DESIGN AND CONSTRUCTION OF A MICROCONROLLER AUTOMATIC BELL

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DEPARTMENT OF ELECTRICAL
ELECRONICS ENGINEERING TECHNOLOGY

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TITLE PAGE

DESIGN AND CONSTRUCTION OF A MICROCONTROLLER AUTOMATIC SCHOOL BELL

NATIONAL DIPLOMA PROJECT REPORT

BY

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THIS PROJECT IS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL/ELECTRONICS ENGINEERING TECHNOLOGY. SCHOOL OF ENGINEERING, NUHU BAMALLI POLYTHECNIC, ZARIA KADUNA STATE.

IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF NATIONAL DIPLOMA (ND) IN ELECTRICAL/ ELECTRONICS ENGINEERING TECHNOLOGY

DECEMBER 2011

DECLARATION

I hereby declare that this project has been conducted by me under the supervision of Malam Zayyanu Nuhu of the department of electrical electronics engineering technology, Nuhu Bamalli Polytechnic Zaria and the authors whose work have been referred to in this project have been duty acknowledged.

4th Jan. 2012

Usman Bello
N/EET/09/13665

Date

APPROVAL PAGE

This is to certify that this is an original work undertaken by Usman Bello, N/EET/09/13665 and has been prepared in accordance with the regulation governing the preparation and presentation of project in Nuhu Bamalli Polytechnic, Zaria.

_______________________ 06/01/12

Malam Zayyanu Nuhu Date

(Project supervisor)

_______________________ _______________________

Engr. Abubakar Mahamud Panti Date

(Project coordination)

_______________________ _______________________

Malam Muhammad Garba Date

(Head of Department)

DEDICATION

This project work is dedication to God almighty for his adoration, guidance and inspiration.

I also dedicate this project to my parents, my brothers and sister for their financial and moral support given to me during my studies.

ACKNOWLEDGMENTS

All praise, honor, majesty and glory is to Allah the cherisher and sustainers of life given me the great time and opportunity to carry out my National Diploma course in Nuhu Bamalli Polytechnic, Zaria.

Special thanks go the Malam Muhammad Garba (HOD) in electrical electronic engineering and all the staff in the department. Similarly my special regards to my supervisor Malam Zayyanu Nuhu and all other staff in the department.

However, the acknowledgment cannot be concluded without conveying my special thanks, regard and gratitude to my parents Alhaji Ahmed Suleiman Shehu, Malama Aisha Indo Shehu, and Malam Bello Suleiman, and my brother and sister Nuhu Bello, Abdullahi M Bello Hafsat M. Bello and Nana M. Bello who sponsored and support the financially and otherwise right from my birth to date, may Allah reward them abundantly Ameen.

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ABSTRACT

The project microcontroller base automatic school bell with PIC. Interfacing is an interesting project which used PIC microcontroller as its brain. This project is very useful in schools, college and education/academic institutions, for automatic of periodic class room. This bell rings only at preprogrammed timings. As the PIC real time clock chip is used, entire the calendar can be programmed into the microcontroller.

The circuit is designed and constructed using microcontroller and discrete components. The microcontroller which is the major component is programmed so that it can trigger the bell at the expected time intervals.

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CHAPTER ONE

INTRODUCTION

1.1 PREAMBLE

In life today, we all know how life have been made easy with advance of the technology in this countries. in keeping this technology advancement electrical and electronic engineering has grow up uniquely to make human endeavor at many facet of living meaniffull. the life and properties are paramount in which the development of any nation depend on how the school or collage operate there time period of lesson or break. Hence, the design and construction of a microcontroller - Based automatic school bell, need to the school.

1.2 AIMS AND OBJECTIVE

The aim of this project is to design and construct a microcontroller-based automatic school bell.

Specifically, the objectives of this project are to:-

- Design a program in assembly language that will control the ringing of a school bell at a predefined interval.
- Compile an assembly language program to develop a machine code.
- Download a machine code to a PIC microcontrollers.
- Design a hardware that will be controlled by the designed program.

1.3 PROJECT MOTIVATION

The project takes over the task of bringing of the bell in school or colleges. it has an inbuilt real time clock which trades over real time equal to the bell ring time, then the relay for the bell is switching on. the ringing time can be edited at any time, so that it can be used at normal class timing as well as exam time.

