DESIGN AND CONSTRUCTION OF MICROCONTROLLER BASED INDUSTRIAL DOOR

BY

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DEDICATION

is project work is dedicated to my parent. Alhaji Sabiu Muhammad and Hajiya Halima Sabiu.

DECLARATION

I, sabiu Kamaluddeen declare that this work was done by me and has never been presented elsewhere for the award of bachelor degree. I also here by relinquish the copyright to the Federal University of Technology, Minna

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ABSTRACT

This project presents the design and construction of an Automatic industrial door that can e used in Industries. The design works on the principle of timing programmed in iicrocontroller chip. It provides four (4) different schedules. An emergency ringing tone is icluded and it is active for every schedule selected. The features included are: the time-select witches, microcontroller, LCD indicator, switching transistor, relay, DC motor and the Alarm. he design and construction of Industrial door was realized using the available components and xpertise. The system worked effectively as desired in the design.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 Introduction

In the world where Science and technology is improving almost every day, most of the present day operations are not manually operate anymore. They are automatically carried out by the use of electronic components. This project, which is the Design and Construction of micro-controller based industrial door with emergency bell, is another electronic automation that steps further in the quest for the improvement of Man's living condition in both industries and many firms where a staff is assigned the responsibilities of opening and closing of the doors.

Engineering is all about making life easier through application of science for the design and construction of machines and structures. Ease and comfort are some of man's basic desires, man's search for a method of perfection brought about what is now known as automation. It is the ability of a machine to perform a self oriented function thereby saving time, human energy dissipation and increasing the accuracy of production specification. The word automatic is an attachment to several machines and equipment in this present generation

Programmable industrial door is an important instrument in industries and Schools and even in firms and other business places where Automatic door plays a critical role in running the day to day affairs [2]. Programmable industrial door are also associated with clocks indicating the hours of working.

A door is a movable panel at entrance a movable barrier used to open and close the entrance to a building, room, closet, or vehicle, usually a solid panel, hinged to or sliding in a frame

1.2 METHODOLOGY

The coordination of the door is digitally archived through the application of microcontroller unit, liquid crystal display unit, alarm and related logical control units. A microcontroller (also microcontroller unit, MCU or µC) is a small computer on a single integrated circuit consisting of a relatively simple CPU combined with support functions such as a crystal oscillator, timers, watchdog, serial and analog I/O etc. program memory in the form of NOR flash or One time programmable Rom (OTP ROM) is also often included on chip, as well as a, typically small, read/write memory LCD. The LCD Character standard requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. If the LCD operates in the 4-bit data bus mode, this requires a total of 7 data lines (3 control lines plus the 4 lines for the data bus). However, for this project, the 8-bit data bus is used and the LCD will require a total of 11 data lines (3 control lines plus the 8 lines for the data bus). This 8-bit mode realizes the desired operational functionalities with the least software overhead. The three control lines are referred to as Enable, Register Select and Read/ Write control lines.

1.3 Project Aim and Objective

1.3.1 Aim

The overall aim of this project is to design and construct a micro-controller based industrial door.

1.3.2 **Objectives**

I. It provides security, comfort, easy access e.t.c

II. It prevent workers from coming late or going out before time

1.4 Features of the Project

This project is design in such a way that it has the following features:

(i.) The door is played at preset times.

(ii.) No need to assign a person for opening and closing door every time.

(iii.) There is accuracy to timings.

(iv.) No manual intervention.

(v.) Man power and money is saved.

(vi.) Provides different possible schedules with emergency

1.5 Scope of the project

Usually there is limitation to everything in this world; nothing is absolutely 100% efficient. Therefore, this project design has limitation, that is, the range at which it operates. It provides timings for maximum number of three (4) periods per day with breakfast period. It has four (4) different time selections excluding emergency that is independent of time, emergency period could be use at any time in case sudden occurrence of hazard or usually of something unpleasant, fighting, fire outbreak or allowing some late staff to get through the building or passing in with production materials etc, It does not operate outside this limit. Due to cost and complication, this project is limited to a simple un-scaled wooden case prototype and can be used almost everywhere in retail outlets, airports, hospitals, ware houses, factories, wherever security and hard working is required

1.6 PROJECT LAYOUT

The general introduction, aims/objectives, methodology and scope are contained in the chapter one; chapter two contains brief about the literature review, power unit, microcontroller unit Display unit, relay driver, then output, Chapter three, deals extensively with the circuits design and analysis, the block diagrams of automatic industrial door with bell system and function units of the system, A review of how the construction was archived is given in chapter four, while chapter five, concludes the project report.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Backgrounds

A door is a moveable barrier used to cover an opening. Doors are widely used and are found in walls or partitions of a building, vehicles, and furniture such as cupboards, cages, and containers. A door can be opened to give access and closed more or less securely using a combination of latches and locks [2]. Doors are nearly universal in buildings of all kinds, allowing passage between the inside and outside, and between internal rooms. When open, they admit ventilation and light. The door is used to control the physical atmosphere within a space by enclosing it, excluding air drafts, so that interiors may be more effectively heated or cooled. Doors are significant in preventing the spread of fire. They also act as a barrier to noise. They are also used to screen areas of a building for aesthetics, keeping formal and utility areas separate. Doors also have an aesthetic role in creating an impression of what lies beyond. Doors are often symbolically endowed with ritual purposes, and the guarding or receiving of the keys to a door, or being granted access to a door can have special significance. Similarly, doors and doorways frequently appear in metaphorical or allegorical situations, literature and the arts, often as a portent of change.

2.1.2 History of Programmable Doors.

The first programmable doors were sliding doors for use by people invented in 1954 by Lew Hewitt and Dee Horto and were installed in 1960 [5]. It made use of a mat actuator. The idea came to them in the mid-1950's, when they saw that existing swing doors had difficulty operating in the high winds of corpus Christi, Texas.

Security is something that provides a sense of protection against loss, attack, or harm. Programmable industrial door serve as a security measure that prevent workers from coming late as well as going out of work before closing time.

2.1.3 Programmable industrial door uses microcontroller to solve the problems of mechanical locks and manual use of door [2]. A wide range of credentials can be used to replace mechanical keys. The programmable Industrial Door grants access based on the credential presented by the administrator or a staff that is in charge of the door operation at the initial time only. Whenever the administrator preset it at a certain time, access is granted, the door will continue operating by itself by opening or closing for a predetermined time and these will prevent workers from going in and out without administrator's permission. The system will also monitor the door during emergency operation.

Also, The programmable industrial door with emergency alarm is an automatic one-way sliding door control which provides an easy and luxury manner of operating the door. Boosting the greater user friendliness and safety features. In physical security, the term access control refers to the practice of restricting entrance to a property, a building, or a room to authorized persons. Physical access control can be achieved by a human (a guard, bouncer, or receptionist), through mechanical means such as locks and keys, or through technological means such as programmable door systems. The design and construction of this project is achieved by the use of electronic components which serve as the mechanism behind the operation of the programmable industrial door. The major component in this project is microcontroller which coordinates and controls the overall activities of the other components. This can better be understood by referring to the fig.2.1. This is an effective and useful project for Industries, firm's, Prisons and some educational institutions. In most

Industry and firms, a staff is assigned to open or close doors or taking attendance of workers or rings the bell after every period. The Staff has to depend on his wrist watch or clock, and sometimes he can forget to ring the bell on time. Programmable industrial door with bell almost solve everything.

