is the *electric gate motor*. This is the device which actually enables the electric gate to open or close without a person having to manually push the gate open or close. There are many different kinds of electric gate motors. They differ in design, in power, and use. Depending on the type of gate you have, the suitable electric gate motor will also differ. A single swing electric gate would need a different electric gate motor from a double swing electric gate. Electric sliding gates would also need a specific electric gate motor. Furthermore, electric wrought iron gates and electric wooden gates would need different kinds of electric gate motors as well. Even for the same type of electric gate, you need to take the size and weight into consideration when choosing an electric gate motor. Electric gate motors may be installed underground or on the ground.

2.2 Theoretical Background

A gate operator comprising:

An electric motor and motor controller circuit;

A speed reduction gear train coupling electric motor is connected to a gate for moving the gate between opened and closed positions; a

A limit switch assembly having an element drivingly coupled to the gate to move between corresponding first and second positions in response to movement of the gate between opened and closed positions. The limit switch assembly include at least one limit switch responsive to movement of element between first and second positions;

An encoder associated with element for providing a pulse train responsive to movement of element between first and second positions;

A microcontroller-based control system including a memory facility and receiving pulse train and an input from limit switch at a particular position of the gate, and responsively providing an output signal to shut off electric motor, control system recording in memory facility a value indicative of a pulse count from pulse train whose value is indicative of coasting of the gate to a stop position after shut off of electric motor, control system includes means for effecting a comparison between stop position of the gate and a desired limit position of stopping for the gate, and control system further predicting gate coast on a future operation based on recorded value to adjust shutting off of said electric motor during the future operation to coast the gate to a stop position substantially at desired limit position.

The present invention relates to a system for opening and closing a gate.

In the past, gate opening systems have relied heavily on the use of electromechanical limit switches to determine the "open" and "closed" position of the gate for de-energizing the motor driving the gate. Further, pressure switches or mechanical "trips" have been used to sense obstructions to movement of the gate during opening or closing. One of the disadvantages of such prior system is that the limit switches had to be accurately installed for sensing the open and closed positions of the gate. If the operation of these switches were in any way impaired or if they became dislodged from their original positions, the system would not operate as intended.

According to the present invention, the shaft driven by a reversible motor used for opening and closing the gate is provided with at least one reflective surface. An optical source/detector is used to generate a train of pulses representative of the rotation of the drive shaft. These pulses are fed into a programmable counter circuit which is incremented for each pulse when the gate is opened. When the counter circuit reaches a predetermined count, the motor is de-energized.

The counter circuit is programmable so that it also may count down, and when the operate push button is pushed a second time, the counter circuit is decremented by the pulses from the optical detector representative of rotations of the drive shaft. When the counter reaches a zero count, the motor is again de-energized.

CHAPTER THREE

DESIGN AND CONSTRUCTION

3.1 Hardware and Software Design Considerations

Certain specifications, parameters, and methods of implementation must be considered in system design and construction in order to give the expected result. The implementation of the design involves segmenting the overall system design into subsystems/modules/units, which are individually designed and tested before the integration of the various subsystems. The system design is divided into:

1) HARDWARE DESIGN consisting of various units as shown in the block diagram below:

- Power Supply Unit
- Sensor Unit
- Comparator Unit
- Micro-controller Unit
- Display Unit
- Gate Control Unit

