DESIGN AND CONSTRUCTION A MICROCONTROLLER BASED ELECTRONIC DOOR LOCK.

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2001/11930EE

A Thesis Submitted in Partial Fulfillment of the Requirement for the award of Bachelor of Engineering Degree (B.Eng) in the Department of Electrical and Computer Engineering, School of Engineering and Engineering Technology, Federal University of Technology, Minna.

November 2007

Dedication

To God the most high who makes all things possible and to my parents Dn. and Mrs. B.O Akingbesote for their relentless efforts in ensuring that I am always successful in life.

Declaration

I, Akingbesote Oluwasola. M, 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 sincere appreciation goes to my Parents most especially my father Dn. B.O Akingbesote, whose Contributions to the success of the completion of my program is invaluable, May God prosper you and lift you higher. I shall not forget to thank Mr. & Evangelist (Mrs.) Otegbayo, my Brothers and sisters, Sir Kay, Bunmi, Dr. Sammo, Oneal, Mary, and Tayo, for there encouragement and moral support.

I owe a lot of appreciation to my Supervisor Engr. A. Attah, for his Constructive criticism and guidance towards the completion of the project, not forgetting my friends, Charles Okponaviobo, Mike Okori, Ayo Oladeji, and Seni Folarin for their support.

Finally, I thank GOD for his mercies and kindness towards me.

Abstract

Opening a lock with the use of a PIN adds more flexibility to security system. This thesis describes the design and implementation of a Microcontroller based security system for home and office devices. It provides users with an efficient and reliable security system that supports the use of an Electronic Keypad arranged to send signals to the control unit (Microcontroller PIC16F877A). This Control Unit either activates the Port to which the LED (the door Latch) is connected when the correct Pin is entered or activates the Port to which the Buzzer Alarm is connected when the wrong Pin is entered. The prototype of the system is successfully implemented according to the proposal giving authorized user the privilege to change the Pin at will.

Overall, the design and implementation of the prototype is fully functional and user friendly.

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Chapter One

Introduction

Due to the need to increase the security of life and properties in our environment, security systems are used as selective systems to decide who has access to a given location based on a personal distinctive trait of the user. It also serves the function of sensing or detecting false intrusion (using input sensory devices and gives early warning using audio warning devices alarm – light indicators and remotely controlled computer systems etc). The term false intrusion here is used to mean any form of attempt to gain entry without following the proper pre-designed protocol(s) [1].

From time past until present, security locks usually includes mechanical devices made of forged metal i.e simple lock and bolt, the door chain, pin tumbler lock, the jam lock and padlock etc. Other recently developed security devices are gadgets like laser beam detectors, motion detectors and magnetic card readers. Most recent of these devices are offshoots of biometric engineering [1]. They include voice recognition systems, finger print readers, retina eye scanners etc. The major characteristic of security devices is to prevent an intruder from gaining access to a location. Most of these devices however have lapses which give an unauthorized person access to where they are barred i.e the simple jam lock and pad lock can be forced open or the keys duplicated by unauthorized persons and under certain conditions, i.e. physical changes of the individual concerned, the biometric devices sometimes fail in recognizing the authentic individual concerned[1]. Hence they cannot be totally relied on. Furthermore, these devices are very expensive; its use is restricted to only a few individuals or organizations that can afford it. Devices such as motion detectors, light detectors among others are susceptible to be triggered by false signals such as noise impulses, whenever its sensitivity is increased. They are not suitable for most outdoor security protection due to the fact that they don't posses high discriminative capability during operation and they are fairly expensive.

It is hence imperative to provide a locking device, one which is also efficient and reliable; with high discriminative capability, non reliance on the physical quality of the individual concerned, which when forced open triggers an alarm and which is by far less expensive than their counterparts. This has led to the design and construction of a microcontroller based electronic lock system. It includes using correct personal identification numbers to operate the locking device, by conditioning the access based on the configuration of the security device thereby granting access to the user with correct pin number [2].

The microcontroller based electronic lock finds application in homes, banks in the field of military applications i.e. ammunition ware house, industries, ministries and government parastatals etc.

1.1 Objectives of the Project

The major objectives of the project are under listed

i) To provide a security lock that is efficient and reliable, at cheaper price in comparison with the old non effective devices, and the more modern but exorbitant ones.

ii) To design and construct a flexible but non porous security system which gives authentic users the privilege to change their personal identification numbers any time.

iii) To provide opportunity of textual displays as compared to conventional ones which only show digits.

iv) To reduce the bulkiness characterized with other security lock of its type by the use of a microcontroller, PIC16F877A

v) To provide the student the opportunity to widen it ability in programming language most especially Microbasic.

1.2 Methodology

The project is carried out by experimental modular design. The circuit is divided into blocks/modules and each module is analyzed extensively before its construction and tested after its construction so as to prove satisfactorily before joining the blocks to form the circuit. The blocks considered in this project are:

i) The power supply module

ii) The keypad unit

iii) The display unit (Nokia 3310 LCD)

iv) The buzzer alarm

v) The control unit (microcontroller PIC16F877A)

vi) The output e.g. LED

Textbooks, journals as well as various materials from the internet formed the major sources of information for this report. A detailed study of the data sheets and instruction set of the microcontroller unit used in construction was undertaken, with the components required sourced locally at affordable prices.

1.3 Brief Description of Project

This project entails the use of a microcontroller PIC16F877A as a base for a security lock. The keypad accepts digits from the user, based on the code written inside the PIC16F877A microcontroller, the digits are simultaneously shown on the Nokia 3310 LCD screen. The microcontroller compares the digits with the right pin number in its EEPROM memory (internal) e.g. if it is correct, it activates the port to which the LED is connected, (the LED represents the load door latch). Else, it prompts the user to try again with a textual display on the Nokia 3310 LCD, and also accompanies it with a buzzer sound. The Authentic user can change the pin to another one, which is stored in the memory by first inputting the right code.

The crystal oscillator used is 20MHz (speed). The system is peculiar because of the use of the microcontroller and the Nokia 3310 LCD, this allows larger memory use and eradicate clumsiness and bulkiness of the project and gives the opportunity of textual displays respectively. The Nokia 3310 LCD has 8 pins and uses a serial protocol which is compatible with the microcontroller PIC16F877A with 4 pins use for communication. It is powered with 2.75V, while the microcontroller is powered with 5V using LM 317 variable voltage regulator.

1.4 Scope of the Project

This project covers technological development in security system. Is supports the supports the use of a microcontroller PIC16F877A with digital keypad input for inputting the required pin number to compare with the right pin in its EEPROM.

In its construction, we made use of crystal oscillator, transistors, microcontroller, LCD display, LEDs, Resistors, Capacitors, Buzzer alarm, PIC Programmer Unit e.t.c. were made used of.

Thus, the project design and construction touches the following aspects of electronic and computer engineering.

i) Analogue electronics

ii) Digital electronics

iii) Computer programming (Microbasic language)

Chapter Two

Literature Review/ Theoretical background

When we think of locks, we think of a bolt containing a notch known as a talon, which is operated by moving the bolt backwards or forward by engaging a key in the talon. But there is more to locks than just a bolt or latch.

A lock is a mechanical device that can be use for securing doors, cabinets, lid of brief cases or other luggage [2]. It consists essentially of a bolt guarded by a mechanism which can be released by a mechanical, hydraulic or electrical/electronic actuator.

2.1 Brief History of Door locks

The use of locks extends back to the beginning of recorded history. The oldest known mechanical functioning lock was an Egyptian door lock used about 2000BC, made of wood and fastened vertically on the door post, the wooden block contained moveable pins or "pin tumblers" that dropped by gravity into openings in the cross piece of "bolts" and locked the door. It was operated by a wooden key with pegs that raised the number of tumblers sufficiently to clear the bolt so that it could be pulled back. The major disadvantage with it is that it was wholly made of wood [2].