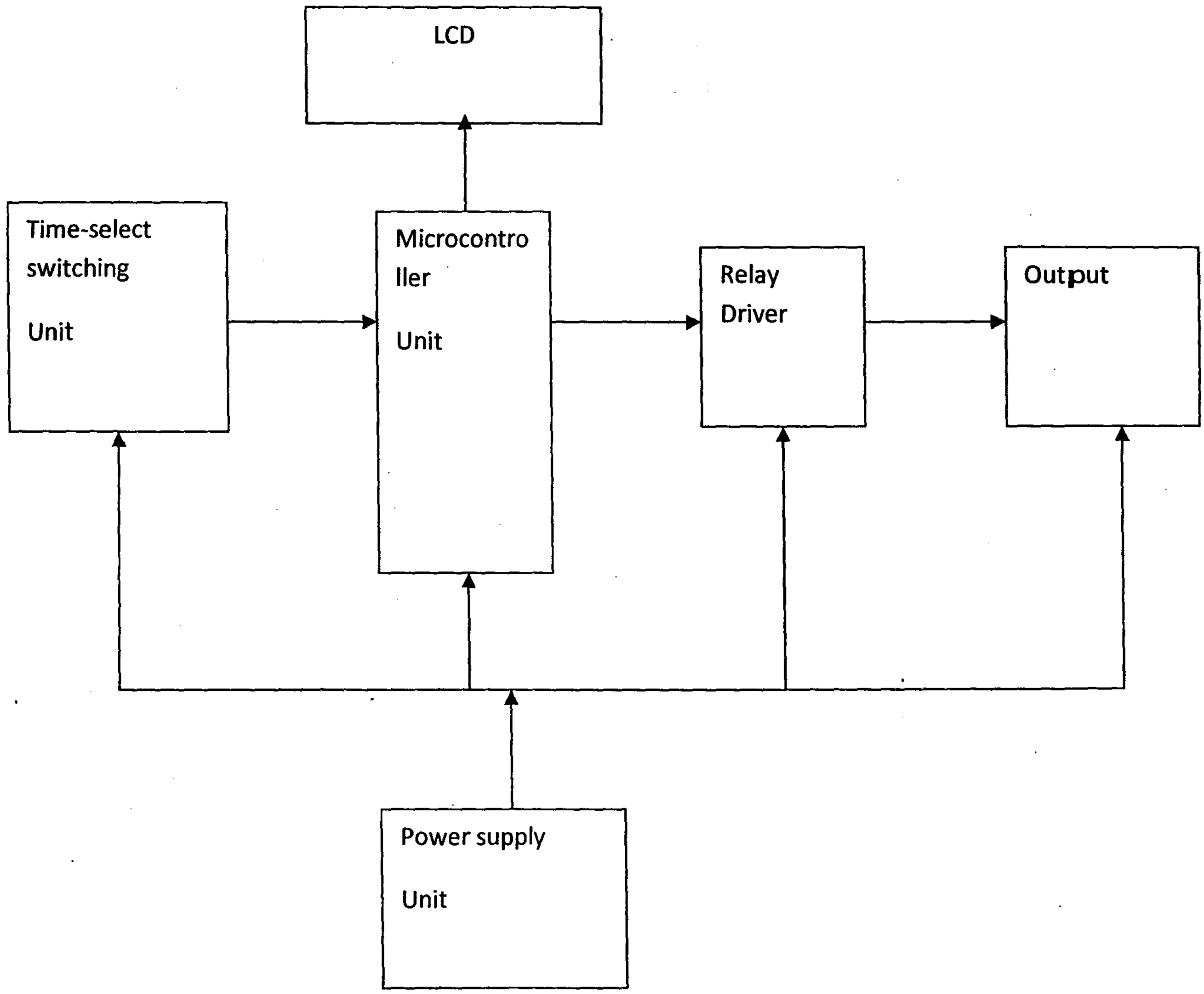


Figure 2.1 Block Diagram of the programmable Industrial Door

(A.) Power Supply

Power supplies are essential part of all electronic systems from the simplest to the most complex one [8.10]. A basic power supply consists of a transformer, a rectifier, a filter and a regulator [12]. A power supply filter greatly reduces the fluctuation in the output voltage of a rectifier and produces a nearly constant-level dc voltage. Filtering is necessary because electronic circuits required a constant source of dc voltage and current to provide power and biasing for proper operation. Filtering is accomplished using capacitors [14], as you will see in the next chapter. Voltage regulation is usually accomplished with integrated circuit voltage regulators. A voltage regulator prevents changes in the filtered dc voltage due to variation in line voltage or load [9].

Fig. 2.2 A typical dc power supply block diagram [9]

These blocks can be briefly explained as follows:

(i.) **Transformer:** its job is either to step up or (mostly) step down the ac supply voltage to suit the requirement of the solid state electronic devices and circuits fed by the dc power supply [9].

(ii.) **Rectifier:** it is a circuit which employs one or more diodes to convert ac voltage into pulsating dc voltage [8, 9, 10, 12, 13]. A rectifier can be either a half-wave rectifier or full-wave rectifier [8]. In this design a full-wave rectifier was employed.

(iii.) **Filter:** the function of filter of this circuit element is to remove the fluctuations or pulsations (called ripples) present in the output voltage supplied by the rectifier [9]. This is done by connecting a capacitor filter to the rectifier.

(iv.) **Voltage Regulator:** its main function is to keep the terminal voltage of the dc supply constant even when the ac input line voltage to the transformer, or the load varies [8, 9, 18].

(v.) **Load:** the load block is usually a circuit for which the power supply is producing the dc voltage and load current [8].

Therefore, the complete circuit diagram of the power supply is as sh

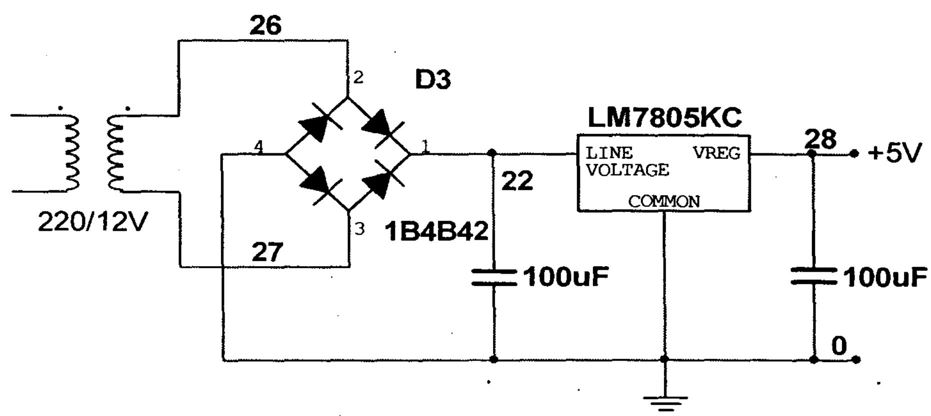


Fig 2.3 Circuit Diagram of Power Supply Unit

(B.) Time-select Switching Unit

This project is design to provide maximum number of ten different schedules. This unit allow for the selection of the schedule suitable for every School. The unit consists of resistors and switches. Each of the switches represents a single schedule which can be chosen by individual. When any of these switches is activated, it directs the microcontroller to carry out some specific task as programmed internally.

Microcontroller

A microcontroller (also microcontroller unit, MCU or μC) is a small computer on a single integrated circuit consisting of a relatively simple CPU combined with support functions such as a crystal oscillator, timers, watchdog, serial and analog I/O etc. program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a, typically small, read/write memory [15].

Microcontrollers are designed for small applications. Thus, in contrast to the microprocessors used in personal computers and other high-performance applications, simplicity is emphasized. Some microcontrollers may operate at clock frequencies as low as 32 kHz, as this is adequate for many typical applications, enabling low power consumption (mill watts or microwatts). They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nano watts, making many of them well suited for long lasting battery applications. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, remote controls, office machines, appliances, power tools, and toys. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes [15]. The first single chip microprocessor was the 4 bit Intel 4004 released in 1971, with other more capable processors available over the next several years. These however all required external chip(s) to implement a working system, raising total system cost, and making it impossible to economically computerize appliances [15].

The first computer system on a chip optimized for control applications - microcontroller was the Intel 8048 released in 1975, with both RAM and ROM on the same chip. This chip went on to be found in over a billion PC keyboards, and numerous applications [15, 21]. The whole story has its beginnings in the far 80s when Intel launched the first series of microcontrollers called the MCS 051. Even though these microcontrollers had quite modest features in comparison to the new ones, they conquered the world and became a standard for what nowadays is called the microcontroller [21]. Most microcontrollers at this time had two variants. One had an erasable EEPROM program memory, which was significantly more expensive than the PROM variant which was only programmable once [15, 21].