2) SOFTWARE DESIGN

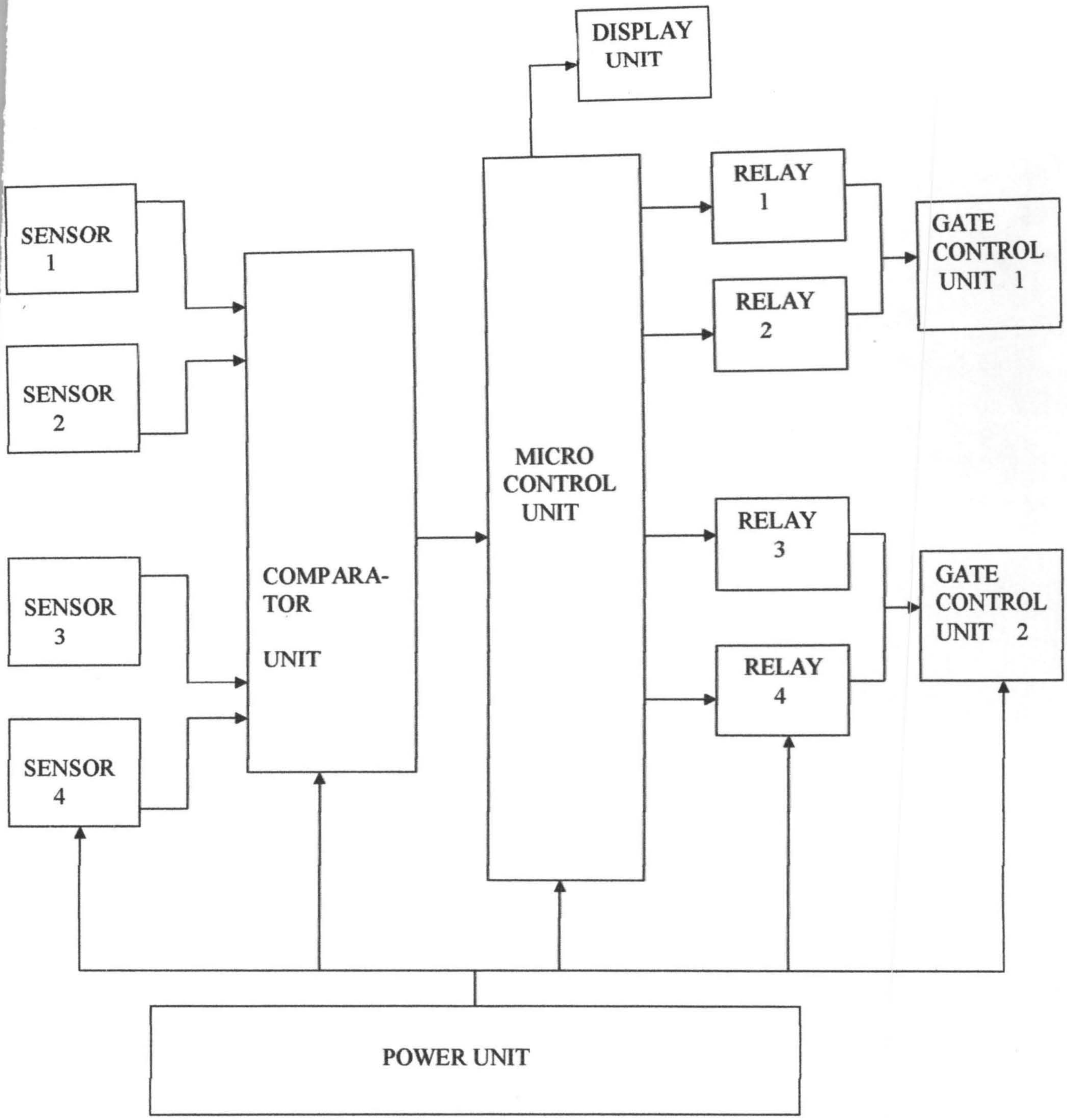


Fig 3.1 Block Diagram of the System

3.2 Hardware Design Considerations

3.2.1 Power Supply Unit

A microcontroller based system design has to be activated with a clean power supply of good regulation characteristics. A transient on the power line could send the microcontroller wandering, resulting in system failure. The system operates on a voltage VCC = 5V ±10% and as a result of this, the power supply unit designed is 5V DC and is not affected by variation in the AC voltage serving as input to the transformer. The components used in the power supply (Figure 2) include:

<u>TRANSFORMER</u>

A 220/240V AC transformer is used with output voltage of 12V AC.

<u>RECTIFYING DIODES</u>

This converts the AC current to DC and satisfies charging current demands of the filter capacitor. The arrangement of the diodes is called a bridge rectifier. Rectification is done by the PN junction diodes. The DC voltage varies above and below an average value. This variation is called ripple voltage. In order to reduce ripple voltage to a very small value, the DC voltage needs to be filtered.

<u>FILTER CAPACITOR</u>

Filter capacitors were chosen to be large enough to reduce the ripple voltage contained in a rectified voltage, to a relatively filtered voltage which resembles a smooth DC voltage as much as possible.

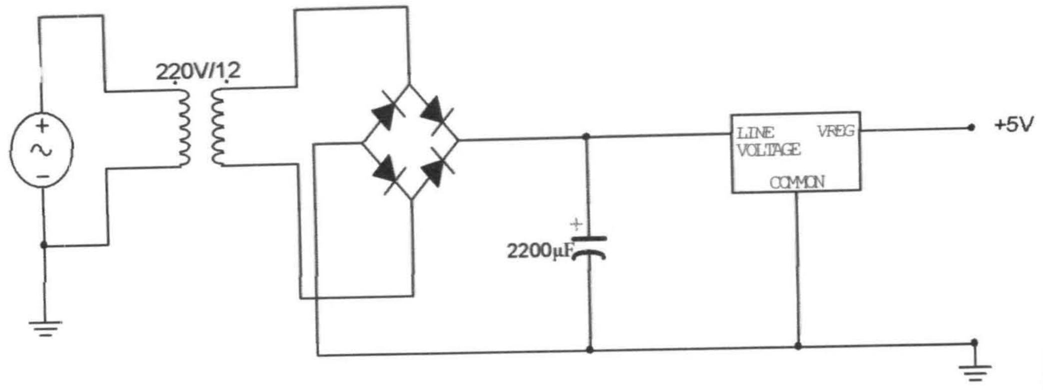


Fig 3.2 Power Supply Unit

Capacitors of low values were used at the output of the regulator in order to give the power supply low AC output impedance. To determine the proper value of capacitors used, the equation given below is employed:

$$V_{DC} = \frac{V_m-(4.7\times10^{-3}I_{DC})}{C} \qquad 3.1$$

Where V_m is the peak rectified voltage in volts

I_{DC} Is the load current in mA

V_{DC} Is the dc voltage

C is the filter capacitor in μF

REGULATOR (7805)

The regulator receives the input of a fairly constant DC voltage and supplies, as output, a somewhat lower value of DC voltage, which it maintains fixed or regulated over a wide range of load current or input variation. The 7805 regulator maintains a 5V DC supply voltage to the system.

MATHEMATICAL REASONS FOR SELECTING THE PARAMETERS:

Peak Voltage from the supply= $V_{rms}\sqrt{2}$ 3.2

Where $V_{rms} = 12V$ 3.3

$V_p = 12\sqrt{2} = 16.97V$ 3.4

But $IT = CdV$ 3.5

$C = \frac{IT}{dV}$ 3.6

$dV = 15\%\ of\ V_{peak}$ 3.7

$dV = \frac{15}{100} \times 16.97 = 2.5V$ 3.8

$dV = \frac{1}{4Cf}$ 3.9

Where $f = 50H_Z$ 3.10

$2.5 = \frac{1}{4 \times C \times 50}$ 3.11

$C = \frac{1}{2.5} \times 4 \times 50 = 2000\mu F$ (Ref: Prof Usifo) 3.12

POWER INDICATOR

$\frac{V_{CC} - V_{LED}}{I_{LED}} = R$ 3.13

But $V_{LED} = 1.7\ and\ I_{LED} = 20mA$ 3.14

If $I_{LED} = 10mA$ 3.15

$R = \frac{12-1.7}{0.01} = 1030\Omega = 1k\Omega$ 3.16

3.2.2 Sensor Unit

This module makes use of an optical sensor, specifically a light dependent resistor (photo conductive cell), whose resistance changes with the intensity of light. The type used is ORP12 and it has a dark resistance of 10MΩ. The sensor unit is shown in Figure3. When light rays are focused on the LDR, the resistance becomes very low (0-500Ω) but when the rays are interrupted, the resistance increases to its dark resistance. The variable resistor is used to vary the sensitivity of the LDR. It is otherwise called Dark Activated Sensor.