The Romans made an improvement on this by fabricating the first metal locks which was later improved by Robert Barson, an English man in 1778 and Linus Yale Jnr an American in 1861[2]. The Yale lock consists of essentially a cylindrical plug placed in an outer barrel. The plug is rotated and in turn moves the bolt of the lock by means of a cam. The inserted key raises five pins of different sizes into corresponding holes in the plug [2]. The most common form of cylindrical lock used in homes is the so-called night latch, operated from a key from outside and a knob from inside. In the 20^{th} century, as machine tools and manufacturing methods became more sophisticated, locks were produced, which are either key operated (opened) or keyless. Hence producing closer part tolerances, resulting in better security narrowing down to the key locks. In the late 20^{th} century, electromechanical locks were developed to trip electrical circuit as seen in automobile ignitions. These key locks are unreliable due to the use of "master keys" by illegal intruders.

Of the various locks that are not operated by keys are the dial, or combinational locks. A set of tumblers or wheels, is activated by a spindle that can be rotated by a graduated dial on the outer end of the lock. When the dial is at a proper combination, the tumblers become arranged so that the bolting mechanism is released. Other keyless locks include remote controlled lock, "security card" operated and electronic code lock.

This project talks more about the electronic code lock, which is designed to respond to an electronic logic signal mechanism, with a digit sequence counter performing the function of a key. They are operated by inputting the correct code by external means through a keypad into a microcontroller which already have a pin number in its EEPROM memory (internal) to compare with, so that if it is correct (that is the pin number inputted by the user), It activates the port to which the LED is connected (the load that represents the door)[3]. Else it activates an audio alarm to alert security men or authorized user when ever there is an intrusion from unauthorized users.

2.2 Theoretical Background of Microcontrollers

A microcontroller often abbreviated MCU is a single computer chip integrated circuit that executes a user program normally for the purpose of controlling some device hence the name microcontroller [4]. Microcontroller includes several thousands of transistors stored into one chip, with addition of external peripherals such as memory input-output lines, timers built into it. This project is built using the microcontroller PIC16F877A.

2.2.1 Microcontroller PIC16F877A and Features.

PIC16F877A belongs to a class of 8-bit microcontrollers of RISC architecture. It has the following features [5] as shown in the table below and an internal structure as shown in Fig.2.1.

Table 2.1 features of PIC16F877A

Key Features PICmicro™ Mid-Range Reference Manual (DS33023)	PIC16F877
Operating Frequency	DC - 20 MHz
RESETS (and Delays)	POR, BOR (PWRT, OST)
FLASH Program Memory (14-bit words)	8K
Data Memory (bytes)	368
EEPROM Data Memory	256
Interrupts	14
I/O Ports	Ports A,B,C,D,E
Timers	3
Capture/Compare/PWM Modules	2
Serial Communications	MSSP, USART
Parallel Communications	PSP
10-bit Analog-to-Digital Module	8 input channels
Instruction Set	35 instructions

Device	Program FLASH	Data Memory	Data EEPROM
PIC16F874	4K	192 Bytes	128 Bytes
PIC16F877	8K	368 Bytes	256 Bytes

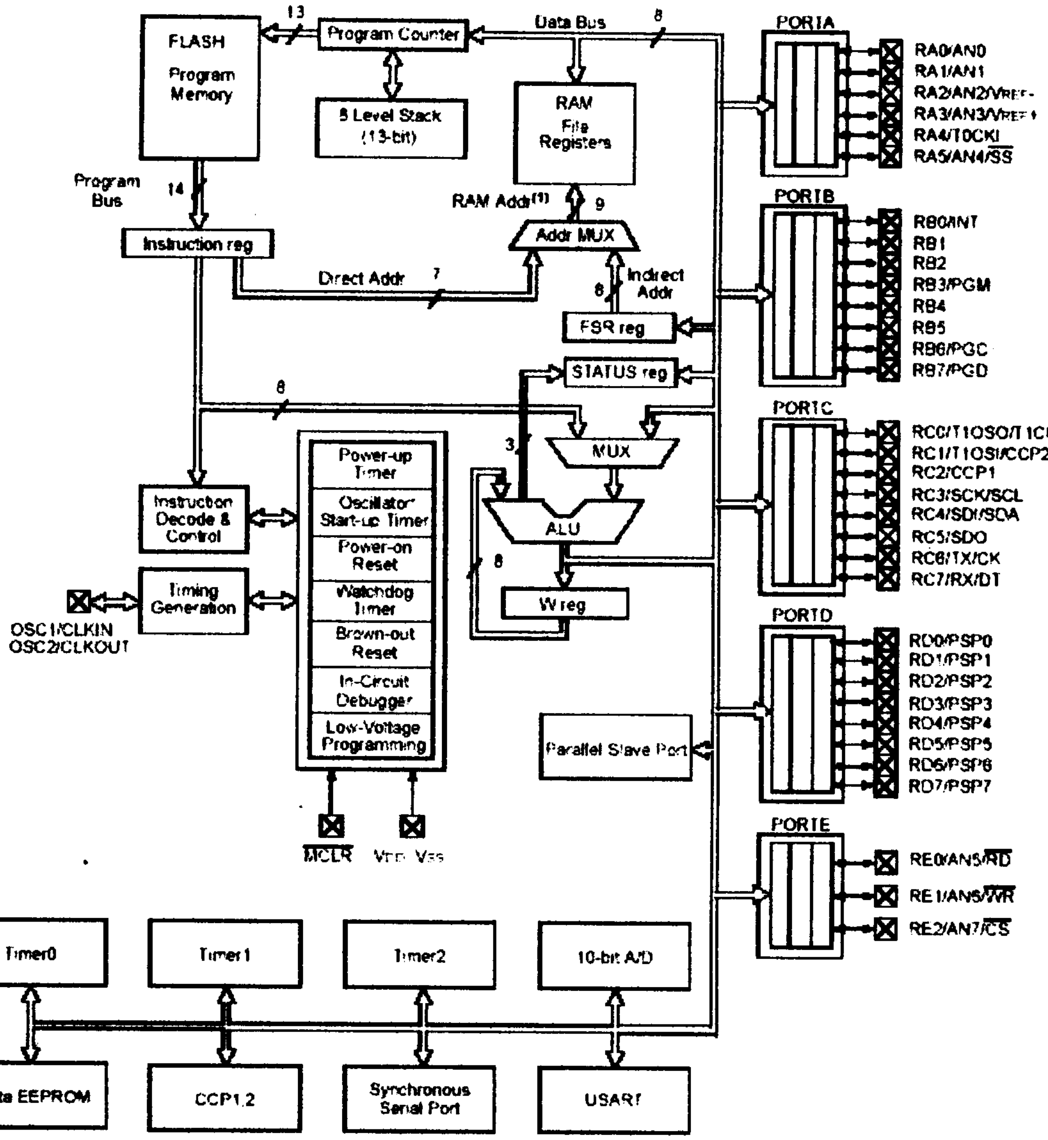


Fig.2.1 Internal block diagram of the PIC16F877A.

Flash program memory: use for storing a written program, it is an 8k x 14 words memory which can be programmed and cleared more than once, it makes the PIC16F877A suitable for device development.

EEPROM: it is a memory used for storing important data that must not be lost if power supply suddenly stops. The PIC16F877A is made up of up to 256 x 8 bytes of EEPROM data memory. For instance the EEPROM stores the personal identification number which is compared with the user input so as to activate the port to which the door relay is connected in correct, else set on the buzzer in not correct.