1.4 SCOPE AND LIMITATION

(a) This project is limited for use in small school only due to size of the ringer used.

(b) The timing of the project cannot be modified without re-programming the PIC IC.

1.5 ORGANIZATION OF THE REPORT

The project is arrange in to five chapters with chapter one, introduction the general aims and objectives of the project and were presented, chapter two deals with relevant literature of active components use in realizing this project, chapter three with design procedures, calculation component selected, chapter four is construction and testing, while, chapter five give the conclusion and recommendation for operating the project.

1.5 METHODOLOGY

In the course of solving the problem, the following methodology will be use

- Designing of power supply
- Design of the controller circuit
- Programming the PIC circuit
- Design of the quartz crystal oscillator
- Design of the relay
- Constructing the complete circuit
- providing a case for the circuit
- testing the project

CHAPTER TWO

THEORETICAL BACKGROUND

2.1 POWER SUPPLY

Most electronics devices and circuits used D.C supply for their operations. This type of power can be obtained from dry battery as well as the wet ones. These batteries are convenient sources of power supply where small amount of energy is needed. But in situation where the system consumes a large amount of energy in certain safe range, Operation, the dry batteries are not capable to do the job. In this case, D.C batteries power supply is obtain from A.C mains source. The processes are rectification, which involves the changing of alternating current to unidirectional source. Filtration is another step that involves removing the ripples to make the output more stable.

2.2 VOLTAGE REGULATION

In electrical engineering, regulation denotes the change in voltage occurring at the output terminals of a power source between no-load and full load. The severity of voltage variation as load current changes is usually expressed as a percentage of voltage regulation. This regulation is the measure of a circuit's ability to maintain a constant output voltage when the a.c input voltage or load current varies. A circuit that is used to realize this is called a constant voltage reference circuit or voltage regulator [Richard, F. (2008)].

The rectifier, along with a suitable filter provides voltage which is nearly D.C. However, a change in A.C input voltage or a change in load resistance causes a change in output voltage.

Since many systems require a constant D.C voltage, a voltage regulator circuit is used in conjunction with rectifier and filter to provide the necessary constant D.C voltage. The three-terminal IC voltage regulators are available with three terminals: an input voltage, a 0V reference pin and an output voltage [Richard, F. (2008), Dickson, E. O. (2000),].

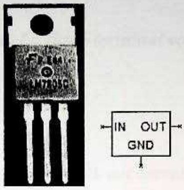

Fig. 2.7: A three-terminal voltage regulator and its circuit representation

The IC regulator does not only keep the output voltage constant but also reduces the amount of ripple voltage after filtration. It is usually expressed in dB. Typical value for 7805 (shown in Fig.2.7) is 78dB. The "7800 series" are three-terminal, positive fixed voltage regulators that have wide range of application. In a 78XX regulator, the last two numbers (XX) in the device part number indicate the output voltage while the 78 shows a positive voltage regulator.

The three-terminal voltage regulator is used in the simplest way by connecting it between the filtered, unregulated D.C voltage and the load as shown in fig.2.8. Capacitors are usually connected across the input and output terminals to maintain stability and improve the transient response of the supply.

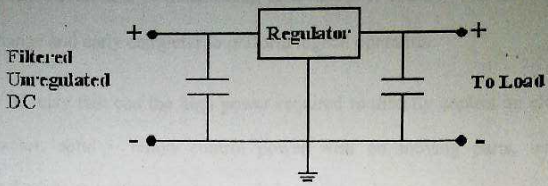

Fig. 2.8: Connection of a three-terminal voltage regulator

2.3 PIC PROCESSOR

A PIC is a programmable integrated circuit microcontroller, a computer – on – a chip. They have processor and memory to run a program responding to input and controlling output, so they can easily achieve complex function which would require several convention ICs.

Programming a PIC microcontroller may see daunting to a beginner but there is a number of systems designed to make these easy. The PICAXE system is an excellent example because it used a standard computer to program (and re-program) the PICs; no specialist equipment it required other than a low- cost download lead. Program can be written in a sample version of Basic or using a flow chart. The PICAXE programming extensive documentation is available to download free of charge.