Two pairs of sensors (4 totals) were used for the entire system; each pair for the entrance and exit gates and the outputs from the sensor units and is part of the comparator circuitry. The sensor unit is arranged in such a way that it consists of two pairs of LDRs to provide signals for the comparator circuitry whenever there is an obstruction through the entrance or exit gate. For the design, two conditions are considered: first, when light rays are focused on the ORP12, and secondly, when the rays are being interrupted.

When light rays of great intensity are focused on the ORP12, the output voltages, V_{01} And V_{02} are low (approximately 0V). When the light beams are interrupted, the output voltages increase to $5V$ approximately.

The circuit has the ability to detect only the passage of an automobile through the entrance and exit gates. Each pair of sensors is separated by a reasonable distance such that the passage of a person or other moving objects cannot obstruct the sensor pair separation. Also, the height of the sensors is considered such that only the body of a vehicle can interrupt the light beams of the sensors and not the tires or its windows. To avoid false triggering, the two sensors must be interrupted one at a time i.e. when the first sensor is interrupted, the gate opens and wait until the other sensor is interrupted before it closes.

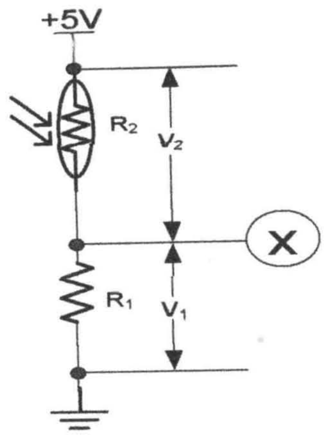


Fig 3.3 Sensor Unit

Initially (i.e. at ambient light), $\frac{2}{3}$ of V_{CC} is expected to drop across R1. To know the value of R1, the Voltage divider theorem is used.

$$V_1 = \frac{R_1}{R_1+R_2} \times V_{CC} \qquad 3.17$$

$$V_{CC} = 5V, \quad R_2 = 50 \qquad 3.18$$

$$V_{CC} \times \frac{2}{3} = \frac{R_1}{R_1+50} \times 12 \qquad 3.19$$

$$3V = \frac{R_1}{R_1+50} \times 5 \qquad 3.20$$

$$3R_1 + 150 = 5R_1 \qquad 3.21$$

$$R_1 = 75K\Omega \approx 100K\Omega \qquad 3.22$$

3.2.3 Comparator Unit

A comparator is an analogue circuit with two inputs and one output. It watches and compares two Voltages at the inputs and decides if the output should change or not based on the inputs e.g. if the Voltage on 1 of the inputs goes above a fixed trigger voltage on the other input, the output could go from LOW to HIGH.

The device used here is the LM324 (an operational amplifier circuitry). In this device, 4 Operational Amplifiers are present. The combination of these 4 Amplifiers is used as a comparator. The basic representation of an Op-Amp is shown below.

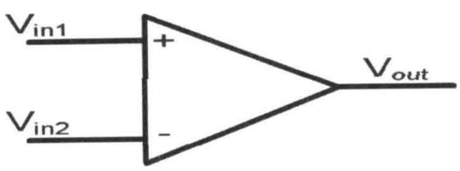


Fig 3.4.1 Basic Representation of an Op-amp

It accepts the output Voltages of the two sensor units. It is configured in such a way that only when there is an output from the two sensing units will the circuitry go HIGH, else it remains at LOW level. When a vehicle interrupts the light beams of the sensor units, the voltage at the output of the comparator goes HIGH. The circuit resets to a LOW voltage level when the interrupt is removed. When used as a comparator, Vout would be high if Vin1 is greater than Vin2. Since initially, one doesn't want a High Output, then Vin2 is obtained from the sensor stage while Vin1 is held constant as shown in the diagram below.

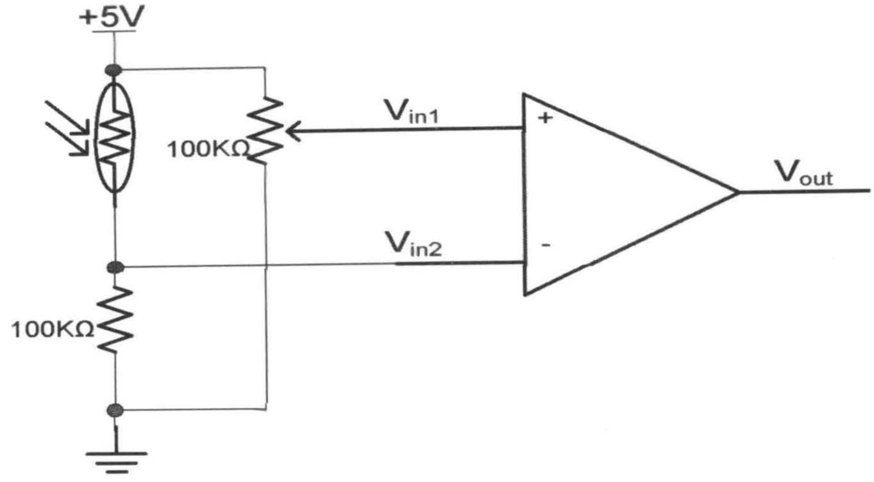


Fig 3.4.2 Operational Amplifier

However, in this project, Two are dedicated for the control of Gate 1(entrance gate) while the other two are used for Gate 2 (the exit gate).