RAM: it contains data used by a program during its execution. The PIC16F877A consists of up to 368 x 8 bytes of data memory (RAM). The stored all inter-results of temporary data during run-time.

Pin Description

PIC16F877A has a total of 40 pins which consist of the following;

Port A (6-pin); its pin RA4 functions as a timer; others have no additional function.

Port B(8- pin); its pin RB0 functions as an input interrupt, RB0 functions as "clock" line in program mode. RB7, 'Data' line in program mode.

Port C (8-pin) its pins are used for transmitting and receiving data from peripheral components.

Port D (8-pin): all pins are use for parallel slave port with external peripherals.

Port E (3-pin): enable port , can be used as chip select CS.

Vcc (2-pin): use for supply of +5V dc to the microcontroller.

MCLR (1 pin): reset input and Vpp programming voltage of microcontroller.

GND (2-pin): use for grounding the supply to the microcontroller.

OSC 1 & OSC2: assigned for oscillator connection, for clocking and clock out respectively.

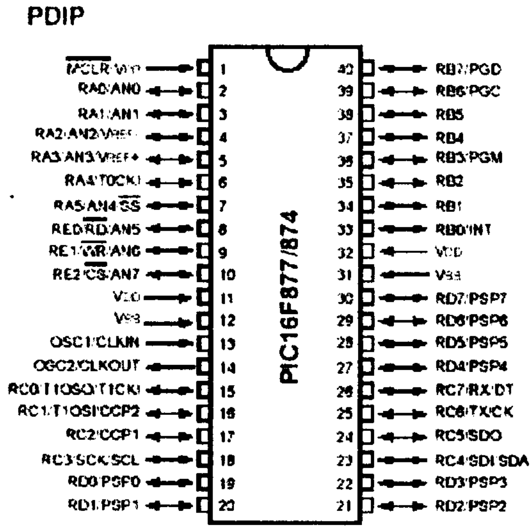


Fig2.2 Pin Description of the PIC16F877A

The clock is microcontroller's main starter [5], and is obtained from an external component called an "oscillator" the clock is divided into four; Q1, Q2, Q3 and Q4. The four together makes up an instruction cycle during which one instruction is executed.

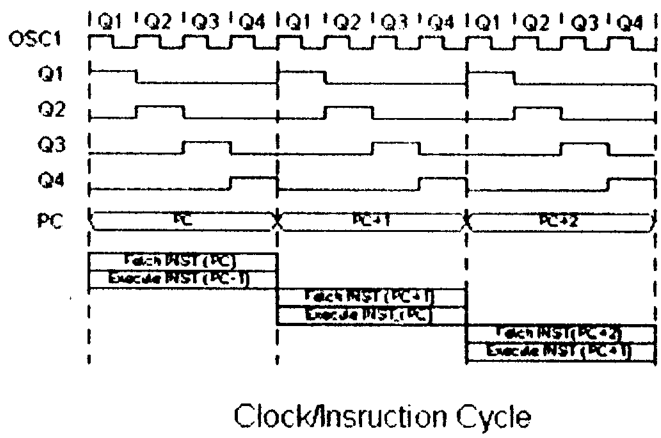


Fig.2.3 Clock/instruction cycle.

2.2.2 APPLICATION OF PIC16F877A

Its applications include the design and implementation of electronic lock with display controlling home appliances, remote sensors and several safety devices. It is also used in systems where permanent storage of various parameters is needed due to its EEPROM memory; this system includes (codes for transmitters, motor speed, receiver frequency etc).

Chapter Three

Design and Construction

In the construction of this project, the modular design is employed, the project is divided into two parts namely hardware and software with each of the section analyzed extensively. The block diagram of the microcontroller based Electronic door lock is shown below:

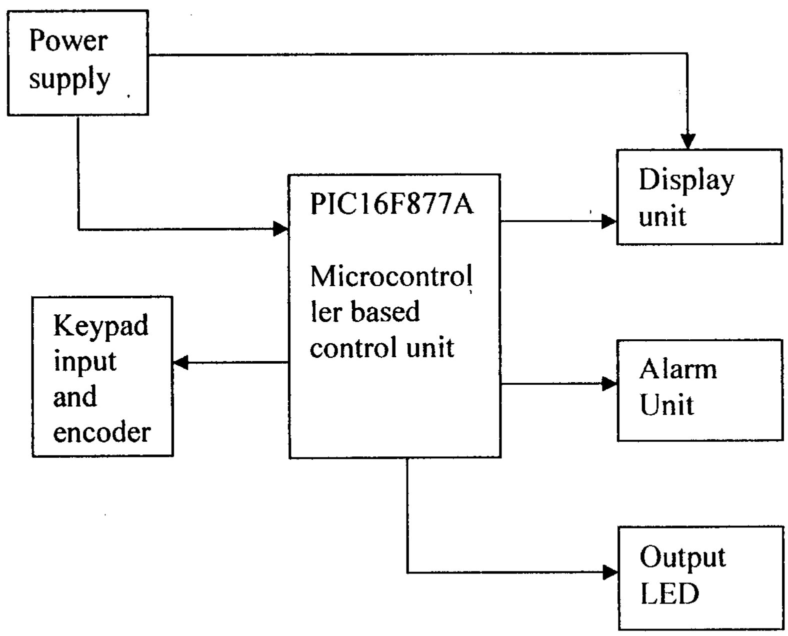


Fig.3.1 Block Diagram of a Microcontroller Based Electronic Door Lock

The construction of this project employs majorly the PIC16F877A microcontroller for several reasons.

Firstly, it is operated on a +5V DC supply and draws very little current. Further more, it has a very low power dissipation and high speed of operation and still maintains its data incase of power loss. Finally it has a large storage memory.

3.1 Power Supply Unit

This project utilizes DC voltages at two specified levels viz; +5V to supply the microcontroller and 2.75V to power the nokia 3310 LCD display. The power supply unit consist of a step down transformer, a rectifier circuit (bridge), a filter and three voltage regulators as shown in the block diagram below;

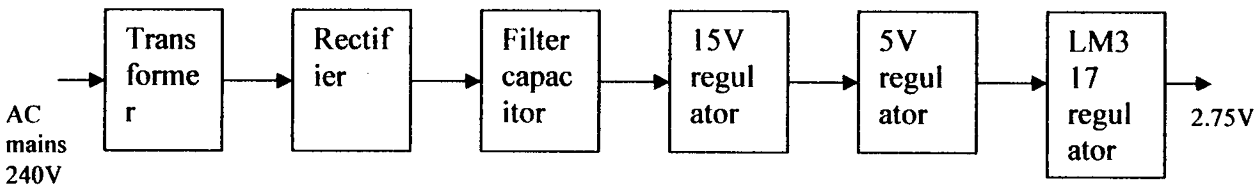


Fig 3.2 Block Diagram of the Power Supply Unit

3.1.1 The Transformer

A transformer is an electrical A.C. component or equipment which consists of two or more coils that are linked together by mutual inductance [6]. The centre tapped step down transformer, with the ratings 240V/24Vrms, 500mA is employed. This is required to suit the circuit fed by the DC supplied, it also the mains circuit from the power line.