2.4 RELAY

A relay is an electrically operation switch. Many relays use an electromagnet to operate a switching mechanism, mechanically, but other operating principles are also used. Relay are used where it is necessary to control and controlled circuit, or where several circuits must be trolled by one circuit and re-transmitting it to another. Relays were used extensively in phone exchange and early computer to perform logical operation.

A type of relay that can the high power required to directly control an electric motor is lled a contactor, solid – relays control power with no moving parts, instead using a miconductor devices to perform switching. Relays with calibrate operating characteristics and metime multiple operating coils used to protect electric circuit from overload or faults; in odern electric power systems, these function are performed by digital instrument still called rotective relay". Small "cradle" relay often used in electronic. The "cradle" term refers to the hape of the relay's armatures.

A simple electromagnetic relay consists of a coil of wire wrapped around a **soft iron ore**, an iron yoke which provides a low reluctance. Path for magnetic flux, a movable iron mature, and one or more sets of content (these are two in the relay picture). The armature is nged to yoke and mechanically linked to one or more sets of moving contacts. A solid state lay uses a thruster or other solid – state switching devices activated by the control signal to witch the controlled load, instead of a solenoid.

.5 CAPACITORS

Capacitor is an electronic device which store charge. They are used with resistor in ming circuit because it takes time for a capacitor with charge. They are used to smooth varying C supplies by acting as a reservoir of charge. They are also used in filter circuit because apacitor easily passes AC charging signal but they block DC constant signal.

Capacitor are measured in capacitance is ability to store charge. A large capacitance eans the more charge can store. Capacitance is measured in farad symbol F. However if is very rge, so prefixed are used to show the smaller value.

6 DIODE

Diode allow electron city to flow in only one direction. The arrow of the circuit symbol the symbol show the direction in which the current can flow. Diode is electrical version of a alue and early diode was actual called value.

Electricity used of a little energy pushing its way true a door with a spring. this mean that ere is a conducting diode, it is called the forward voltage drop and it about 0.7v for all normal iode which are made from silicon.

When a reverse voltage is applied a perfect diode those not conduct, but all real diode ast a very thing current of a few or less. This can b ignored in more circuit because it will be ery much smaller than the current flowing in the forward direction. However all diode have a aximum reverse voltage (usually 50v or more) and if it is exceeded. The diode will fail and fast lager current in the verse direction this call brake down.

.7 RESISTOR

Resistor restrict the flow of electric current, for example a resistance is placed in series ith transistor to limited the current passing true the transistor. Resistor may be connected either ay round.

Resistor values are normally shown using colored band each color represent a number.

CHAPTER THREE

HARDWARE AND SOFTWARE DESIGN

3.1 DESIGN OF THE RELAY DRIVER CIRCUIT

The output of the PIC at pin-17 is connected to the base of transistor Q1 through resistor R_1 for further driving the relay. The transistor used is a general purpose, NPN transistor with the following specifications.

Turn-on voltage V_i = 0.7V, Collector current I_C = 450mA, Power dissipation P_D = 500mW Current gain factor β =100 (min). The part number of the transistor is C945.

The base current of the Q1 is obtained as follows;

This base current is delivered to the Q1 through a resistor R_1 = 1KΩ which limits the current to the safe, maximum value. The dc power output produce by the Q1 is evaluated as follows;

$$P_{o(dc)} = V_{CC} I_{CQ} + \frac{(V_{CC})^2}{R_1}$$

$$P_{o(dc)} = 9\ x225mA + \frac{9^2}{1000} = 375mW$$

The output of the Q1 drives the relay with following specifications.

Part number, JZC 4088, DC trigger voltage = 6V, Maximum current capacity = 10A, AC frequency = 50-60Hz. The peak inverse voltage of Diode D1 (1N4001) is 50V with maximum rrent of 1A. The diode D1 is to serve as free whirling diode to protect the transistor against the ck EMF from the relay's coil.

2 POWER SUPPLY DESIGN

he circuit requires a regulated DC supply of 5V. A 9V DC battery is used as the source. A 5V egulator LM7805 is used together with 1uF capacitor to further filter the output. This voltage owers both the PIC and the relay driver circuit. But the electric bell is AC type and it obtains its upply directly from the mains.