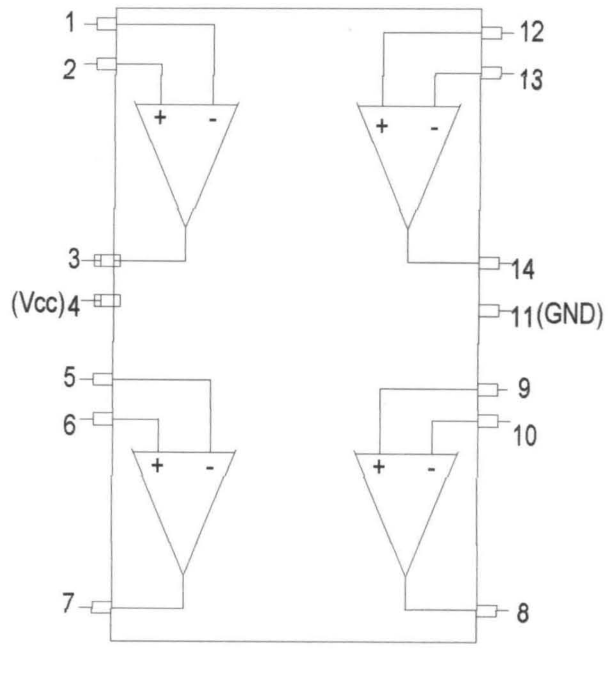


Fig 3.4.3 Internal structure of LM324Comparator

OPERATIONS

At Gate 1: When the sensor 1 is broken, Gate 1 is expected to Open. When Sensor 2 is broken, the counter counts up (increases) and the door closes.

At Gate 2: When Sensor 3 is broken, Gate 2 is expected to Open. When Sensor 4 is broken, the counter counts down (decreases) and the door closes.

3.2.4 Microcontroller Unit

This unit consist of the 89S51 Microcontroller which is programmed to switch certain relays so as to control the gate and the display accordingly.

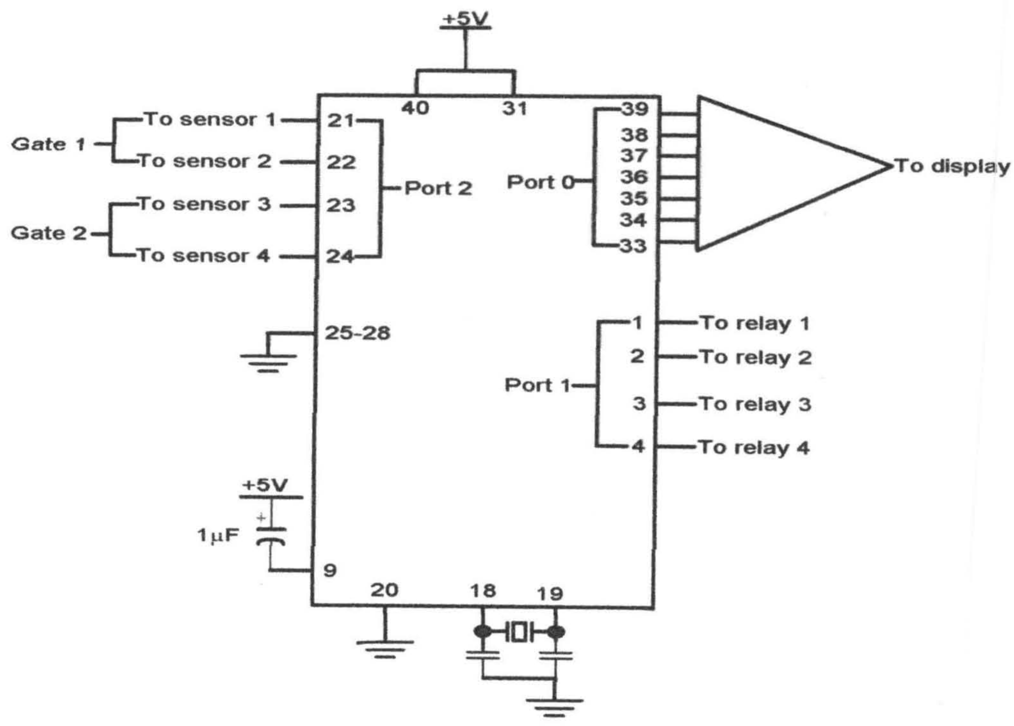


Fig 3.5 Microcontroller Circuit

The program that controls the Microcontroller is written in the Appendix.

3.2.5 Display Unit

One of the most popular methods for displaying information (numerical data) in a form that can be understood readily by the user or operator uses a 7-segment configuration to form the decimal characters 0 through 9 and sometimes the hex characters A through F.

The display unit comprises the Common anode 7-Segment display.

The Microcontroller used in the display unit provides two 8-bit I/O ports, which have been programmed as output ports which provide the outputs that will pass through the appropriate segments to display the decimal digits.

The anodes of the LEDs are all tied to Vcc (+5V). The cathodes of the LEDs are connected through current–limiting resistors to the appropriate outputs of the Microcontroller.

This is because LED readouts may require 10 to 40mA per segment, depending on their type and size.

The display unit is used to show, in decimal values, the number of vehicles that passed through the entrance gate (number of vehicles coming in) and the number of vehicles going out through the exit gate. The difference between the two gives the number of vehicles in the facility at any time. This serves as a counter.

The system is designed in such a way that it monitors the space available in the park. Once the limit is reached, the system will disallow any additional vehicle that wants to enter unless another vehicle leaves through the exit gate. This feature makes the design work like a monitoring system in that when the 9cars capacity is reached, without the exit of a car through Gate2, there would be no response by Gate1 to any car's entrance.