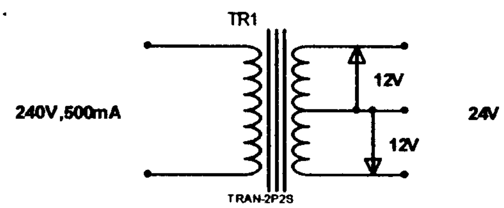


Fig 3.3 Transformer Circuit

For an ideal transformer,

$$VpIp = VsIs$$

Where Vs - is the voltage at the secondary coil

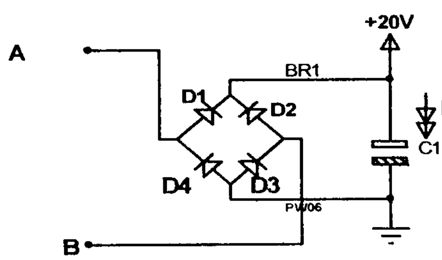
Vp - is the voltage at the primary coil

Is - is the current at the secondary coil

Ip - is the current at the primary coil

3.1.2 The Rectifier

This circuit converts the transformer AC output to DC power supply. This design uses four diodes; this arrangement is known as bridge rectification, as shown in the diagram below;



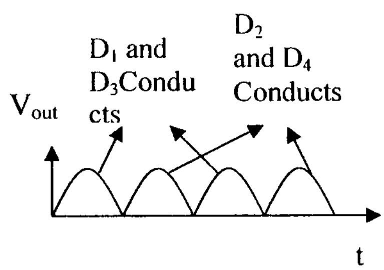


Fig 3.4 Full wave (Bridge) Rectifier and Wave forms using four Diodes

When point A is positive with respect to point B (positive half cycle), current flows through the forward biased diodes D1 and D3 while D1 and D2 are reverse biased, giving the output wave form in (b). Conversely, when point B is positive with respect to point A (positive half cycle), current flows through the forward biased D1 and D2 giving an output wave form in (c) [6]. The result of the two wave form is an output voltage whose ripple frequency is twice the supply frequency [7].

For a bridge rectifier with four diodes

$V_{rms} = 12V$

$V_{peak} = V_{rms}\sqrt{2}$

$= 12\sqrt{2} = 16.9V$

The average DC voltage is given by

$V_{dc} = V_{peak}$ – diode drop imposed by rectifier circuit

$V_{dc} = 16.9V - 1.5V$

$V_{dc} \approx 15V$

3.1.3 The filter circuit

The output of the rectifier circuit above is pulsating; it has a DC value and very significant AC component called RIPPLES. The filter circuit consists of capacitors (reservoir condenser) and is necessary to minimize the ripple content in the rectifier output. The capacitor charges up during the diode conduction period, to peak secondary voltage and discharges through the load when the rectifier voltage falls. If the output voltage has a ripple voltage of 50V, the filter can be chosen as follows;

$$I = C\left(\frac{dv}{dt}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

Where I = 500mA (max transformer secondary current)

dv = ripple content = 50V

dt = time during which the capacitor discharges

$= \frac{1}{2}$ the period of the 50Hz supply input

$= \frac{1}{2} \times \frac{1}{50} = \frac{1}{100} = 10ms$

Hence,

$$C ==500\times10^{-3}\times10\times10^{-3}/50=100\mu F$$

Thus, the filter capacitor is chosen as 100µf.

3.1.4 The Regulator.

The microcontroller IC requires a +5V DC supply. The 7805 fixed voltage regulator thus functions to provide a stable 5V, DC voltage at its output. The 7805 is a three-pin integrated circuit with external connections. Its input voltage is from the 7815 Regulator output and has a capacitor C2 =100µF, connected across the output to remove transient response. Apart from the supply to the microcontroller the 7805 regulator supply the input of the LM 317 regulator which gives a voltage output of 2.75V for powering the Nokia 3310 LCD. The entire power supply unit is shown below

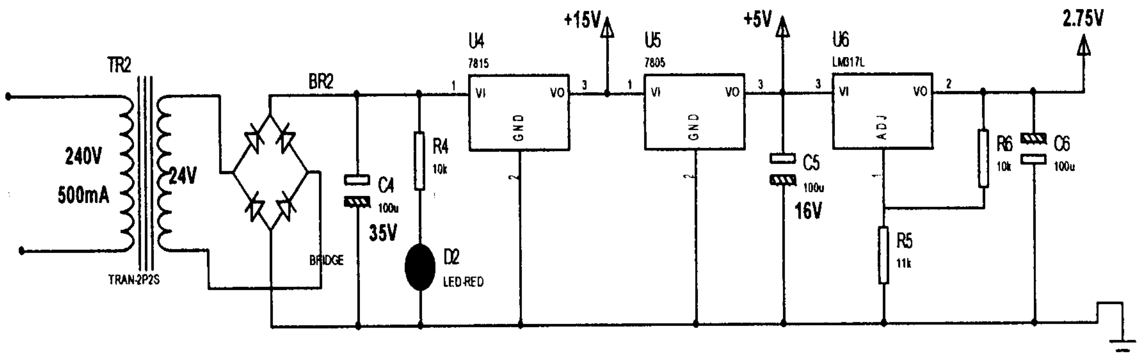


Fig 3.4 The Power Supply Unit

3.2 Hardware Design.

The functional Operation of the control Circuitry of the project is described in the subsection.

3.2.1 The Control Unit

The microcontroller PIC16F877A is the main control unit it processes and verifies the keypad inputs (Entered pin), and generate control signals to power the lock mechanism [3].Thus, this is done by comparing the digits with the right PIN number in the EEPROM memory (internal), if it is correct, it activates the port RD1, which has the LED (this represents the load), and also send an output text display on the Nokia 3310 LCD, indicating "ACCESS GRANTED". Else, it prompts the user with a text display that "ACCESS DENIED" and also with a buzzer sound.

The speed of execution of each task is enhanced using higher frequency of 20Hz. The instruction cycle of the microcontroller divide this frequency by four. [5]

$$\text{Finstruction} = \frac{Foscillator}{4} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

$$= \frac{20MHz}{4} = 5\text{MHz}$$

The instruction period is therefore;

$$\frac{1}{Finstruction} = \frac{1}{5MHz}$$

$$= 0.2\mu\text{s}$$

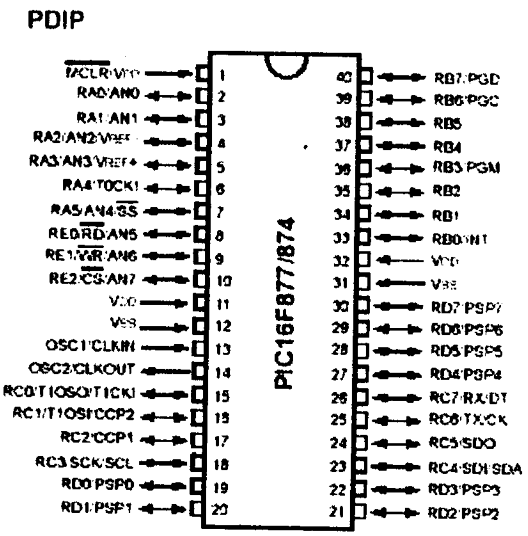


Fig.3.5 Microcontroller PIC16F877A.

3.2.2 Clock Generator (Oscillator)

The clock oscillator is a clock pulse generator required to operate the microcontroller, it increases the speed of execution of each task. Based on the microcontroller PIC16F877A, a 20MHz is suitable for the operation hence; it is used in this project [5].

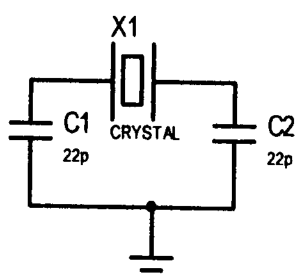


Fig 3.6 Clock Generator Circuit

3.2.3 The keypad unit

The keypad is employed as an external interface to the system through a user can communicate with the microcontroller to perform already programmed function. In this project a 4 x 4 matrix keypad was employed as shown if fig 3.7.

The keypad perform two separate functions, they can serve as numeric keys and function keys. The numeric keys are design to input numeric values into the system, they include "0 – 9". While the function keys "A – D" and "#", "*" are used to process the inputs. In the design of the keypad, there is a need for mandatory processing unit to decipher an authentic key pressed from an unwanted noise pulse [6].This is known as key debouncing, to prevent against multiple single inputs a debounced delay of 150ms was chosen as a start value in the program written, this provided an advantage of reduced hardware and flexible debouncing period.