3.3 DESING OF THE CLOCKING CIRCUIT OF THE PIC

The clocking signal to the PIC which is needed for its operation can be supplied using either crystal oscillator or RC oscillator. In this project crystal oscillator is used since it is more stable. The instruction cycle with respect to the frequency is given by:

The instruction cycle of 1μS is used, using (3.1) the frequency F is calculated as 4MHz.

3.4 SOFTWARE DESIGN

The PIC is the brain of the system and it has to be programmed to carry out the desired task. The PIC is programmed by first developing the flowchart that depicts the sequence of the task to be performed in operating the system. Fig. 3.2 shows the complete flowchart from which the programming in carried out. The sequence as seen on the chart begins by initializing the PIC when it is powered on and then creating the loop that repeats the programming nine times corresponding to nine periods in school. The bell rings three times during each period and then y for 45Sec representing 45Min of each period in school. When the nine periods re over the ation stops until the system is reset.

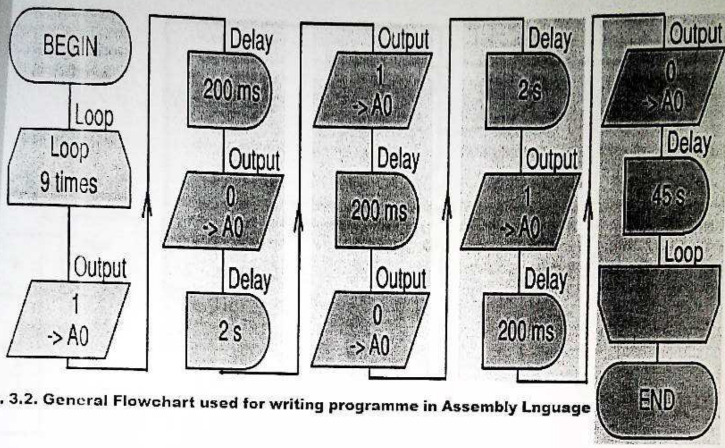

Fig. 3.2. General Flowchart used for writing programme in Assembly Lnguage

he complete programmed is written in assembly language and is shown on the Appendix.

.5 GENERAL CIRCUIT DIAGRAM AND MODE OF OPERATION

This project is aimed at designing and constructing a microcontroller based automatic School bell which is used to control the period of a school system. The objective of which is to design and construct a simple, reliable and cost effective device. This device as shown on Fig 3.1 is achieved by the use of components like PIC microcontroller, quartz crystal oscillator, transistor and some other active and passive components. The circuit is powered using a 9V battery but the microcontroller needs 5V, as such a regulator (7805) is used to regulate the voltage to 5V and a stabilizing capacitor is used to stabilize the voltage for the microcontroller.

artz crystal oscillator generates clock pulses for the microcontroller, while the capacitors re used to stabilize the clocking from the quartz crystal oscillator to the microcontroller.

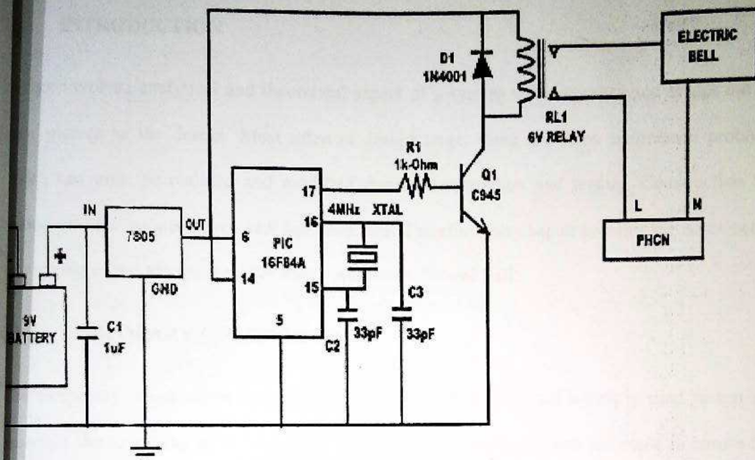

Fig. 3.1 General Circuit Diagram of the Microcontroller - Based automatic School Bell

The microcontroller is programmed in such a way that after every second (which is the mple time equivalent to the period length of the school) the bell will ring three (3) times. The put of the microcontroller at pin is high; as such the base resistor of the transistor Q_1 limits s high output in order to drive the relay driver circuit and the freewheeling diode prevent the nsistor from damage by the feedback from the relay . The switching characteristic of the nsistor energizes the relay to enable the output circuit of the bell.