In 1993, the introduction of EEPROM memory allowed microcontrollers (beginning with the Microchip PIC16x84) to be electrically erased quickly without an expensive package as required for EPROM, allowing both rapid prototyping, and In System Programming [15].

(A.) The LCD Character standard requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. If the LCD operates in the 4-bit data bus mode, this requires a total of 7 data lines (3 control lines plus the 4 lines for the data bus). However, for this project, the 8-bit data bus is used and the LCD will require a total of 11 data lines (3 control lines plus the 8 lines for the data bus). This 8-bit mode realizes the desired operational functionalities with the least software overhead. The three control lines are referred to as EN, RS, and RW. The EN line is called "Enable". This control line is used to tell the LCD that you are sending it data.

To send data to the LCD, your program should make sure this line is low (0) and then set the other two control lines and/or put data on the data bus.

The RS line is the "Register Select" line. When RS is low (0), the data is to be treated as a command or special instruction (such as clear screen, position cursor, etc.). When RS is high (1), the data being sent is text data which should be displayed on the screen. For example, to display the letter "T" on the screen you would set RS high.

(A.) Relay Driver

This consists of transistor and relay. A transistor is used to establish the current necessary to energize the relay in the collector circuit [14]. The bipolar transistor is a very commonly used switch in digital electronic circuits. It is three-terminal semiconductor component that allows an input signal at one of its terminals to cause the other two terminals to become a short or an open circuit [13]. Also in [14] the application of transistor is not limited solely to the amplification of signals. Through proper design transistors can be used as switches for computer and control applications. Transistor can be used to: switch currents, voltage and power; perform digital logic functions; and amplify time-varying signals [9, 12]. The output from the microcontroller is connected to the base of the transistor. With no input at the base of the transistor, the base current, collector current and coil current are essentially 0A, and the relay sits in the un-energized state (normally open, NO). However, when a positive pulse (NPN type) is applied to the base, the transistor turns on, establishing sufficient current through the coil of the electromagnet to close the relay [14], thereby triggering the output (Bell). Ideally, at turn-off the current through the coil and the transistor will quickly drop to zero, the arm of the relay will be released, and the relay will simply remain dormant until thenext 'ON' signal [14].

MOTOR DRIVE

An electric motor converts electrical energy into mechanical energy. Most electric motors operate through the interaction of magnetic fields and current- carrying conductors to generate force. The reverse process, producing electrical energy from mechanical energy, is done by generators such as an alternator or a dynamo; some electric motors can also be used as generators, for example, a traction motor on a vehicle may perform both tasks.

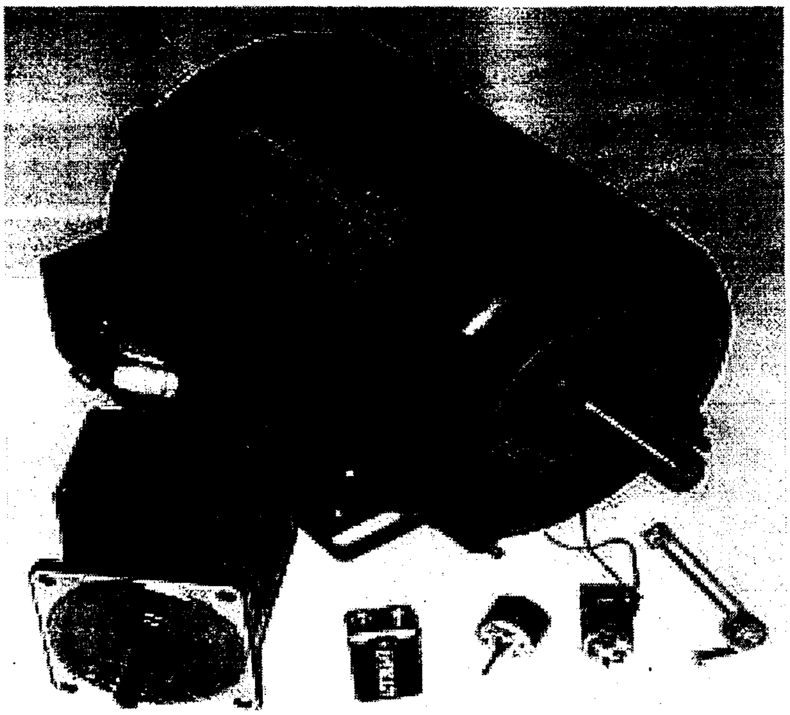


Fig 2.4 Diagram of Motor Drive

Electric motors and generators are commonly referred to as electric machines. Electric motors are found in applications as diverse as industrial fans, blowers and pumps, machine tools, household appliances, power tools, and disk drives. They may be powered by direct current (e.g., a battery powered portable device or motor vehicle), or by alternating current from a central electrical distribution grid or inverter. The smallest motors may be found in electric wristwatches. Medium-size motors of highly standardized dimensions and characteristics provide convenient mechanical power for industrial uses. The very largest electric motors are used for propulsion of ships, pipeline compressors, and water pumps with ratings in the millions of watts. Electric motors may be classified by the source of electric power, by their internal construction, by their application, or by the type ofmotion they give.

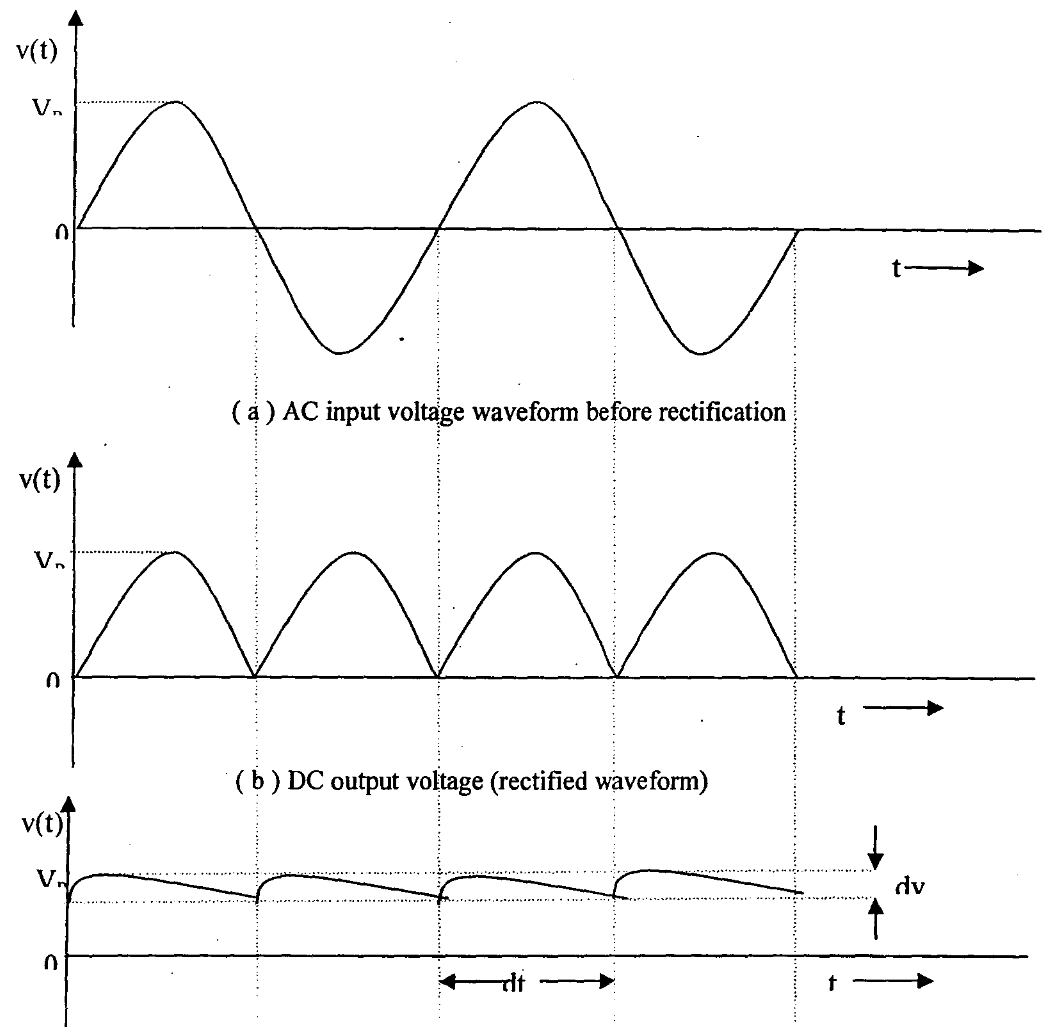
CHAPTER THREE

DESIGN AND CONSTRUCTION

3.1 Design of Power Supply Unit

Most of the electronic devices and circuits required a dc source for their operation [9]. The dc power supply converts the standard 230V, 50Hz ac mains into a constant dc voltage. The dc voltage produced by the power supply is used to power the electronic circuit. Hence the supply must be regulated to prevent fluctuation in voltage level.