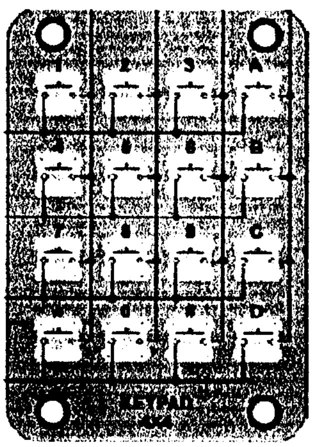


Fig 3.8 Showing the 4x4 Matrix Keypad

The output of the button pressed on the keypad is displayed on the Nokia 3310 LCD, this help to makes correction if a mistake is made during the typing of the codes. When the input pin is correct it causes the microcontroller to generate the control signal to drive the lock mechanism else it setoff the buzzer alarm.

3.2.4 The Display Panel Unit

The display used is the Nokia 3310 liquid crystal display so as to give the user the opportunity of textual display as compared to conventional ones which shows digits. The Nokia 3310 LCD uses a serial protocol having 8pins with 4pins used for communication with the microcontroller and the rest four pins used for other various function such as Reset, Ground, Vout and Vdd of 2.75V to run the LCD.

During the operation the following text will be displayed:

MENU 1. OPEN 2. MODIFY 3. SETTINGS Select option

When an input is to be made,"1" is selected so that "Enter Pin" shows on the screen to tell the user to input the three digits pin, if the digits is not 1 to 3, "Invalid option" is displayed with a prompt telling the user "1 – 3 pls then # ". If correct pin is entered, it displayed "ACCESS GRANTED" else "ACCESS DENIED". The modified option is used to change the PIN to ensure security of the user's code, the user is asked for the Old pin "Enter Old Pin" when done it displays a prompt "Enter Old Pin Again". If the former is the same with the latter it prompt the user "Enter New Pin", it ask once again for the new pin else it prompt with "PIN MISMATCH OLD PIN RETAIN".

The setting option is used if the pin is to be displayed in hidden mode or to appear as typed. The user is prompt with "HIDE OR DISPLAY AS TYPED". If the Hide is picked, then the pin appears with "+", else it displayed as typed.

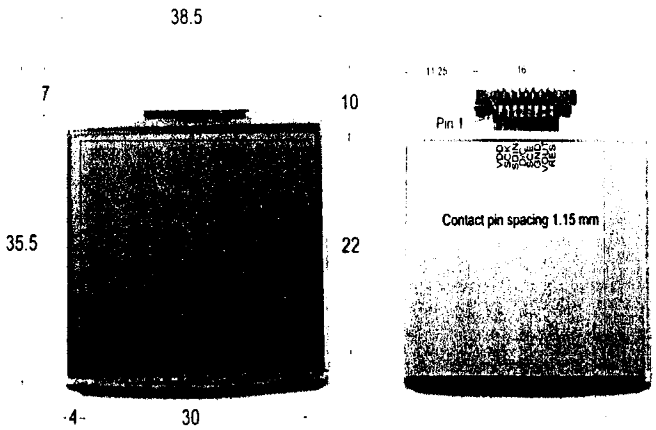


Plate3.9 Picture of the Nokia Display

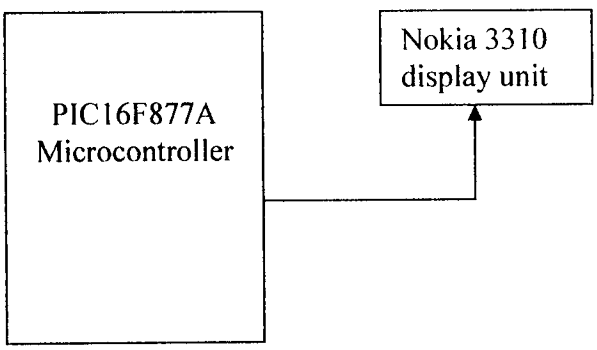


Fig 3.10 Block Diagram of Display Panel Unit

The LM317 output is used in powering the Nokia 3310 display. From the fig 3.4., 5V is supplied to the input of LM317; two resistors R1and R2 of 10KΩ and 11KΩ are respectively used to limit the load.

From fig 3.4., Using voltage divider

$$\text{Vout} = \frac{R1}{R1 + R2} \times V \quad \text{.........................} \quad (3.3)$$

$$= \frac{11}{11+10} \times 5$$

$$= 0.55 \times 5$$

$$Vout \approx 2.75V$$

This is with in the range of voltages that can power the LCD.

3.2.5 The PIC Programmer Unit

Programming the microcontroller requires a special hardware called PIC programmer. It is a device that connects to the PC via either serial, parallel or USB port. With the microcontroller chip placed into the socket on the device, a special software known as mickrobasic helps transfer the program from PC to the PIC programmer which in turn "Burns" the program into the chip. Once done the chip is removed and inserted into the circuit, to perform its functions.

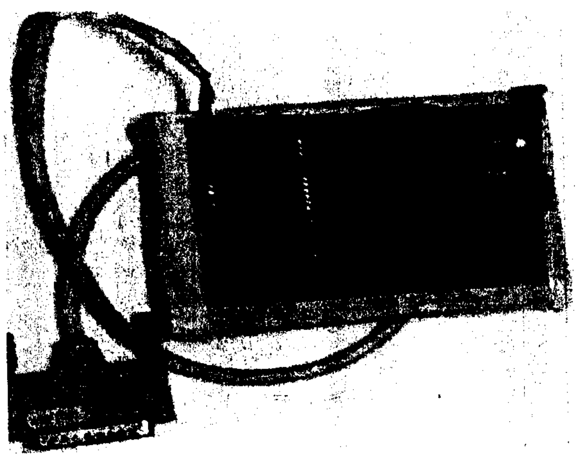


Plate3.11. The programmer hardware unit.

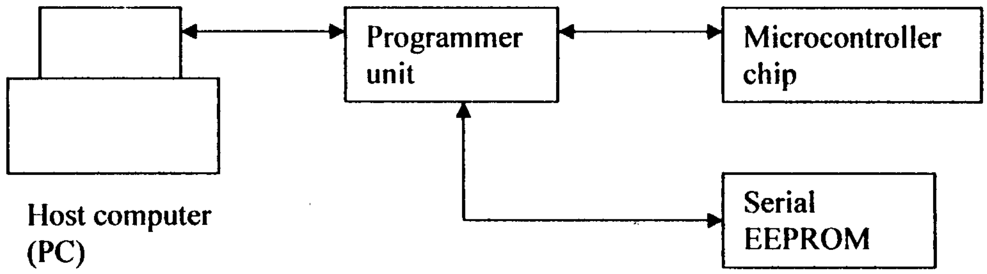


Fig.3.11. The schematic diagram of programming the controller unit.

3.2.6 Alarm unit.

The buzzer alarm is included in the circuit to come on when a wrong pin is inputed, so as to alert against intruders. When a wrong pin is entered the microcontroller activates the port to which the Buzzer is connected to.

3.3 SOFTWARE DESIGN.

The software is designed in order to support the effectiveness of the hardware device. The complex and intricate operating routine of the software is achieved by writing the program in modules starting with the program algorithm, followed by the program flowchart as shown in the Fig.3.13. The software was written in Mikrobasic language, and was written in sections for easy debugging and troubleshooting. Each section is tailored to meet the duty that will be imposed on the corresponding hardware unit.