CHAPTER FOUR

CONSTRUCTION, TESTING AND CASING

4.1 INTRODUCTION

Design involves analytical and theoretical aspect of a system while construction brings out the clear picture of the design. Most often at design stage, there are some unforeseen problems which can only be realized and modified during Construction and testing. Construction and testing prompt engineers with real life situations. Therefore this chapter presents the construction and testing of the Microcontroller Based Automatic School Bell.

4.2 TEMPORARY CONSTRUCTION

The temporary construction is done on an experimental breadboard which is used to test and ascertain the feasibility of the system design and necessary adjustments are made to ensure that the design output is obtained. The breadboard does not require soldering; hence it is reusable and can be used for temporary prototypes and experimenting with circuit design more easily.

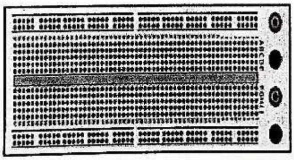

Fig. 4.1. Breadboard

4.3 PERMANENT CONSTRUCTION

The various components of the system are then soldered onto a veroboard together with the 9V dry battery. Assembly of devices on the veroboard presents special problems in terms of aligning, lead bending, inserting, crimping, and protecting the device before and during the construction. During the soldering of the components, proper care is taken to ensure that the soldering temperature does not exceed the maximum allowable temperature as provided in the manufacturer data sheets. This is to protect the components from excessive heat that can damage them.

Fig. 4.2 Diagram of the components placed permanently on a veroboard.

4.4 COMPONENT TEST

In this, the individual component used for the construction of the circuit where tested one by one to ensure their good condition before used in the construction. Digital multimeter as shown in Fig. 4.3 is used to test component live resistors, capacitors, transistor, the diode as well as the relay while the integrated circuit (IC) were tested using simple circuit in which they work.

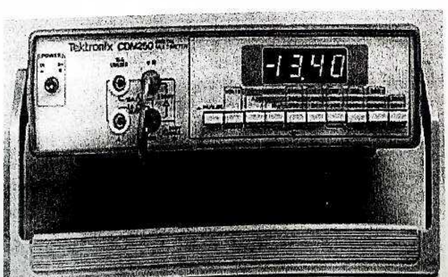

Fig. 4.3: Digital Multimeter CDM 250

4.5 CASING

The circuit is cased after the permanent construction discussed above. The casing material used is plastic due to its availability, easy to manipulate as well as suitability for casing electronics project because it is an insulator. The case used for this project is of rectangular shape.

4.6 TESTING

The circuit has undergone different test from the stage of construction to the point where it is finally constructed.

4.4 LIST OF COMPONENTS USED

The components used in the project are shown in table 4.1.

Table 4.1. List of Components used

S/N	COMPONENT	DESCRIPTION	QUANTITY
1	Resistor	1KΩ	
3	Capacitor	(i) (ii) , 50V (iii) , 50V	
4	Diode	1N4001	
5	Regulator	7805	
6	Relay	6V, 10A RELAY	
7	Quartz Crystal Oscillator	4MHz	

8	PIC Processor	16F84A	
9	Transistor	C945	

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

To summarize the whole work, this project involves the design and construction of microcontroller based automatic school bell.

The circuit is designed and constructed using microcontroller and discrete components. The microcontroller which is the major component is programmed so that it can trigger the bell at the expected time intervals. The circuit is tested and found to function normally and satisfactory.

5.2 DIFFICULTIES

There are exist limits to any technical work on either design or construction or both. It is the limitations that give the room for other people to carry out further work on this project topic. The following limitations were encountered in the course of implementation of the micro controller based automatic school bell.