Table 1: Truth Table Of The Seven Segment Display

Numbers displayed	a	b	c	d	e	f	G
1	1	0	0	1	1	1	1
2	0	0	1	0	0	1	0
3	0	0	0	0	1	1	0
4	1	0	0	1	1	0	0
5	0	1	0	0	1	0	0
6	0	1	0	0	0	0	0
7	0	0	0	1	1	1	1
8	0	0	0	0	0	0	0
9	0	0	0	0	1	0	0

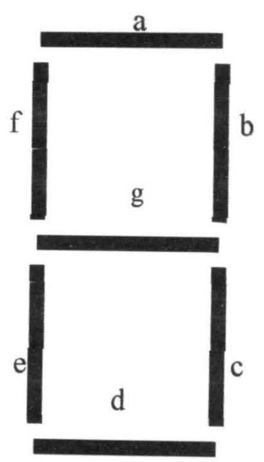


Fig 3.6 A Typical Seven Segment Display

3.2.6 Relay Unit

A relay is an electromagnetic device or a solid device operated by varying the input, which in turn is used to control other devices connected to its output. They form the simplest of automatic switch in the electric circuit. Relays come into existence because of the need to develop electrically operated mechanical switches. The delay used in this case is a mechanical type, which has a movable spring armature mounted above the core of the electromagnet. When the core is energized, the armature is altered and the contact pint changes position.

To make a relay operate, you have to pass a suitable pull-in and holding current (DC) through its energising coil. The relay coils used here are designed to operate from the supply voltage 5V; the coil has a resistance which will draw the right pull-in and holding currents when it's connected to that supply voltage. It becomes necessary to provide a suitable relay driver circuit so that your low-power circuitry can control the current through the relay's coil. In this project, a PNP transistor is being used to control a relay with a 5V coil, operating from a +5V supply. A Series base resistor is used to set the base current for the transistor, so that the transistor is driven into saturation (fully turned on) when the relay is to be energised. That way, the transistor will have minimal voltage drop, and hence dissipate very little power . As well as delivering most of the 5V to the relay coil. The transistor will turn on and energise the relay when Vin is low (0V), and will turn off when Vin is high (+5V).

A power diode is connected across the relay coil, to protect the transistor from damage due to the back-EMF pulse generated in the relay coil's inductance when the transistor turns off.

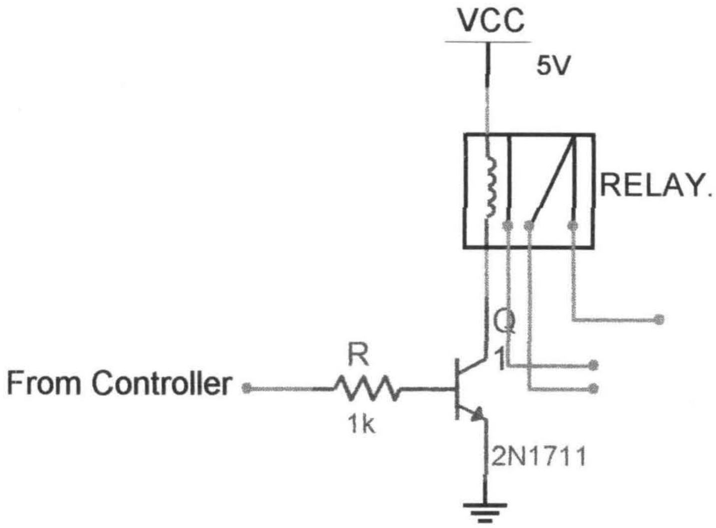


Fig 3.7 Relay circuit

3.2.7 Gate Control Unit

The gate control unit is made up of: The DC motor and the gates.

The figure below shows the gate control unit. The PNP transistors are arranged in such a way that a pair controls the opening of the gate through the motor and the other pair reverse the polarity of the motor by rotating it in the opposite direction to close the gate. There is a time interval of 1second between the opening and closing of the gate. The software could vary this. The arrangement of the diodes serves to protect the transistors from reverse-bias polarity and the resistors serve to improve switching times.

The motor is used to control the opening and closing of gate. The electric (DC) motor used is one that has the ability to rotate in both directions simply by reversing the polarity.

A LOW signal output from a transistor buffer through the PIO applied to point A bases the PNP transistors and these energizes the coils of the relays causing the motor to rotate in a particular direction. Similarly, a LOW signal applied to point B reverse (change) the rotation of the motor in the opposite direction. The control circuit is use for both entrance and exit gates.

