SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)
SRM NAGAR, KATTANKULATHUR-603203

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

LAB MANUAL

EI3468-MICROPROCESSORS & MICROCONTROLLERS LAB

IV SEMESTER
(Academic Year – 2024-25 Even Semester)

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Prepared By

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EI3468 MICROPROCESSORS & MICROCONTROLLERS LAB LTPC
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SYLLABUS

COURSE OBJECTIVES:

- To provide training on programming of microprocessors
- To provide training on programming of microcontrollers
- To provide training on interfacing peripherals with microprocessors.
- To provide training on interfacing peripherals with microcontrollers
- To provide training on interfacing I/O devices with arduino / raspberry pi development boards

LIST OF EXPERIMENTS

8-bit Microprocessor

1. Simple arithmetic operations: addition / subtraction / multiplication / division.
2. Programming with control instructions: a. Ascending / Descending order, Maximum / Minimum of numbers. b. Programs using Rotate instructions. c. Hex / ASCII / BCD code conversions.
3. Interface Experiments: with 8085 a. A/D Interfacing & D/A Interfacing.
4. Traffic light controller.
5. I/O Port / Serial communication
6. Read a key, interface display

8-bit Microcontroller

7. Demonstration of basic instructions with 8051 Micro controller execution, including: (i) Conditional jumps & looping (ii) Calling subroutines.
8. Programming I/O Port and timer of 8051 (i) study on interface with A/D & D/A (ii) Study on Interface with DC & AC motors
9. Application hardware development using embedded processors.
10. Interfacing of LEDs and sensor with arduino / raspberry pi modules.

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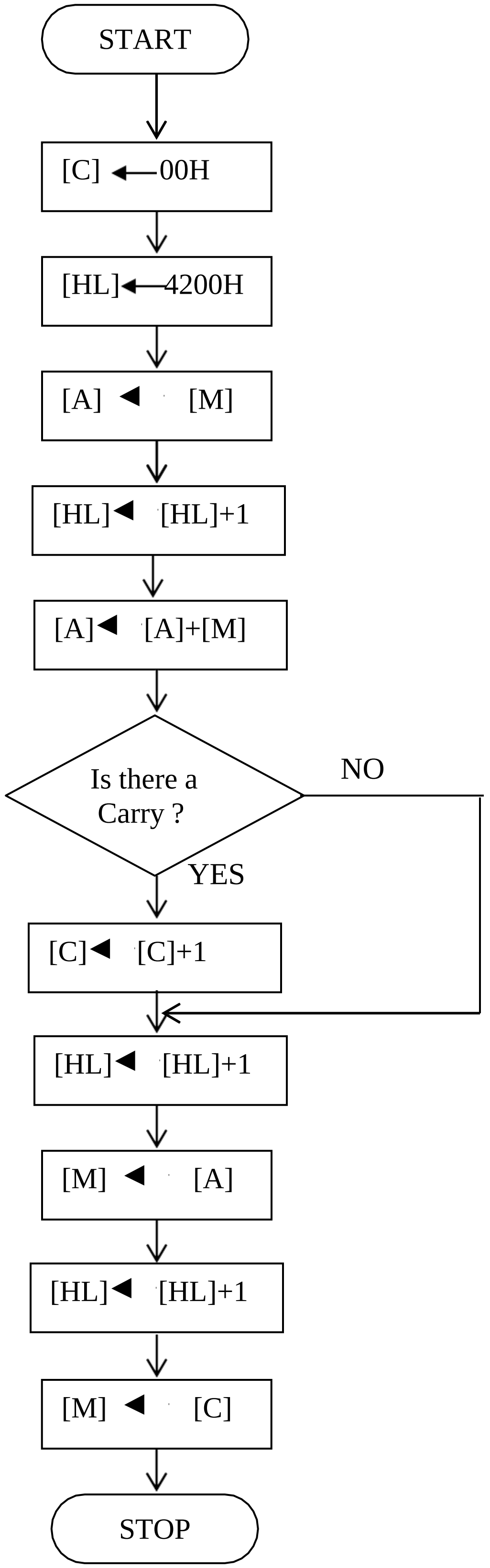
FLOW CHART:


START
[C] ← 00H
[HL] ← 4200H
[A] ◄ [M]
[HL] ◄ [HL]+1
[A] ◄ [A]+[M]
Is there a Carry ?
NO
YES
[C] ◄ [C]+1
[HL] ◄ [HL]+1
[M] ◄ [A]
[HL] ◄ [HL]+1
[M] ◄ [C]
STOP

1(A) 8-BIT DATA ADDITION

AIM:

To add two 8 bit numbers stored at consecutive memory locations and also to verify the result.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board

ALGORITHM:

1. Initialize memory pointer to data location.
2. Get the first number from memory in accumulator.
3. Get the second number and add it to the accumulator.
4. Store the answer at another memory location.

PROGRAM:

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
4100		START	MVI	C, 00	Clear C reg.
4101					
4102			LXI	H, 4200	Initialize HL reg. to 4500
4103					
4104					
4105			MOV	A, M	Transfer first data to accumulator
4106			INX	H	Increment HL reg. to point next memory Location.
4107			ADD	M	Add first number to acc. Content.
4108			JNC	L1	Jump to location if result does not yield carry.
4109					
410A					
410B			INR	C	Increment C reg.
410C		L1	INX	H	Increment HL reg. to point next memory Location.
410D			MOV	M, A	Transfer the result from acc. to memory.
410E			INX	H	Increment HL reg. to point next memory Location.
410F			MOV	M, C	Move carry to memory
4110			HLT		Stop the program

OBSERVATION:

INPUT		OUTPUT	
4200		4202	
4201		4203	

RESULT:

Thus the two 8 bit numbers stored at 4200 &4201 are added and the result is stored at 4202 & 4203.