- Problems due to inexperience in mounting of the component on bread and Vero board and so many numbers of components were damaged.
- Most of the calculated components are not available in the market and so equivalents are used.
- The micro controller based automatic school bell operates in 24hrs daily.

5.3 RECOMMENDATION FOR FURTHER WORKS

An auxiliary dc battery can be incorporated so that it supplies power to the system in case the primary battery is disconnected or if the battery runs down.

The possibility of incorporating a recharging system in the device is also highly suggested. This will help to prolong the lifespan of the battery since the battery may not be working constantly, and there is that inherent property for it to run down and eventually die.

5.4 CONCLUSION

The ethics of engineering practice in solving problems using available materials in the most economical manner has been the guiding principle of this project. The author views the objective of the project in the most general way and using the knowledge acquired from the series of lectures in electronics to device a scheme of achieving this objective bearing in mind the reliability convenience and relative justifiability of the design.

The design and construction of the Micro Controller Based Automatic School Bell is simple and cheap with very few components. This kind of Automatic system can therefore be produce in commercial quantities to be used in schools, offices, institutions, houses, banks and colleges where time keeping is required.

APPENDIX

```
;///////////////////////////////////////////////////////////////
;// Assembly language code for PIC based automatic school bell
;// Author: USMAN BELLO        N/EEET/09/13665
;// Supervisor: ZAYYANU  NUHU
;//  PIC used: 16F84A
;///////////////////////////////////////////////////////////////////////////

      include "P16F84A.inc"
; Heap block 0, size:30 (0x00000031 - 0x0000004E)
__HEAP_BLOCK0_BANK               EQU 0x00000000
__HEAP_BLOCK0_START_OFFSET       EQU 0x00000031
__HEAP_BLOCK0_END_OFFSET         EQU 0x0000004E
; Heap block 1, size:0 (0x00000000 - 0x00000000)
__HEAP_BLOCK1_BANK               EQU 0x00000000
__HEAP_BLOCK1_START_OFFSET       EQU 0x00000000
__HEAP_BLOCK1_END_OFFSET         EQU 0x00000000
; Heap block 2, size:0 (0x00000000 - 0x00000000)
__HEAP_BLOCK2_BANK               EQU 0x00000000
__HEAP_BLOCK2_START_OFFSET       EQU 0x00000000
__HEAP_BLOCK2_END_OFFSET         EQU 0x00000000
; Heap block 3, size:0 (0x00000000 - 0x00000000)
__HEAP_BLOCK3_BANK               EQU 0x00000000
__HEAP_BLOCK3_START_OFFSET       EQU 0x00000000
__HEAP_BLOCK3_END_OFFSET         EQU 0x00000000
gbl_status                       EQU 0x00000003 ; bytes:1
gbl_16_LSR                       EQU 0x0000000C ; bytes:4
gbl_float_detect_tininess        EQU 0x00000025 ; bytes:1
gbl_float_rounding_mode          EQU 0x00000026 ; bytes:1
gbl_float_exception_flags        EQU 0x00000027 ; bytes:1