The main voltage of 220V is stepped down by a 220V/15V, 2A transformer. It is then rectified by full wave bridge diode rectifier. The waveform at this stage has no negative component, but a lot of ripples. Smoothing capacitors are needed to reduce the ripple to an acceptable level. The resulting ripple voltage (dv) can be calculated by considering the waveforms given in fig. 3.3.



(a) AC input voltage waveform before rectification

(b) DC output voltage (rectified waveform)

(c) Smoothened (Filtered) waveform

Fig. 3.3 Power supply waveforms

The load causes the capacitor to discharge between half cycles. If the load current stays constant, as it will for small ripple, then

$$I = C\frac{dV}{dt}$$

The frequency of the full wave signal is double the input frequency. This makes sense. A full wave output has twice as many cycles as the sine wave input has. The full wave rectifier inverts each negative half cycle, so that we get double the number of positive half cycles. The effect is to double the frequency [18].

3.2 Design of Time-Select Switching Unit

This unit made provision for the selection of timing suitable for a particular Industry. This is done by pressing the switch that corresponds to the Industry schedule on the time-table. It is considered that an industry has a total of four periods which are

1. Entrance time
2. Break time
3. Closing time
4. Emergency period

3.2.1 Calculation of Pull-up Resistors

The circuit consists of four (4) push-to-on switches, S1 through S4. Each switch is connected from the pins of microcontroller to the ground. Every microcontroller has ability to sink or source current. The type of microcontroller used in this design is AT89S52.

From the datasheet [22] of AT89S52, port1, 2 and 3 can sink current of about 1.6mA. Therefore, by taking the sinking current to be 0.5mA, the pull-up resistors can be calculated.

From the fig.3.4, V_{cc} = IR,

Where V_{cc} = +5V, I = 1.5mA, R = pull-up resistor.

Therefore, $R = \frac{Vcc}{I} = \frac{5V}{0.5mA} = 10k\Omega$

3.2.2 Description

The switches were connected in such a way that, they were held HIGH with the 10kΩ pull-up resistors. All switches are normally opened switch which has the contact by pressing the button and loose contact by releasing the button. Each switch from S1 to S4 represents a single function. The fourth switch, S4 provides room for any emergency that arises which will leads to door opening and ringing, thus called an emergency switch. This emergency switch is common for every schedule selected and active at any point in time during the working hours.

switch	Functions
S1	Increment time
S2	Decrement time
S3	Set clock
S4	Emergency

3.2.3 Principle of Operation

The pins that were connected to the switches are held HIGH by the pull-up resistors. The I/O ports of the 8052 microcontroller can be both read and written to (bidirectional), therefore, if any of the switches, after being powered, is pressed to select the schedule, the concerned pin of the microcontroller will be pulled down to ground which serves as the input to the microcontroller. When microcontroller senses a signal from that pin, it will start executing some specific instructions as directed by the software programming. Emergency switch always active at every point in time, once the schedule has been chosen.

3.3 Microcontroller Unit

The major component in this project design is AT89C52 microcontroller which controls, coordinates and directs all the activities and behaviors of this design. Most control application required extensive I/O and need to work with individual bits. The AT89C52 addresses both of these needs by having 32 I/O, bit manipulation and bit checking.

The input from timing unit to the microcontroller, automatically select the corresponding timing programmed within the microcontroller chip. The output of this goes to the LED indicator and inverter units. Fig.3.5 shows the unit circuit diagram. 1μF is connected from Vcc to the reset pin of microcontroller.The AT89C52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full-duplex serial port, on-chip oscillator, and clock circuitry.

In addition, the AT89C52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM contents but freezes the oscillator, disabling all other chip functions until the next hardware reset.

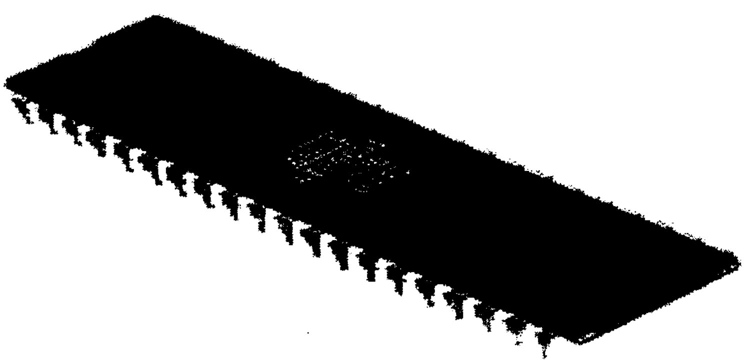


Figure 3.3.1 sample diagram of a microcontroller

Figure 3.3.2 Diagram of the AT89C52

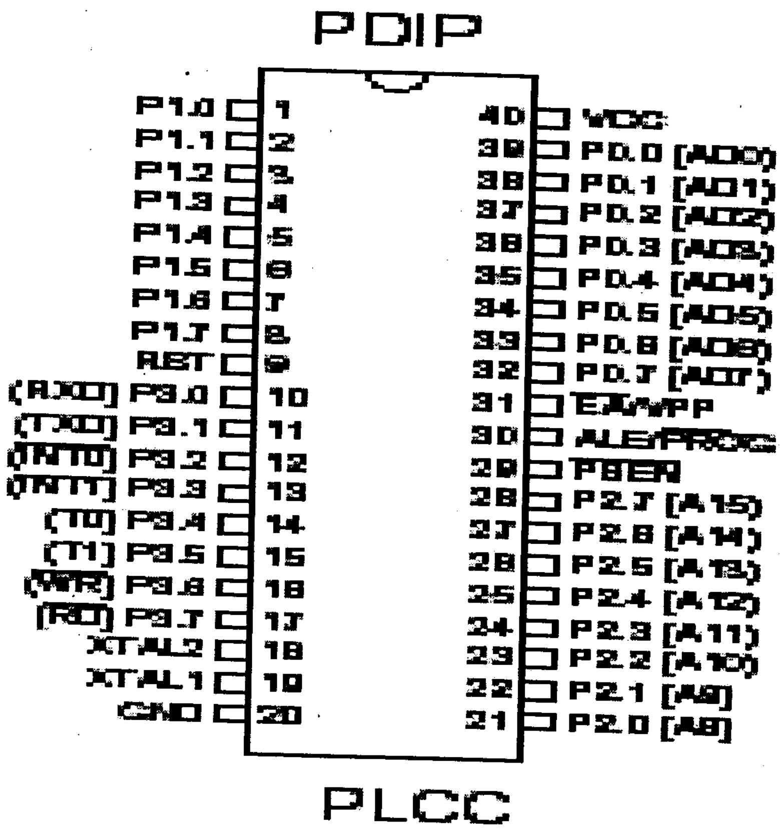


Fig 3.3.2The pin description of the AT89C52

3.3.1 Microcontroller Pins and their functions

Port 0:

Port 0 is an 8-bit open-drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high impedance inputs.

Port 0 may also be configured to be the multiplexed low order address/data bus during accesses to external program and data memory. In this mode P0 has internal pull ups.