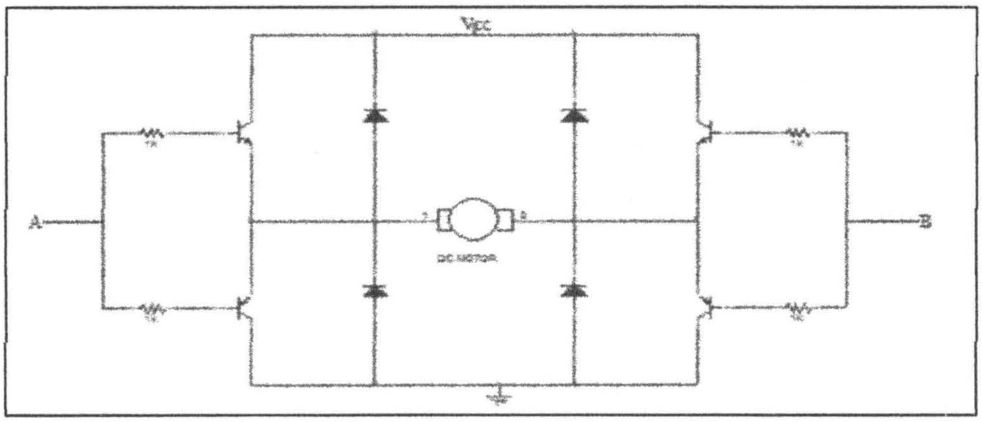
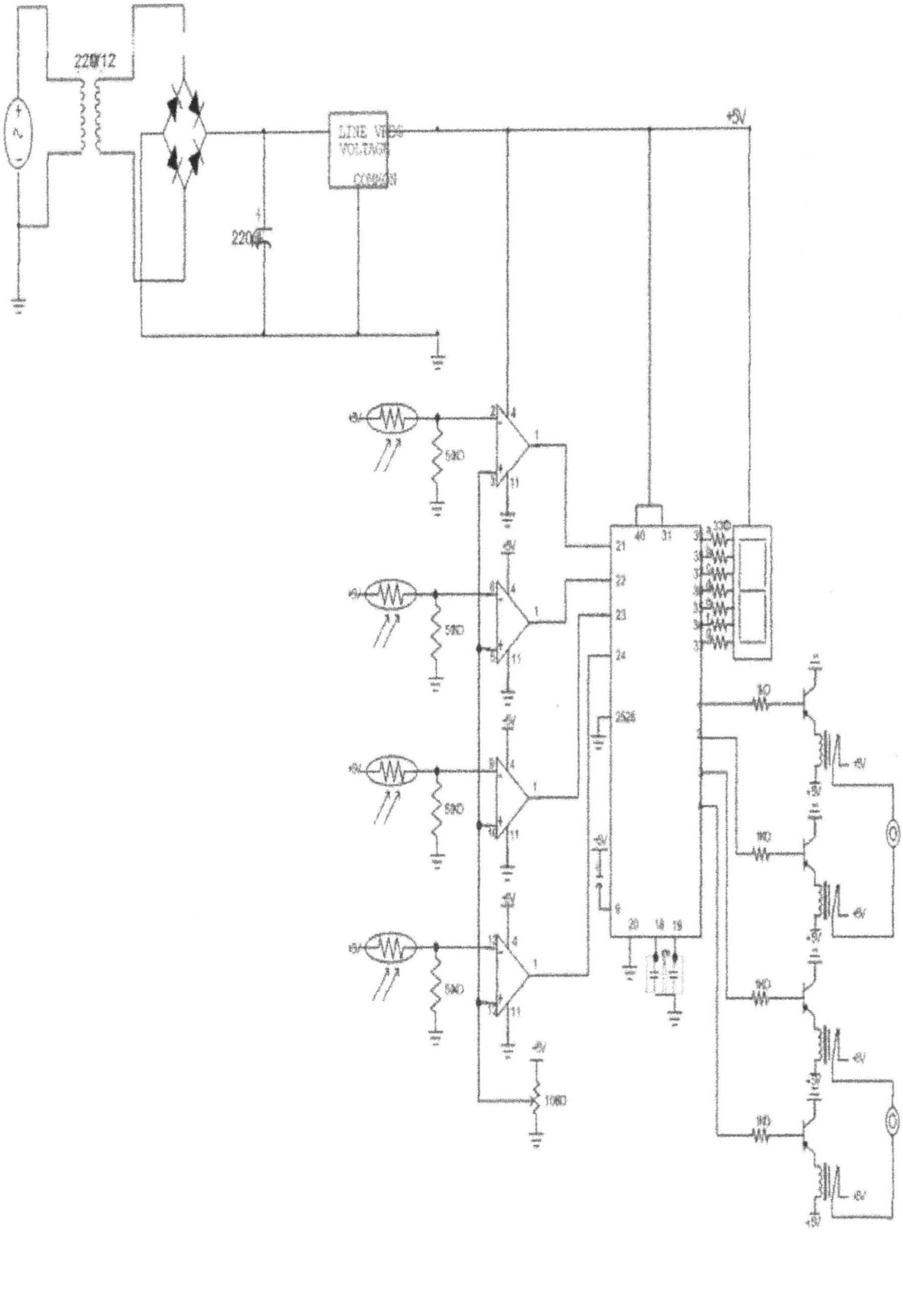


Fig 3.8 Gate Control Circuit.

MAIN CIRCUIT DIAGRAM



3.3 Software Design

3.3.1 Software Development Procedure

Designing software for the automatic gate was not a trivial task. In the development cycle of a microcontroller-based system, decisions are made on the parts of the system to be realized in the hardware design and the parts to be implemented in software. The software is decomposed into modules so that each module can be individually tested as a unit and debugged before the modules are integrated and tested as a software system in order to ensure that the software design meets its specification.

The program for the system is written in assembly language for speed optimization. Assembly code represents halfway position between machine code and a high level language. The assembly code is usually a mnemonic derived from the instruction itself, i.e. LDA is derived from LoaD the Accumulator. Assembly code is thus very easy to remember and use when writing programs.

When entering an assembly program into a microcontroller, the assembly code must first be converted into machine code. For short programs, of a few lines, this is relatively easy and usually requires that the programmer construct a table which contains the assembly mnemonics and the equivalent machine code. This technique is known as *Hand Assembly* and is limited to programs of about one hundred lines or less.

For longer programs, a separate program called an assembler program is used to convert the assembly code into machine code, which is placed directly into the microcontroller memory. The program modules are segmented into:

a. Main program

b. Sensor subroutine

c. Delay subroutine

d. Output (Gate Control) subroutine

The software was designed using the following steps:

1. Algorithm
2. Flowchart
3. Assembly Language Codes.

3.3.2 Algorithm

The algorithm used to implement the program for the system described in this paper is as follows:

START

1. Initialize counter = 0, space limit =9
2. Fetch the status of the sensor bit
3. Compare the status of the sensor bit with entrance and exit codes
    a. If status = entrance code then step 5
    b. Else if status = exit code then step6
4. Go to step 2