gbl_17_gbl_aSig                  EQU 0x00000010 ; bytes:4
gbl_17_gbl_bSig                  EQU 0x00000014 ; bytes:4
gbl_17_gbl_zSig                  EQU 0x00000018 ; bytes:4
gbl_17_gbl_aExp                  EQU 0x00000028 ; bytes:1
```

```
_17_gbl_bExp              EQU 0x00000029 ; bytes:1
_17_gbl_zExp              EQU 0x00000023 ; bytes:2
_17_gbl_aSign             EQU 0x0000002A ; bytes:1
_17_gbl_bSign             EQU 0x0000002B ; bytes:1
_17_gbl_zSign             EQU 0x0000002C ; bytes:1
_17_gbl_zSigZero          EQU 0x0000002D ; bytes:1
_17_gbl_ret               EQU 0x0000001C ; bytes:4
bl_indf                   EQU 0x00000000 ; bytes:1
bl_tmr0                   EQU 0x00000001 ; bytes:1
bl_pcl                    EQU 0x00000002 ; bytes:1
bl_fsr                    EQU 0x00000004 ; bytes:1
bl_porta                  EQU 0x00000005 ; bytes:1
bl_portb                  EQU 0x00000006 ; bytes:1
bl_eedata                 EQU 0x00000008 ; bytes:1
bl_eeadr                  EQU 0x00000009 ; bytes:1
bl_pclath                 EQU 0x0000000A ; bytes:1
bl_intcon                 EQU 0x0000000B ; bytes:1
gbl_option_reg            EQU 0x00000081 ; bytes:1
gbl_trisa                 EQU 0x00000085 ; bytes:1
gbl_trisb                 EQU 0x00000086 ; bytes:1
gbl_eecon1                EQU 0x00000088 ; bytes:1
gbl_eecon2                EQU 0x00000089 ; bytes:1
gbl_FCLV_LOOP1            EQU 0x0000002E ; bytes:1
CompTempVar2205           EQU 0x0000002F ; bytes:1
CompTempVar2206           EQU 0x0000002F ; bytes:1
CompTempVar2207           EQU 0x0000002F ; bytes:1
delay_ms_00000_arg_del    EQU 0x00000030 ; bytes:1
delay_s_00000_arg_del     EQU 0x0000002F ; bytes:1
Int1Context               EQU 0x0000004F ; bytes:1
Int1BContext              EQU 0x00000020 ; bytes:3
    ORG 0x00000000
    GOTO    _startup
    ORG 0x00000004
    MOVWF Int1Context
    SWAPF STATUS, W
```

```
	BCF STATUS, RP0
	MOVWF Int1BContext
	SWAPF PCLATH, W
	MOVWF Int1BContext+D'1'
	SWAPF FSR, W
	MOVWF Int1BContext+D'2'
	BCF PCLATH,3
	BCF PCLATH,4
	GOTO	interrupt
	ORG 0x00000010
delay_ms_00000
; { delay_ms ; function begin
	MOVF delay_ms_00000_arg_del, F
	BTFSS STATUS,Z
	GOTO	label1
	RETURN
label1
	MOVLW 0xF9
label2
	ADDLW 0xFF
	BTFSS STATUS,Z
	GOTO	label2
	NOP
	DECFSZ delay_ms_00000_arg_del, F
	GOTO	label1
	RETURN
; } delay_ms function end

	ORG 0x0000001C
delay_s_00000
; { delay_s ; function begin
label3
	MOVLW 0xFA
	MOVWF delay_ms_00000_arg_del
	CALL delay_ms_00000
```

```
MOVLW 0x01
IORWF CompTempVar2205, W
MOVWF gbl_porta
MOVLW 0xC8
MOVWF delay_ms_00000_arg_del
CALL delay_ms_00000
MOVLW 0xFE
BSF STATUS, RP0
ANDWF gbl_trisa, W
MOVWF gbl_trisa
MOVLW 0xFE
BCF STATUS, RP0
ANDWF gbl_porta, W
MOVWF gbl_porta
MOVLW 0x02
MOVWF delay_s_00000_arg_del
CALL delay_s_00000
MOVLW 0xFE
BSF STATUS, RP0
ANDWF gbl_trisa, W
MOVWF gbl_trisa
MOVLW 0xFE
BCF STATUS, RP0
ANDWF gbl_porta, W
MOVWF CompTempVar2206
MOVLW 0x01
IORWF CompTempVar2206, W