Port 0 also receives the code bytes during Flash programming, and outputs the code bytes during program verification. External pull ups are required during program verification.

Port 1:

Port 1 is an 8-bit bi-directional I/O port with internal pull ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins they are pulled high by the internal pull ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull ups. Port 1 also receives the low-order address bytes during Flash programming and verification.

Port 2:

Port 2 is an 8-bit bi-directional I/O port with internal pull ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins they are pulled high by the internal pull ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull ups. Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses. In this application, it uses strong internal pull ups when emitting 1s. During accesses to external data memory that use 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

Port 3:

Port 3 is an 8-bit bi-directional I/O port with internal pull ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins they are pulled high by the internal pull ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull ups. Port 3 also serves the functions of various special features of the AT89C52 as listed below:

Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	$\overline{INT0}$ (external interrupt 0)
P3.3	$\overline{INT1}$ (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	$\overline{WR}$ (external data memory write strobe)
P3.7	$\overline{RD}$ (external data memory read strobe)

Table 3.3.1

RST:

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device.

ALE/PROG:

Address Latch Enable output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation ALE is emitted at a constant rate of 1/6 the oscillator frequency, and may be used for external timing or clocking purposes. Note, however, that.

one ALE pulse is skipped during each access to external Data Memory.

If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

PSEN:

Program Store Enable is the read strobe to external program memory. When the AT89C52 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

EA/VPP:

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset.

EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage(VPP) during Flash programming, for parts that require12-volt VPP.

XTAL1:

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2:

Output from the inverting oscillator amplifier.

AT89C52 Microcontroller with flash memory from Atmel that supports the entire range of 8052 microcontroller family. Flash memory controllers are easily programmed with the help of a serial port a Computer eliminating the need of programmers to load the programs in the controller's memory. Atmel controller's flash memory are available up to 64KB flash size and 2KB of internal RAM. Also the kit has left all the I/O ports open thereby increasing the options for interfacing other devices. The ports are provided with a berg strip for easy connection of the external devices in accordance with requirements. Toggle between programming/execution is within a single switch.

PIN	DESCRIPTION
1-8	P1.0-P1.7, Port 1
9	RST- Reset
10-17	P3.0-P3.7, Port 3
18	XTAL2-Crystal
19	XTAL1-Crystal
20	GND-Ground
21-28	P2.0-P2.7, Port 2
29	PSEN-Program Store Enable
30	ALE-Address Latch Enable

32-39	P0.7-P0.1, Port 0
40	Vcc-Positive Power Supply

Table 3.3.2 Pin Description of 8052

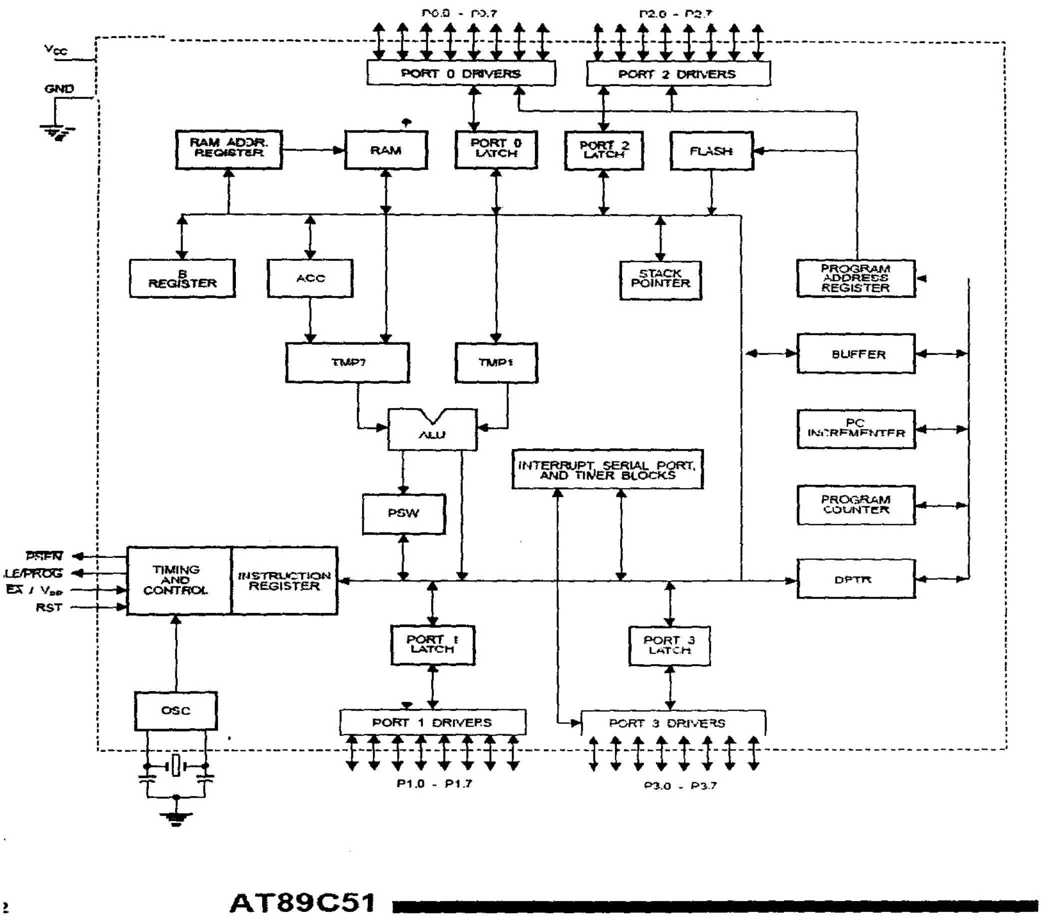


Fig: 3.3.3 Diagram showing interconnection of the microcontroller

3.3.1 Features of AT89S52

- Compatible with MCS-51™ Products
- 8K Bytes of In-System Reprogrammable Flash Memory
- Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation; 0 Hz to 24 MHz
- Three-level Program Memory Lock
- 256 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters
- Eight Interrupt Sources
- Programmable Serial Channel
- Low-power Idle and Power-down Modes

3.3.4 Oscillator Characteristics

XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier which can be configured for use as an on-chip oscillator, as shown in Fig. 3.5. Either a quartz crystal or ceramic resonator may be used. In this design, a quartz crystal was used.

From the datasheet of AT89S52 [25], it is noted that

C1, C2 = 30 pF ± 10 pF for Crystals

= 40 pF ± 10 pF for Ceramic Resonators

Therefore, since crystal was used, 33pF was chosen for both C1 and C2 as shown in fig. 3.5.

3.4 VISUAL DISPLAY UNIT

The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. In this tutorial, we will discuss about character based LCDs, their interfacing with various microcontrollers, various interfaces (8-bit/4-bit), programming, special stuff and tricks you can do with these simple looking LCDs which can give a new look to your application. Liquid display device designed for interfacing with embedded systems. These screens come in common configurations of 8x1 characters, 16x2, and 20x4 among others. The largest such configuration is 40x4 characters, but these are rare and are actually two separate 20x4 screens seamlessly joined together.

Character LCDs can come with or without backlights. Backlights can be LED,.

PIN DISCRIPTION

The most commonly used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers.

Most LCDs with 1 controller has 14 Pins and LCDs with 2 controller has 16 Pins (two pins are extra in both for back-light LED connections). Pin description is shown in the table below.