3.3.1 Display program.

The display panel unit display upto twelve different statutes based on the operating state of the device, these statutes are "OPEN","ENTER PIN","ACCESS GRANTED","ACCESS DENIED","ENTER OLD PIN","ENTER NEW PIN","PIN MISMATCHED","PIN CHANGED","ENTER NEW PIN AGAIN","HIDE OR

DISPLAY NUMBER","PRESS ANY KEY","CLOSE DEVICE". The design of the font was done using the LCD font designer in the mikrobasic crack. The program for the display is contained in the Appendix A.

3.3.2 Keypad program.

Apart from the programming of the key pad to coordinating the activities of the microcontroller, another major programming done here is preventing jumping of the input key (bouncing). The program scans each key to detect a depressed key, and then a debouncing routine which is about 150ms delay is then executed. The routine is important so as to decipher authentic key pressed from Electrical noise [7] which can lead to multiple input. The program decodes an authentic key pressed and stores the numeric values in a given register, it repeats this until the required numbers of key inputs are collected are collected. The "#" function key then enters the values to be processed. The full detailed program is written in the Appendix A.

3.3.3 Algorithm for the Electronic Lock.

1. Default pin is stored in EEPROM.
2. Menu Showing Options

MENU
4. OPEN
5. MODIFY
6. SETTINGS
Select option

If digit is not 1-3, prompt with "invalid option" next message 1-3 pls, then #

is the default enter key, pin should be 3 digits (use a function to alert user about this).

3. For Option 1.

i) Code entered with Keypad command, analyzed for screen.

ii) Compare pin code with correct code.

iii) If wrong, increase counter by one – display wrong code, and beep

iv) If right, activates LED and display, "access granted"

v) Display Reset Option for activated LED.

4. For Option 2.

i) Prompt for user to type former code.

ii) Code entered with the keypad command, analyzed for Screen.

iii) Compare pin code with correct code.

iv) If wrong, increases counter by one – display wrong code, and beep.

v) If right, prompt user to type new pin, followed by #.

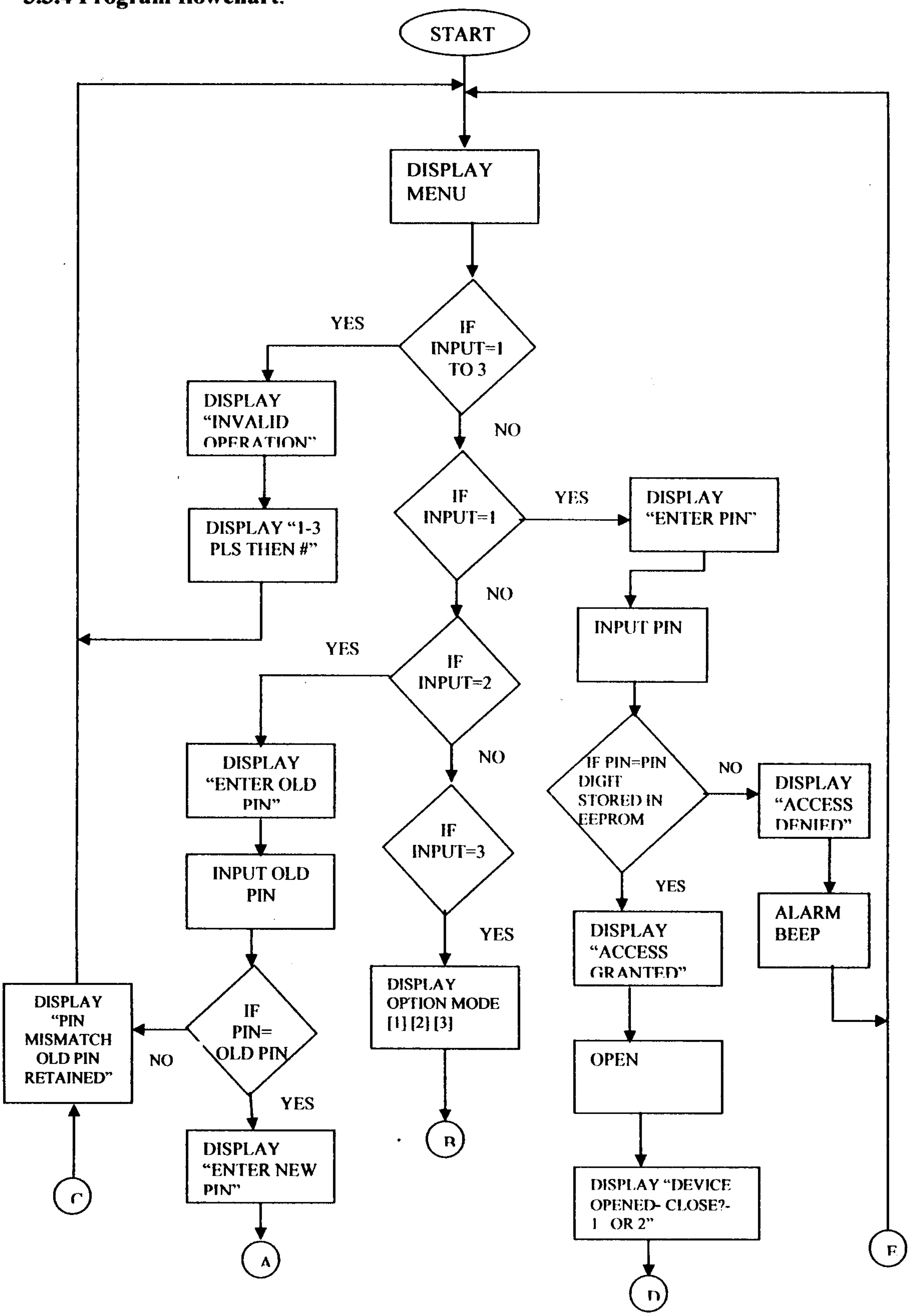
vi) prompt the user to type new pin again, followed by # to confirm if new code is not repetitive, retain original code and go back to menu, Else replace with new code and store in EEPROM Memory then go back to Menu.

5. For Option 3.

i) Prompt the user to hide or Display the pin.

ii) If the Hide is picked, then the Code/pin is shown with "+" sign. Else the pin is shown.