MOVWF gbl_porta
MOVLW 0xC8
MOVWF delay_ms_00000_arg_del
CALL delay_ms_00000
MOVLW 0xFE
BSF STATUS, RP0
ANDWF gbl_trisa, W
MOVWF gbl_trisa
```

```
MOVLW 0x01
IORWF CompTempVar2205, W
MOVWF gbl_porta
MOVLW 0xC8
MOVWF delay_ms_00000_arg_del
CALL delay_ms_00000
MOVLW 0xFE
BSF STATUS, RP0
ANDWF gbl_trisa, W
MOVWF gbl_trisa
MOVLW 0xFE
BCF STATUS, RP0
ANDWF gbl_porta, W
MOVWF gbl_porta
MOVLW 0x02
MOVWF delay_s_00000_arg_del
CALL delay_s_00000
MOVLW 0xFE
BSF STATUS, RP0
ANDWF gbl_trisa, W
MOVWF gbl_trisa
MOVLW 0xFE
BCF STATUS, RP0
ANDWF gbl_porta, W
MOVWF CompTempVar2206
MOVLW 0x01
IORWF CompTempVar2206, W
MOVWF gbl_porta
MOVLW 0xC8
MOVWF delay_ms_00000_arg_del
CALL delay_ms_00000
MOVLW 0xFE
BSF STATUS, RP0
ANDWF gbl_trisa, W
MOVWF gbl_trisa
```

```
MOVLW 0xFE
BCF STATUS, RP0
ANDWF gbl_porta, W
MOVWF gbl_porta
MOVLW 0x02
MOVWF delay_s_00000_arg_del
CALL delay_s_00000
MOVLW 0xFE
BSF STATUS, RP0
ANDWF gbl_trisa, W
MOVWF gbl_trisa
MOVLW 0xFE
BCF STATUS, RP0
ANDWF gbl_porta, W
MOVWF CompTempVar2207
MOVLW 0x01
IORWF CompTempVar2207, W
MOVWF gbl_porta
MOVLW 0xC8
MOVWF delay_ms_00000_arg_del
CALL delay_ms_00000
MOVLW 0xFE
BSF STATUS, RP0
ANDWF gbl_trisa, W
MOVWF gbl_trisa
MOVLW 0xFE
BCF STATUS, RP0
ANDWF gbl_porta, W
MOVWF gbl_porta
MOVLW 0x2D
MOVWF delay_s_00000_arg_del
CALL delay_s_00000
INCF gbl_FCLV_LOOP1, F
GOTO    label4
label5
```

```
    GOTO    label5
; } main function end

    ORG 0x00000082

_startup
    MOVLW 0xD5
    BCF STATUS, RP0
    MOVWF gbl_16_LSR
    MOVLW 0xC4
    MOVWF gbl_16_LSR+D'1'
    MOVLW 0xBB
    MOVWF gbl_16_LSR+D'2'
    MOVLW 0xDC
    MOVWF gbl_16_LSR+D'3'
    CLRF gbl_17_gbl_aSig
    CLRF gbl_17_gbl_aSig+D'1'
    CLRF gbl_17_gbl_aSig+D'2'
    CLRF gbl_17_gbl_aSig+D'3'
    CLRF gbl_17_gbl_bSig
    CLRF gbl_17_gbl_bSig+D'1'
    CLRF gbl_17_gbl_bSig+D'2'
    CLRF gbl_17_gbl_bSig+D'3'
    CLRF gbl_17_gbl_zSig
    CLRF gbl_17_gbl_zSig+D'1'
    CLRF gbl_17_gbl_zSig+D'2'
    CLRF gbl_17_gbl_zSig+D'3'
    CLRF gbl_17_gbl_aExp
    CLRF gbl_17_gbl_bExp
    CLRF gbl_17_gbl_zExp
    CLRF gbl_17_gbl_zExp+D'1'
    CLRF gbl_17_gbl_aSign
    CLRF gbl_17_gbl_bSign
    CLRF gbl_17_gbl_zSign
    CLRF gbl_17_gbl_zSigZero
    CLRF gbl_17_gbl_ret
```

```
CLRF gbl_17_gbl_ret+D'1'
CLRF gbl_17_gbl_ret+D'2'
CLRF gbl_17_gbl_ret+D'3'
CLRF gbl_float_rounding_mode
CLRF gbl_float_exception_flags
CLRF gbl_float_detect_tininess
BCF PCLATH,3
BCF PCLATH,4
GOTO    main
ORG 0x000000A9
interrupt
; { interrupt ; function begin
    BCF STATUS, RP0
    SWAPF Int1BContext+D'2', W
    MOVWF FSR
    SWAPF Int1BContext+D'1', W
    MOVWF PCLATH
    SWAPF Int1BContext, W
    MOVWF STATUS
    SWAPF Int1Context, F
    SWAPF Int1Context, W
    RETFIE
; } interrupt function end
    ORG 0x00002007
    DW 0x3FFA
    END
```

References

- www.google/electronics PICS.
- Electronics III handout of Malam Auwal Sale Aliyu.
- Linear electronics circuit and system. G.D. bishop senior teacher, Paddingtor Technical College.