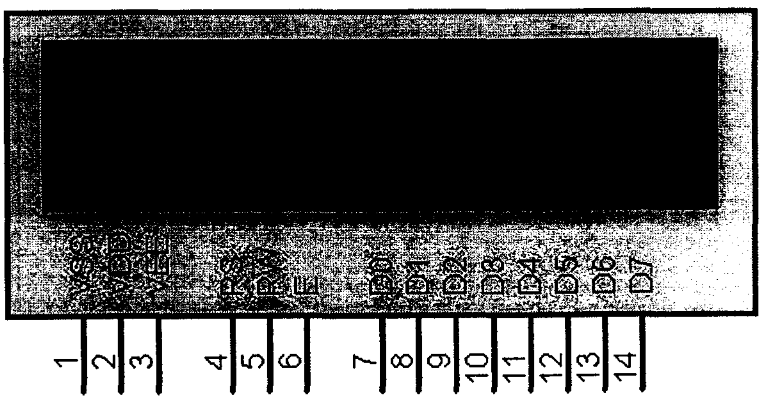


Fig 3.4.1 pin Description of the LCD

The visual unit used was a 16-character-by-2line dot matrix alphanumeric LCD. This is shown in the figure below:

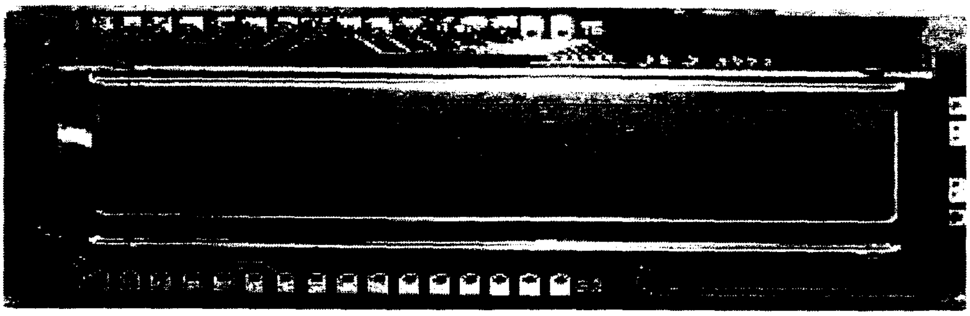


Fig. 3.4.2 Diagram of the 16x2 LCD

3.5.1 LCD Interfacing with System Controller

The LCD Character standard requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. If the LCD operates in the 4-bit data bus mode, this requires a total of 7 data lines (3 control lines plus the 4 lines for the data bus). However, for this project, the 8-bit data bus is used and the LCD will require a total of 11 data lines (3 control lines plus the 8 lines for the data bus). This 8-bit mode realizes the desired operational functionalities with the least software overhead. The three control lines are referred to as EN, RS, and RW.

The EN line is called "Enable". This control line is used to tell the LCD that you are sending it data. To send data to the LCD, your program should make sure this line is low (0) and then set the other two control lines and/or put data on the data bus.

The RS line is the "Register Select" line. When RS is low (0), the data is to be treated as a command or special instruction (such as clear screen, position cursor, etc.). When RS is high

(1), the data being sent is text data which should be displayed on the screen. For example, to display the letter "T" on the screen you would set RS high.

The RW line is the "Read/Write" control line. When RW is low (0), the information on the data bus is being written to the LCD. When RW is high (1), the program is effectively querying (or reading) the LCD. Only one instruction ("Get

LCD status") is a read command. All others are write commands, so RW will almost always be low.

Table: 3.5.1 LCD Pins and Their Functions

PIN	NAME	FUNCTION
1	V_{ss}	Ground Voltage
2	V_{cc}	+5V
3	V_{ee}	Contrast Voltage
4	RS	Register select 0 = write mode 1 = read mode
5	R/W	Read/Write, to choose read or write mode 0 = write mode 1 = read mode
6	E	Enable

		0 = start latch data to LCD character 1 = disable
7	DB0	LSB
8	DB1	-
9	DB2	-
10	DB3	-
11	DB4	-
12	DB5	-
13	DB6	-
14	DB7	MSB
15	BPL	Black Plane Light
16	GND	Ground Voltage

The display was interfaced to Port 0 (P0) of the microcontroller with P2.7 and P2.6 implementing the RS (Register Select) and EN (Enable) functions. Since the display was not read back during the course of system operation, read/write was made permanently low. From reset, instructions are written to the LCD using the specified set of routines outlined in the system controller subsection, and data likewise. Backlights are provided on the display for night use.

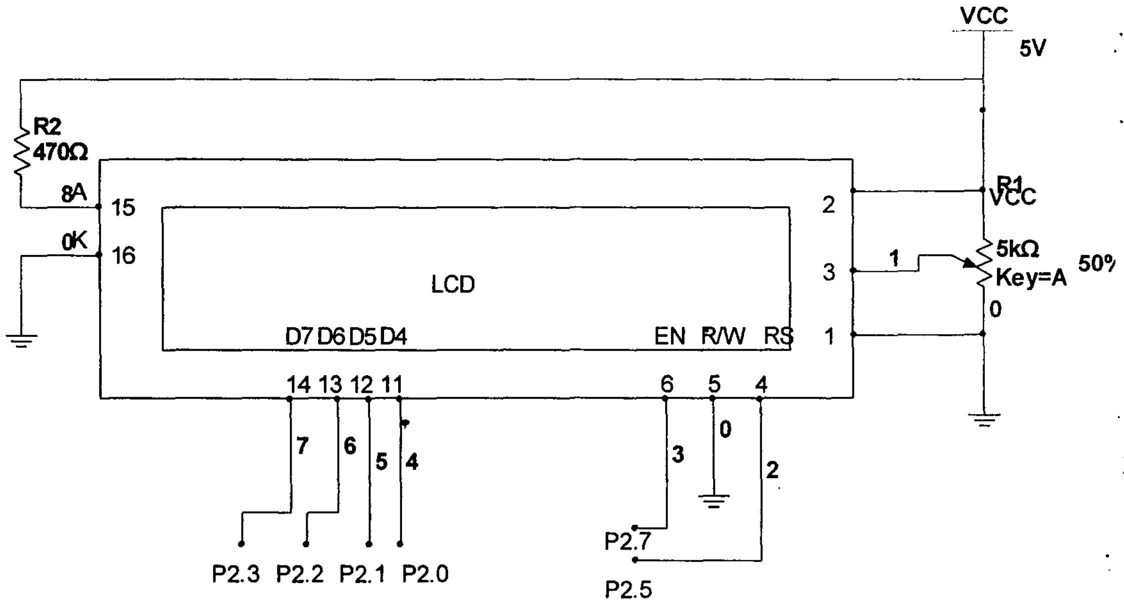


Figure 3.4.3 shows the pin diagram of LCD

3.5 Design of Relay Driver Unit

The transitions between 0 and 1 digit levels are caused by switching from one voltage level to another (usually 0V to +5V). One way that switching is accomplished is to make and break a connection between two electrical conductors by way of a manual switch or an electromechanical relay. Another way to switch digital levels is by use of semiconductor devices such as diodes and transistors [13]. Thus, this is the unit that controls the ON and OFF of the Industrial Door and it comprises of switching transistor and relay.

3.6 Transistor as a Switch

In an electronic circuit, the input signal (1 or 0) is usually applied to the base of the transistor, which causes the collector-emitter junction to become a short or an open circuit. The rules of transistor switching are as follows: [13]

1. In an NPN transistor, applying a positive voltage from base to emitter causes the collector-to-emitter junction to short (this is called "turning the transistor ON"). Applying a negative voltage or 0V from base to emitter causes the collector-to-emitter junction to open (this is called "turning the transistor OFF").

2. In a PNP transistor, applying a negative voltage or 0V from base to emitter turns it ON. Applying a positive voltage from base to emitter turns it OFF.

When a transistor is used as a switch it must be either OFF or fully ON. In the fully ON state the voltage V_{CE} across the transistor is almost zero and the transistor is said to be saturated because it can not pass any more collector current I_C. The output device switched by the transistor is usually called the 'load'.

Refer to the fig. 3.11. In the case of a transistor, there is a time delay between the leading edge of the input voltage pulse and the time that the collector current takes to reach 90% of its maximum value. This is known as the turn-on time. The time required for the collector current to decrease from $I_{(sat)}$ when input voltage goes negative is called the turn-off time.