5 Open, wait and close

    a. Increment counter and display

6 Open, wait and close

    a. Decrement counter and display

7. Compare result with space limit
    a. If result = space limit then step 9

b. Else go to step 2

8. Fetch status of the sensor bit

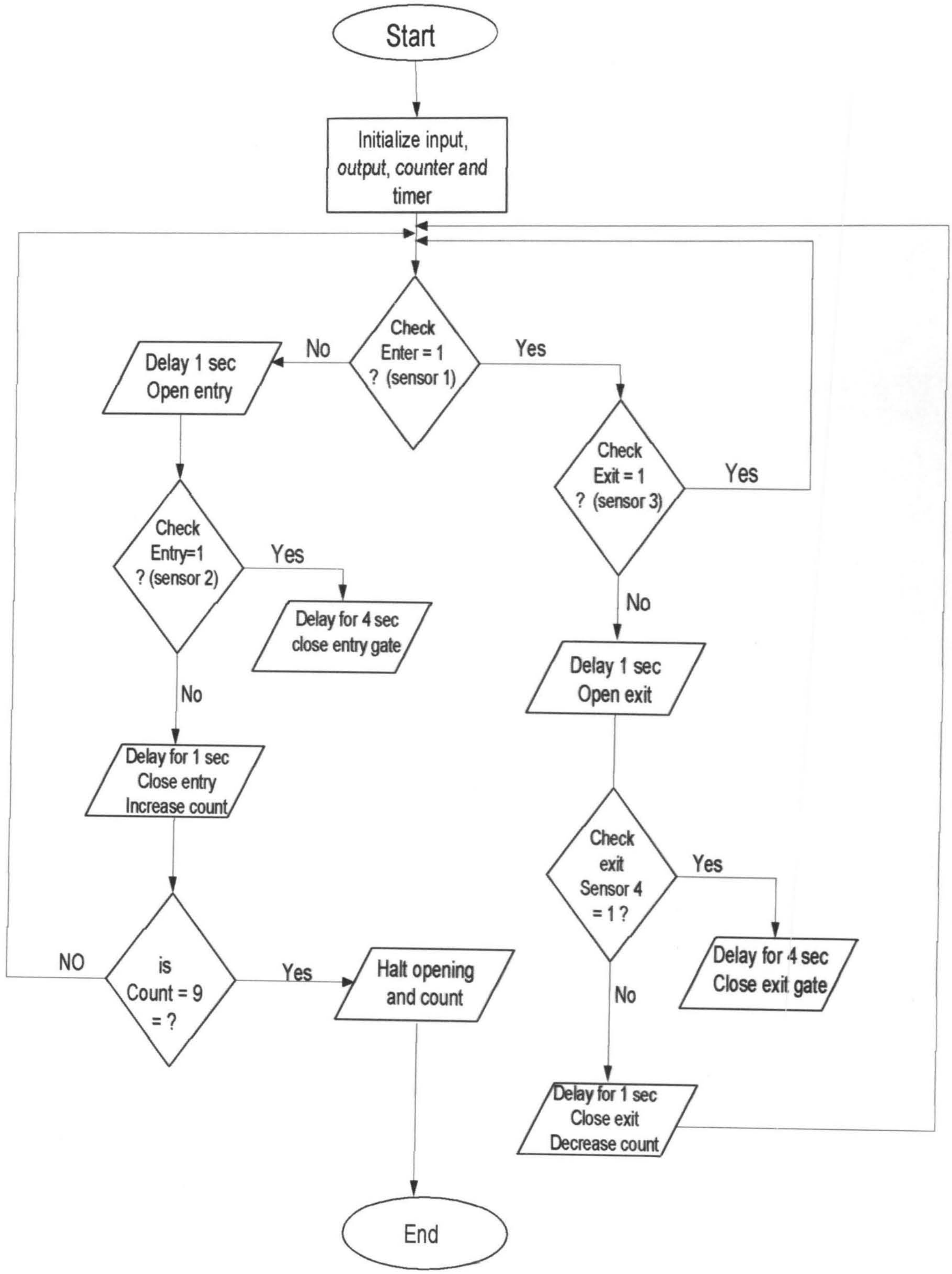
9. Compare status of the sensor bit

    a. If status = exit code then step 6

    b. Else deny entry

    10. Goto step 8

3.3.3 Flowchart



CHAPTER FOUR

TESTS, RESULT AND DISCUSSIONS

4.1 Testing

The testing of the entire circuit was carried out in stages.

∟ Each of the components was first tested using a multimeter in order to check for their state of performance and accurate values.

∟ The connection of each component on the vero board was then tested. This was done in order to assess the continuity, which is meant for proper connection of the circuit, and to detect any wrong connections.

∟ The sensor unit circuitry was tested to ascertain the degree of sensitivity. A small prototype car (object) was placed between the two pairs of the photoconductive cell to obstruct light rays. The voltage levels at the output were observed with the aid of a digital multimeter. The result is shown in Table 1.

∟ Before the results were obtained, the variable resistor was adjusted to obtain the output voltages.

∟ The outputs of the trigger circuitry were tested by connecting an LED across the circuit to check if it lights or not. A light indicates the presence of HIGH logic while a non-light indicates the presence of LOW logic as shown in Table 2.

∟ Also, the gate control circuit was tested by applying logic 1 or 0 to points A and B of the circuit. When logic 1 is applied to point A, the motor rotates in a clockwise direction while logic 1 at point B changes the direction of the motor. Logic 0 at both points will never activate the motor. The result is shown in Table 3.

∟ After the peripherals were tested and found to be in working order, the entire circuit was tested. A series of programs (software) were written and tested before the working program was finally achieved. The circuits worked perfectly as designed. The display unit was also observed during the testing and found to be working correctly.

4.2 Results

Table 2: Voltage Levels of the Sensor Unit.

Test	Result
Without Object	0.8V
With Object	4.39V
Object Removed	0.8V

Table 3: Trigger Circuitry Logic Level

Sensor Voltage Levels		Output Logic
V01	V02	F
0.80	0.80	0
0.80	4.39	1
4.39	0.80	1
4.39	4.39	0

Table 4: Gate Control Circuit Truth Table.

A	B	Motor Direction
0	0	Inactive
0	1	Anticlockwise
1	0	Clockwise
1	1	Inactive

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Summary

When sensor 1 is broken, Gate 1(Entrance) opens. If the car passes to break sensor 2, there would be a count up which is displayed before the gate closes. When sensor 3 is broken, Gate 2 (Exit) opens. If the car passes to break sensor 4, there would be a count down which is displayed before the gate closes.