3.3.4 Program flowchart.



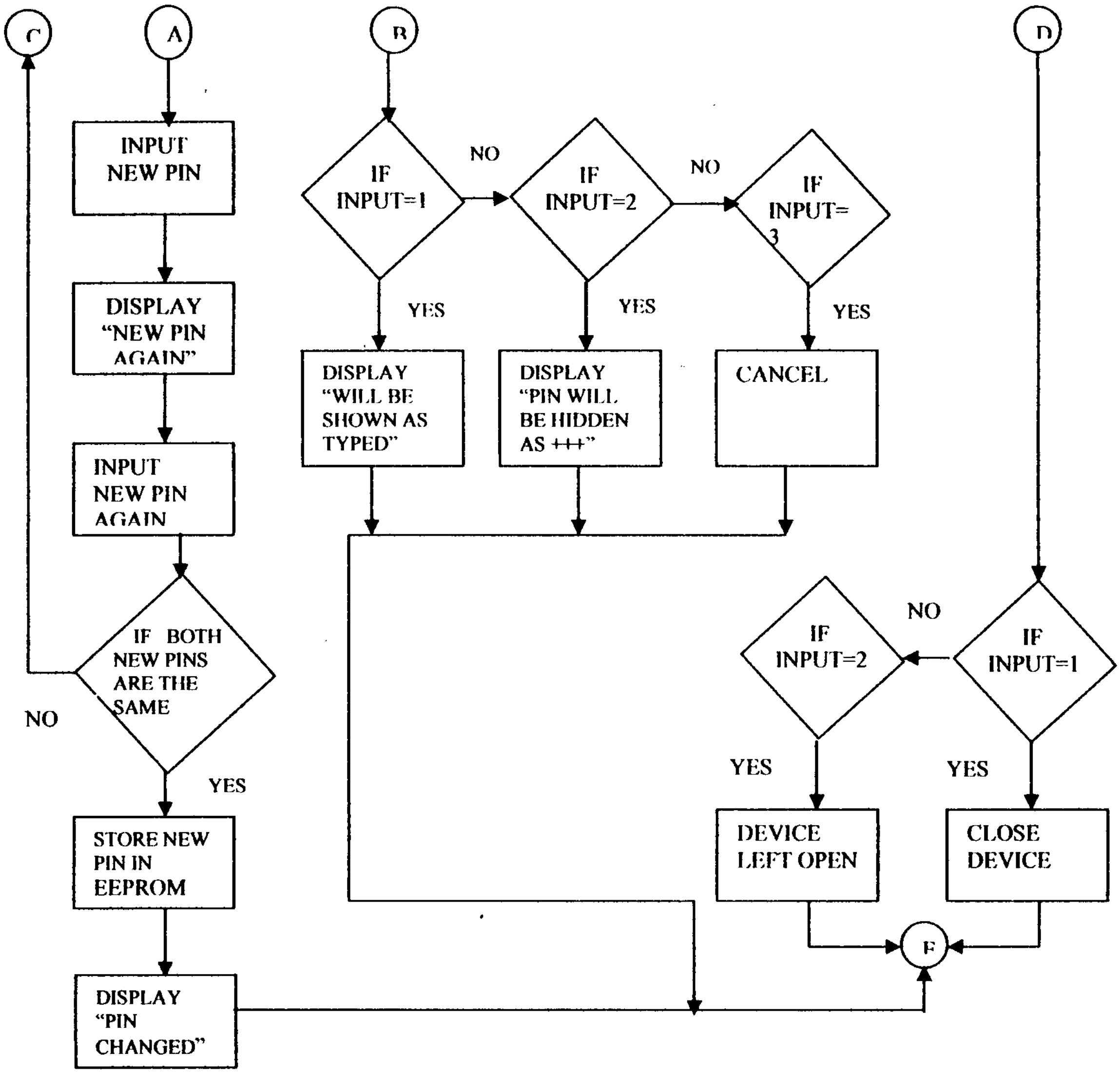


Fig.3.13 program flowchart

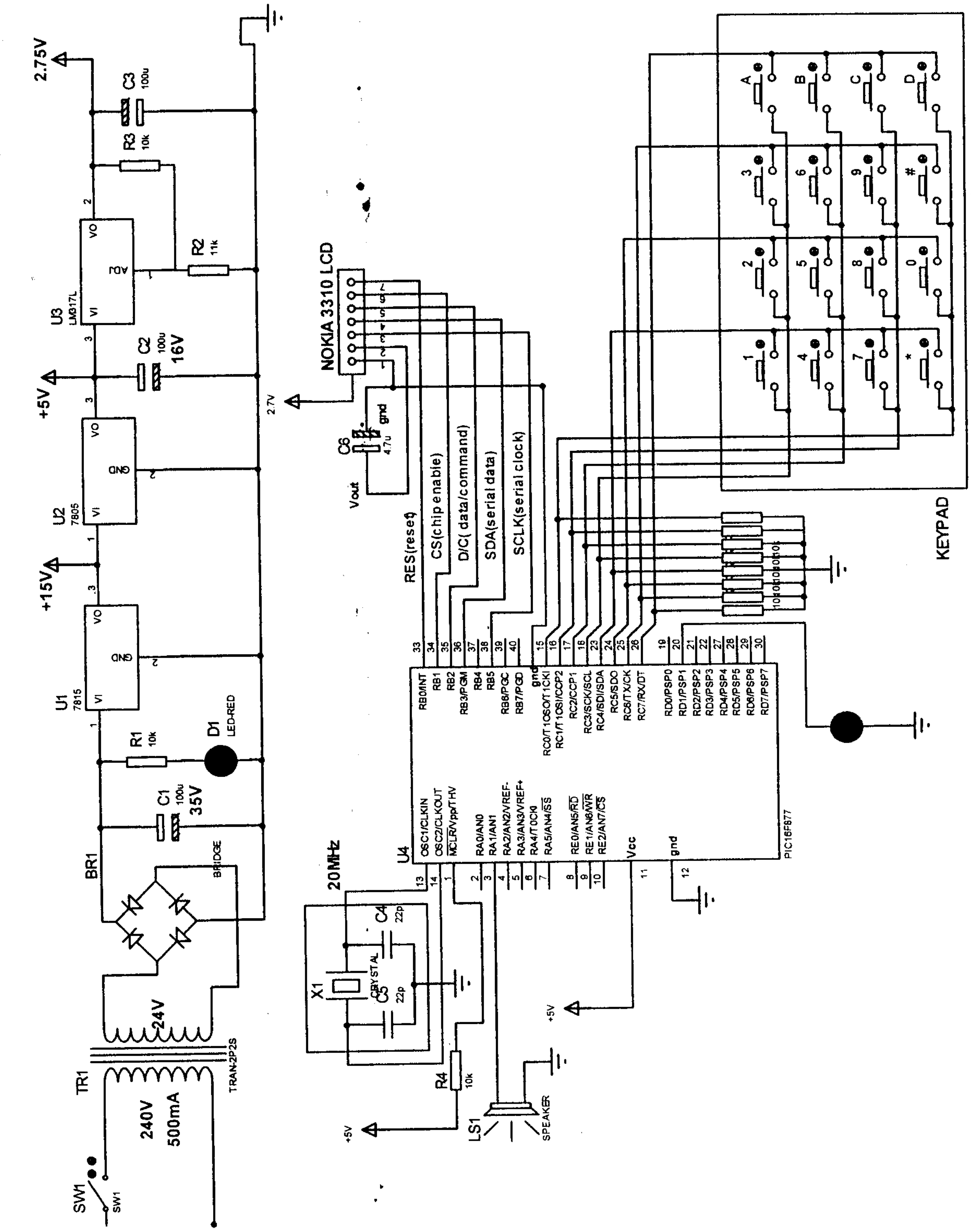


Fig.3.13 Complete circuit diagram.

CHAPTER FOUR

Tests, Results and Discussion

4.1 Test

After construction of the entire system, the hardware parts including the power supply, the Nokia LCD, the keypad were tested on the bread board while the software debugging was done using the microbasic crack simulator

4.1.1 Testing of the Power Supply unit.

The power supply circuit was connected on the breadboard as shown in Fig 4.1 with voltmeters connected across some points to get the output voltages and currents.