3.6.1 Calculation of Base Resistance, R_B

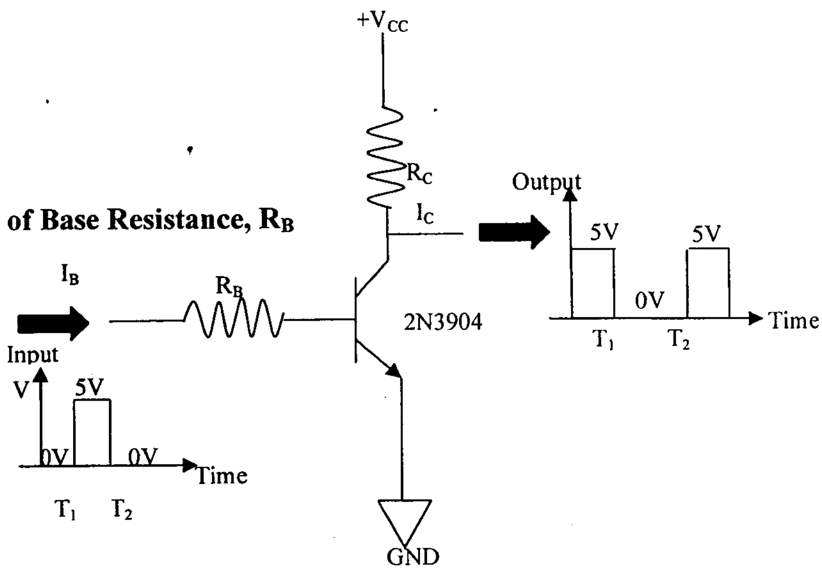


Fig.3.6.1 Transistor as a switch

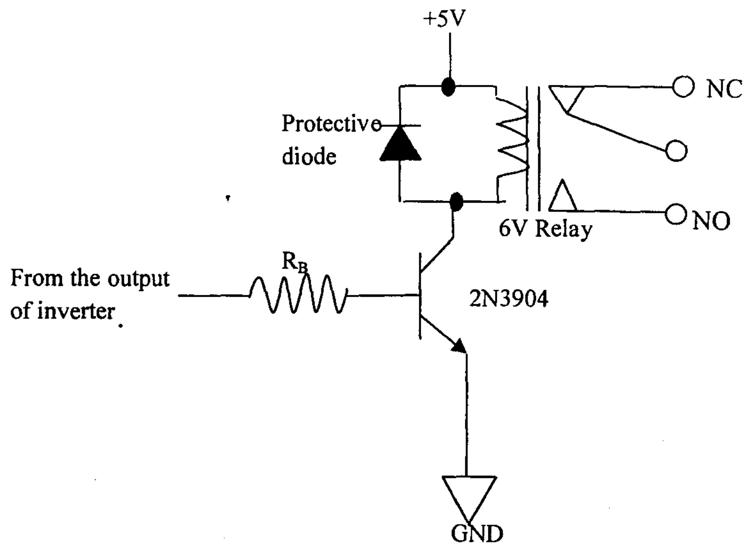


Fig. 3.6.2 Circuit Diagram of Relay Driver Unit

From fig. 3.12, the load resistance which is the collector resistance is the resistance of the relay coil. The 6V relay used has the coil resistance of 100Ω. Therefore, R_C=100Ω. The NPN transistor used is 2N3904 [23].

3.6.2 Relay as a Switch

An electromechanical relay has contacts like a manual switch, but it is controlled by external voltage instead of being operated manually. They are of two types in operation, Normally Closed (NC) and Normally Opened (NO) relays. In NC relay, the contacts are touching or closed at rest but opened by energizing the magnetic coil. While in NO relay, the contacts are not touching, they are opened, but closed by energizing the magnetic coil [8, 13, 16].

A relay provides total isolation between the triggering source applied to the terminal and the output. This total isolation is important in many digital applications, and it is a feature that certain semiconductor switches (e.g. transistors, diodes and integrated circuits) can not provides. Also, the contacts are normally rated for currents much higher than the current rating of semiconductor switches [13].

3.6.3 Protective Diode

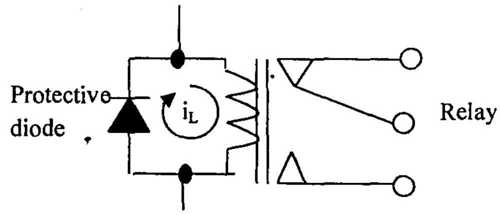


Fig. 3.13 Illustration of Protection Diode

If the load is a motor, relay, or solenoid (or any other device with a coil) a diode must be connected across the load to protect the transistor from the brief high voltage produced when the load is switched OFF. The diagram in fig. 3.12 shows how a protection diode is connected 'backwards' across the load, in this case a relay coil. It is known from the basic circuit courses that the current through a coil cannot change instantaneously, and in fact, the more quickly it changes, the greater the induced voltage across the coil as defined by $V_L=L(\frac{di_L}{dt})$.

In this case, the rapidly changing current through the coil will develop a large voltage across the coil with the polarity shown, which will appear directly across the output of the transistor. The changes are likely that its magnitude will exceed the maximum ratings of the transistor, and the semiconductor device will be permanently damaged. The voltage across the coil will not remain at its highest switching level but will oscillate as shown until its level drops to zero as the system settles down.

This destructive action can be subdued by placing a diode across the coil as shown. During the "ON" state of the transistor, the diode is back-biased; it sets like an open circuit and does not affect a thing. However, when the transistor turns OFF, the voltage across the coil will reverse and forward-bias the diode, place the diode in its "ON" state. The current through the inductor established during the "ON" state of the transistor can then continue to flow through the diode eliminating the severe change in current level [14].

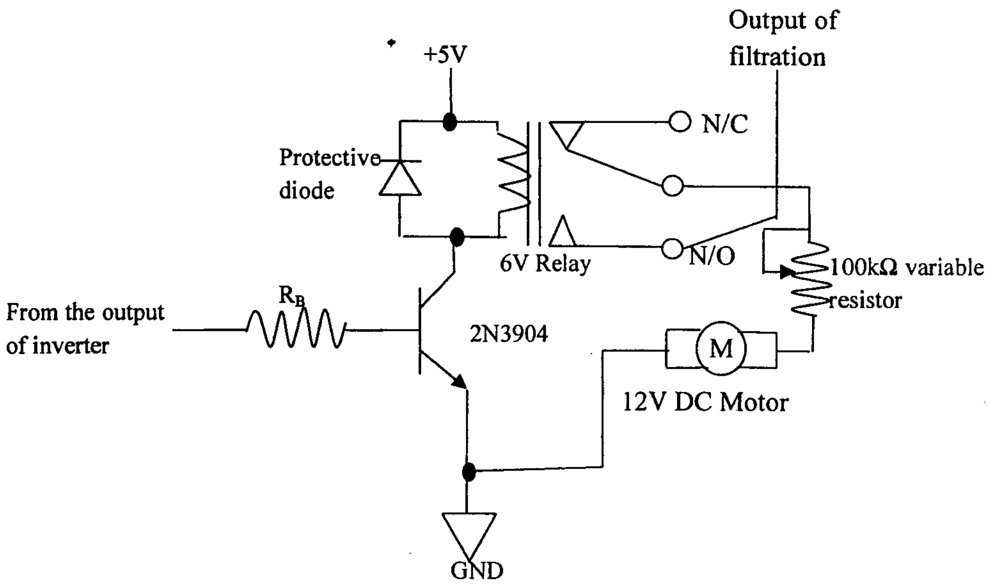


Fig. 3.7: Circuit Diagram of Relay and Motor

The circuit in fig. 3.8 uses a relay to isolate an electric motor from the logic devices. Notice that the logic circuit and dc motor have separate power supplies. When the output of inverter goes HIGH, the transistor is turned on and the NO contacts of the relay snap closed. The dc motor operates. The dc motor provides a rotary motion, which drives the mechanical devices that result in opening the door and closing. The Door keeps on operating as the dc motor rotates. When the output of the inverter goes LOW, the transistor stops conducting and the relay contacts spring back to their NC position. This turns off the motor, The 560kΩ variable resistor connected in series with the motor is use to regulate the rpm of the motor, thereby setting the torque frequency of the door.