But if there was a false interruption at sensor 1 with no further interruption of sensor 2, the gate opens, wait for 4 seconds after which if sensor 2 is still not broken, the gate 1 closes without any count.

When the 9cars capacity is reached, without the exit of a car through Gate2, there would be no response by Gate1 to any car's entrance.

5.2 Conclusion

The design and implementation of a microcomputer system had been achieved in this project. This design can be easily adapted to any electric gate and any form of control which requires the use of sensors. To effectively design this kind of system, it is necessary to understand the basic sensor characteristics, microprocessor input and output interfacing, and assembly language principles, utilized in the system plan. Sensors serve as a transducer for vehicle detection while the programming language is fundamental to software design based on the system requirements, specifications, and planned operation of the system. There is total agreement between the system designed and the required operation of the system.

5.3 Limitations

Every good project has limitations; the limitation of this design lies in the effectiveness of the sensor. The sensor will work most effectively if operated under high intensity light. The automatic gate designed in this research can be employed in organizations, public car parks, residential parking lots, and automobile termini where no form of security measure is required.

5.4 Recommendations

For an improved, effective, and security gate system to be implemented and achieved, the following suggestions should be considered for further work.

1. A form of vehicle identification should be provided for security purposes. For instance where a vehicle stands still at the focus of the sensors.

2. A better sensor is recommended to achieve new functionality. For instance, a suitable sensor such as radar sensor that could detect contraband goods in any vehicle.

3. To achieve full automation, a real time system should be employed and a Closed Circuit Television (CCTV) system provided for proper monitoring and security purposes. This can helpful in detecting the presence of vehicles before the system is activated.

4. Upgrading the system using higher bit microprocessors for speed optimization.

With the revolutionary impact that microprocessors have had on the electronics industry, it is not unreasonable to expect that everyone working in electronics and related areas will have to become knowledgeable with the operation and integration of microprocessors.

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APPENDIX

The Assembly Language Codes

```
ORG 0000H
        MOV P2, #0FFH
        MOV P1, #0FFH
        MOV P0, #0FFH
        MOV TMOD, #10H
        CLR A
        CALL one_sec_sub
        CALL display
test_entry:
        JB P2.0, test_exist
        JMP open_entry
test_exist:
        JB P2.2, test_entry
open_exist:
        CALL one_sec_sub
        SETB P1.2
        CLR P1.3
        lcall one_sec_sub
        lcall one_sec_sub
        CLR p1.2
        MOV R2, #00H
        MOV R3, #00H
LOOP_1:
        MOV TH1, #3CH
        MOV TL1, #0B0H
        SETB TR1
        JNB TF1, $
        CLR TR1
        CLR TF1
```

```
        INC R2
        CJNE R2, #20, LOOP_1
        MOV R2, #00H
        INC R3
        JB P2.3, repeat_1
        CLR P1.2
        SETB P1.3
        lcall one_sec_sub
        lcall one_sec_sub
        clr p1.3
        DEC A
        CJNE A, #00H, there_1
        CALL display
        JB P2.0, $
        JMP open_entry
repeat_1:
        CJNE R3, #04H, LOOP_1
        CLR P1.2
        SETB P1.3
        lcall one_sec_sub
        lcall one_sec_sub
        clr p1.3
        JMP test_entry
there_1:
        CALL display
        JMP test_entry
open_entry:
        CALL one_sec_sub
        SETB P1.0
        CLR P1.1
        lcall one_sec_sub
        lcall one_sec_sub
        CLR p1.0
```

```
        MOV R0, #00H
        MOV R1, #00H
LOOP_2:
        MOV TH1, #3CH
        MOV TL1, #0B0H
        SETB TR1
        JNB TF1, $
        CLR TR1
        CLR TF1
        INC R0
        CJNE R0, #20, LOOP_2
        MOV R0, #00H
        INC R1
        JB P2.1, repeat_2
        CLR P1.0
        SETB P1.1
        lcall one_sec_sub
        lcall one_sec_sub
        clr p1.1
        INC A
        CJNE A, #09H, there_2
        CALL display
        JB P2.2, $
        JMP open_exist
repeat_2:
        CJNE R1, #04H, LOOP_2
        CLR P1.0
        SETB P1.1
        lcall one_sec_sub
        lcall one_sec_sub
        clr p1.1
        JMP test_exist
there_2:
```

```
        CALL display
        JMP test_exist
display:
        CJNE A, #00H, aas_1
        MOV P0, #0C0H
        RET
aas_1:
        CJNE A, #01H, aas_2
        MOV P0, #0F9H
        RET
aas_2:
        CJNE A, #02H, aas_3
        MOV P0, #0A4H
        RET
aas_3:
        CJNE A, #03H, aas_4
        MOV P0, #0B0H
        RET
aas_4:
        CJNE A, #04H, aas_5
        MOV P0, #99H
        RET
aas_5:
        CJNE A, #05H, aas_6
        MOV P0, #92H
        RET
aas_6:
        CJNE A, #06H, aas_7
        MOV P0, #82H
        RET
aas_7:
        CJNE A, #07H, aas_8
        MOV P0, #0D8H
```

```
        RET
aas_8:
        CJNE A, #08H, aas_9
        MOV P0, #80H
        RET
aas_9:
        CJNE A, #09H, aas_10
        MOV P0, #90H
        RET
aas_10:
        MOV A, #00H
        AJMP display
one_sec_sub:
        MOV R4, #0FAH
loop_sec:
        LCALL one_milli_sub
        LCALL one_milli_sub
        LCALL one_milli_sub
        LCALL one_milli_sub
        DJNZ R4, loop_sec
        RET
one_milli_sub:
        MOV R5, #0FAH
loop_milli:
        NOP
        NOP
        DJNZ R5, loop_milli
        RET
        END
```