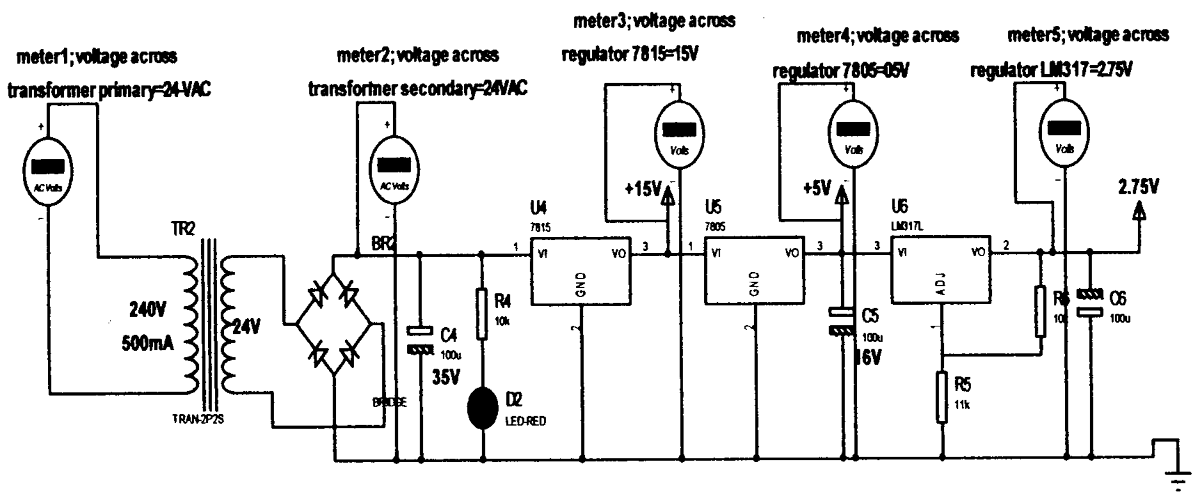


Fig. 4.1 Testing of the power supply unit

Table4.1 power supply test results

COMPONENT	RESULTS
Current through the transformer at the secondary side	500mA
Voltage across the capacitor C2 after the regulator	15V
Voltage into the transformer (AC supply)	240V
Voltage across secondary side of the transformer	24V
Voltage across the capacitor C3 after the regulator	5V
Voltage across the capacitor C4 after the LM317	2.75V

The result shows the proper working condition of the power supply unit.

4.1.2 Keypad Unit Testing.

The keypad is tested for continuity by connecting an avometer across each button as shown below

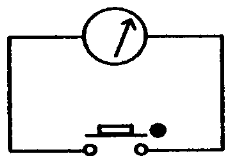


Fig.4.2 The Continuity test of the Keypad.

The continuity test circuit of the meter was selected and the pointer deflected fully to a zero resistance reading in addition to sounding of the meter buzzer, indicating the good condition of the buttons.

4.1.3 Nokia 3310 LCD Testing

The Nokia 3310 LCD was tested by connecting the variable resistor between the V_{out} and the V_{dd} legs of the Nokia 3310 LCD. The following displays were shown as tabulated in table 4.2 varying the variable resistor.

Table 4.2 The result of the test of the display unit

Value of Voltage	Display quantity (contrast)
0.50	No display
1.50	No display
2.00	No display
2.50	Traces of display/blurred screen
2.75	Clear display
3.00	Sharp screen with clear display

The results of the testing shows that the LCD works properly only at the voltage range of 2.75V – 3.3V, this is its rated voltage.

4.2 Software Debugging.

The program for the keypads was tested and buttons were discovered not working properly due to bounce [3], to overcome this problem key debounce with delay varied was done until the bouncing disappeared.

The power supply, keypads and display unit were further tested by-employing them in the circuitry of the electronic door lock, the input into the microcontroller was done using the keypads and it worked properly without no error of bouncing. Also the display unit displays the output of the keypad. It was however observed that the display (LCD) had some of its lines cut off; this is due to manufacturers fault, because another Nokia 3310 display was tested with the circuit and no such fault discovered.

The whole project was later tested by inputting the correct and wrong PINs. The microcontroller activated the port to which the LED (which represent the load) was connected when the correct PIN was entered. And when the wrong pin was entered the microcontroller activated the port to which the alarm unit was connected causing a beep. All the process involves were displayed on the Nokia 3310 LCD accordingly. Hence the whole circuit was confirmed to be working properly.

4.3 Discussion of Result

From the above stated test results, it shows that the LED flashes when the right code is entered, when the port to which it is connected is activated. Also the alarm is triggered ON when the wrong code is inputted. But this whole process is without some limitations, which includes majorly the strange behavior of the buttons of the keypad unit. The cause of the problem was because of the need for more debounce time for the buttons [3]. This was promptly adjusted making the output of the keypad to be better.

Chapter Five.

Conclusion and Recommendation.

5.1 Conclusion.

In summary, the microcontroller based Electronic lock is a security system device that utilizes pin input as key for user's Access. It can does serves as a device for securing personal wares in vaults, rooms, etc. against intruders by setting off the alarm for every wrong pin inputs. This unit finds use in homes and offices especially banks.

The achievable features of this project stems from the use of the microcontroller chip which reduced the size of the project compared to the previous ones that utilizes more integrated chips(IC) making it bulky.

5.2 Recommendations.

Improvements can further be carried out on the project in the under listed aspect,

1. The inclusion of Backup power supply through the use of batteries will help buy sometime for the user in case of power failure.
2. The LCD can be replaced with one with backup Light so as to provide visibility for the user at night.
3. The use of wireless keypad unit can also reduce the bulkiness of the project.

References.

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APPENDIX B.
Operation Manual

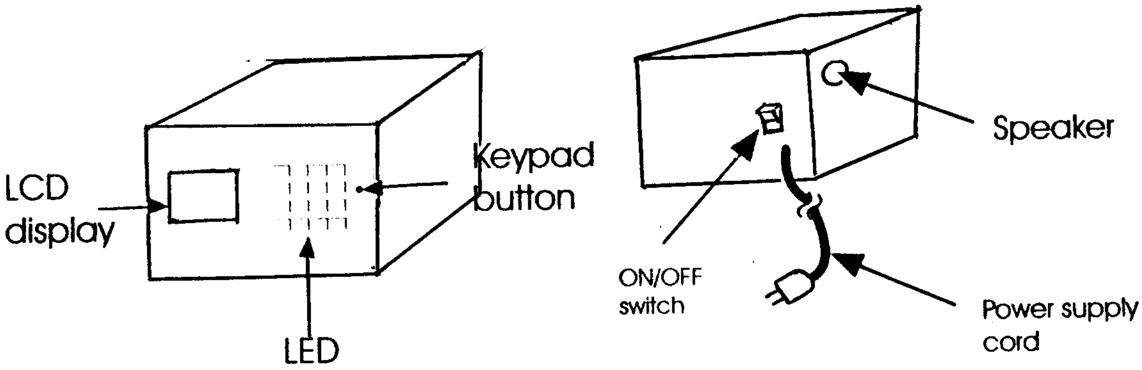

Plate 5.1 Label diagram of the microcontroller based Electronic door Lock.

Device Operation

- Plug the power supply cord to the 230V main unit.
- Put ON the ON/OFF switch.
- Device display the menu page as shown below:

MENU
1. OPEN
2. MODIFY
3. SETTING
Select option.

TO OPEN DEVICE;

- Press1, follow the prompt displayed "ENTER PIN" by inputting # digits PIN, and press #, if correct PIN is entered it Activates the LED(turns on the LED) and display "ACCESS GRANTED" else it triggers the Buzzer alarm(turn on the alarm) with the display "ACCESS DENIED".

To open device;
Open>enter pin>Access granted (turn on LED)/Access denied (turn on the alarm).
To close device when opened;
Open>enter pin>Access granted (LED turns on)>press1.

TO MODIFY PIN/CHANGE PIN;

- Press2,follow the prompt displayed "ENTER OLD PIN" if inputted "ENTER OLD PIN AGAIN" is prompted if former is the same with latter it prompt the user "ENTER NEWPIN" ,it verifies the new pin again by prompting "ENTER NEWPIN AGAIN", if the former is the same with the latter, it prompt "PIN CHANGED" (New pin now stored in the EEPROM).

To change pin;
Modify>enter old pin>enter old pin again>enter new pin>enter new pin again (pin changed).

TO HIDE OR DISPLAY PIN (SETTING);

- Press3,follow the prompt "HIDE OR DISPLAY AS TYPED"
- Press1 to show typed pin in hidden mode as "+".
- Press2 to show typed pin in display mode as typed.

To Hide or Display pin;
Setting>Hide/displayed as typed.