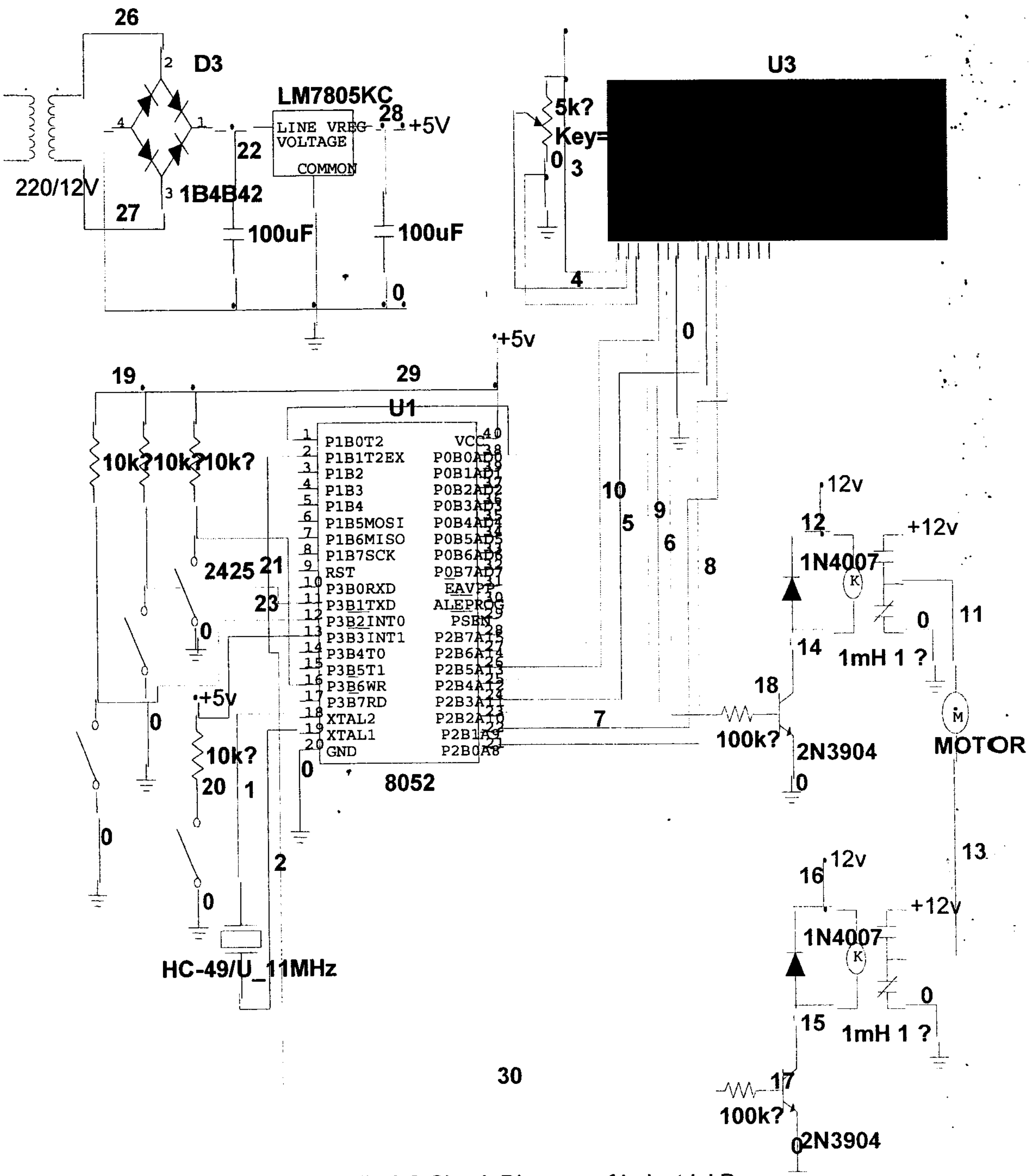


Fig 3.8 Circuit Diagram of Industrial Door

3.9 Construction

The complete circuit was constructed on a 20*10cm Vero board. The flow of the logic signal was noted and the different sections were laid out accordingly. The power circuit was constructed on a separate Vero board and the output was taken through wires to the required points in the main board. The switches to the selection of different schedules were also constructed on a separate board and wires were drawn to the main board. This was done so that the switches could be attached separately to the casing. A wood casing is design for this project.

The power is supplied to the main board by 7805 voltage regulator which feeds the driving circuit. Heat sink is screwed on to 7805 to cool it down. The output of rectification immediately after filtration was taken to the common terminal of the relay, from it powers dc motor through a variable resistor, whenever the relay is energized.

As a precaution during construction, IC sockets were used, so that the heat does not harm them. Also, the Vero board was checked carefully for any solder bridging.

A list of all the components used is given below:

i. <u>Power Supply Unit</u>

(a.) One 220V/12V*2, 300mA transformer

(b.) One 7805 regulator

(c.) Two 100μF capacitor

(d.) One 2.2kΩ resistor

(e.) Four IN4007 diode

(f.) One 0.25A fuse

ii. <u>Time-select Switching Unit</u>

(a.) Four 10kΩ resistor

(b.) Four push-to-on switches (normally open)

iii. <u>Microcontroller Unit</u>

(a.) One AT89C52 Chip

(b.) One 12MHz crystal

(c.) Two 33pF capacitor

(d.) One 1μF capacitor

iv. <u>Relay Driver Unit</u>

(a.) Two 100kΩ resistor

(b.) Two 2N3904 NPN transistor

(c.) Two IN4007 diode

(d.) Two 12V relay

v. <u>Output</u>

(a.) One 12V dc motor

(b.) One 560kΩ variable resistor

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CHAPTER FOUR

TESTS, RESULTS AND DISCUSSION

4.1 Testing

An AT89C52 microcontroller is a programmable IC, which needs to be programmed to suit the design. The source code was first compiled on the notepad and then test run on Edsim51 Simulator. Proper concentration was given to the code during compilation in order to avoid any logic errors. The hex file was then generated and transferred to the chip with the aid of a programmer.

All the ICs were tested separately on a bread board to make sure they work properly. The whole circuit was also tested on the bread board to make sure it was designed correctly. During construction, each section was tested as it was built to make sure the connections were done correctly before going onto the next section. This was done by applying the correct logic signals to the ICs and observing the output.

CHAPTER FIVE

CONCLUSION

5.1 Conclusion

The basic design of the programmable Industrial door mainly for industries, Schools, Firms and prisons, was done. The device can open and closedoors at pre-scheduled time of the day. There are different times per period, from one industry to the other. The project provides chances of selecting the suitable time schedule for every industry, by momentarily pressing one of the push-to-on switches. This signal the microcontroller to carry out the specific task thereby opening and closing the door at a regular interval as the case may be.

Therefore, from the results obtained, it can be concluded that the aim of this project work has been practically and theoretically achieved.

5.2 Possible Improvement

There are a lot of other things that can be included in the project to increase its functionality, performance and dynamism. Some of these are given below:

i. Inclusion of a rechargeable battery source for back-up in case the power fails, so as to maintain the School periods of the day.

ii. Interfacing a keypad with microcontroller based system, so as to provides room for entry of time per period as desired by every industry.

5.3 Recommendation

In respect to the features included in this work, it could be useful for the following recommended areas below:

i. It could be used mainly in firms and prisons where automatic door play a significant role.

ii. It could be used in Industries where a specific work is to be carried out at a regular interval.

iii. It can also be used for other applications where you want a sound to play at preset times.

iv. Finally, it can be used in some other businesses where the automatic door plays a critical role in running the day.

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APPENDIX A: USER'S MANUAL

AUTOMATIC INDUTRIAL DOOR

A. **Power Supply**

Plug in the power cable into ac main. The power indicator glows on the LCD, meaning that the device is now powered. Then turn ON the toggle switch to set time for the device

B. **Selection of the schedule**

It is considered an industry has a total number of three periods with a breakfast after the fourth period. The duration per period differs from one schedule to the other,

To set this programmable industrial door to start the first period, the administrator needs to choose the suitable schedule by momentarily press the corresponding switch. Thereafter, the door start operating automatically every day,