VIVA QUESTIONS:

1. What is the function of LXI H, 4000 H instruction?
2. How you can store a data in a memory location?
3. What is the meaning of INX
3. How you can read a data from a memory location?
4. What are flags available in 8085 ?
5. What is the function of RESET key of a 8085 microprocessor kit
6. What is the function of JNC instruction?
7. What is the difference between conditional and unconditional jump instruction?
8. What is multi byte?

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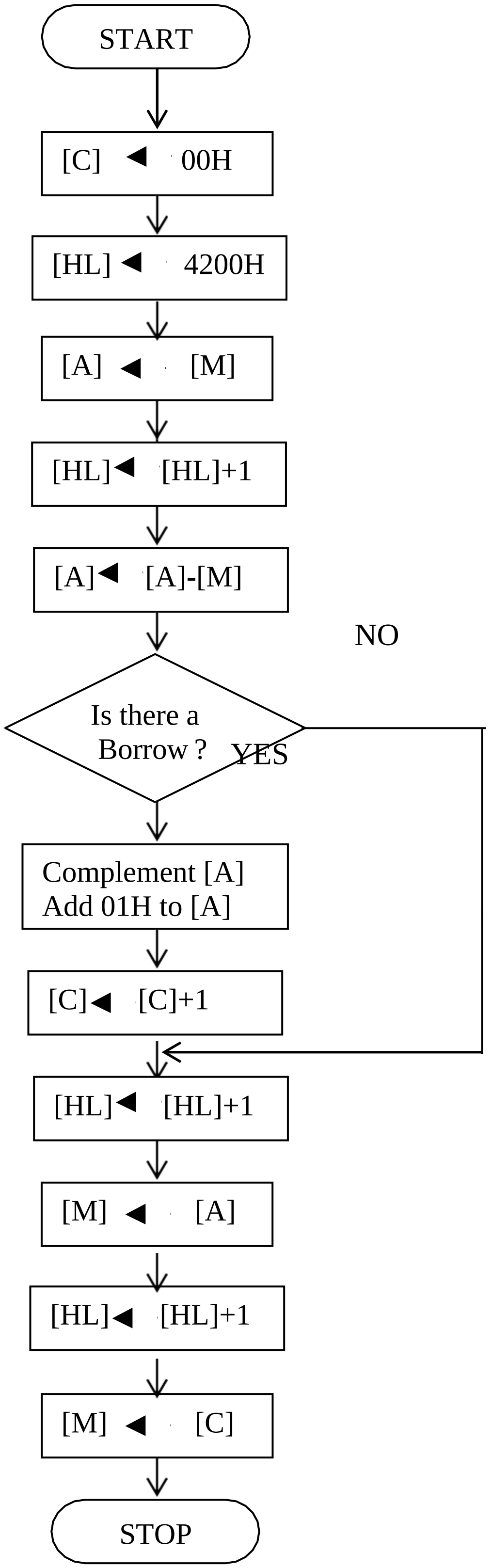
START
[C] ◄ 00H
[HL] ◄ 4200H
[A] ◄ [M]
[HL]◄ [HL]+1
[A]◄ [A]-[M]
NO
Is there a Borrow ?
YES
Complement [A]
Add 01H to [A]
[C]◄ [C]+1
[HL]◄ [HL]+1
[M] ◄ [A]
[HL]◄ [HL]+1
[M] ◄ [C]
STOP

1(B) 8-BIT DATA SUBTRACTION

AIM:

To subtract two 8 bit numbers stored at consecutive memory locationsand also to verify the result.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board

ALGORITHM:

1. Initialize memory pointer to data location.
2. Get the first number from memory in accumulator.
3. Get the second number and subtract from the accumulator.
4. If the result yields a borrow, the content of the acc. is complemented and 01H is added to it (2’s complement). A register is cleared and the content of that reg. is incremented in case there is a borrow. If there is no borrow the content of the acc. is directly taken as the result.
5. Store the answer at next memory location.

PROGRAM:

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
4100		START	MVI	C, 00	Clear C reg.
4102					
4102			LXI	H, 4200	Initialize HL reg. to 4500
4103					
4104					
4105			MOV	A, M	Transfer first data to accumulator
4106			INX	H	Increment HL reg. to point next mem. Location.
4107			SUB	M	Subtract first number from acc. Content.
4108			JNC	L1	Jump to location if result does not yield borrow.
4109					
410A					
410B			INR	C	Increment C reg.
410C			CMA		Complement the Acc. Content
410D			ADI	01H	Add 01H to content of acc.
410E					
410F		L1	INX	H	Increment HL reg. to point next mem. Location.
4110			MOV	M, A	Transfer the result from acc. to memory.
4111			INX	H	Increment HL reg. to point next mem. Location.
4112			MOV	M, C	Move carry to mem.
4113			HLT		Stop the program

OBSERVATION:

INPUT		OUTPUT	
4200		4202	
4201		4203	

RESULT:

Thus the 8 bit numbers stored at 4200 &4201 are subtracted and the result is stored at 4202 & 4203.

VIVA QUESTIONS:

1. What is meant by ADI instruction
2. What is an instruction?
3. What is Mnemonic?
4. What is the purpose of CMA instruction?
5. What is the function of stack pointer?
6. Why ADI 01H is used in two’s complement of an 8-bit number.
7. How many memory locations can be addressed by a microprocessor with 14 address lines?

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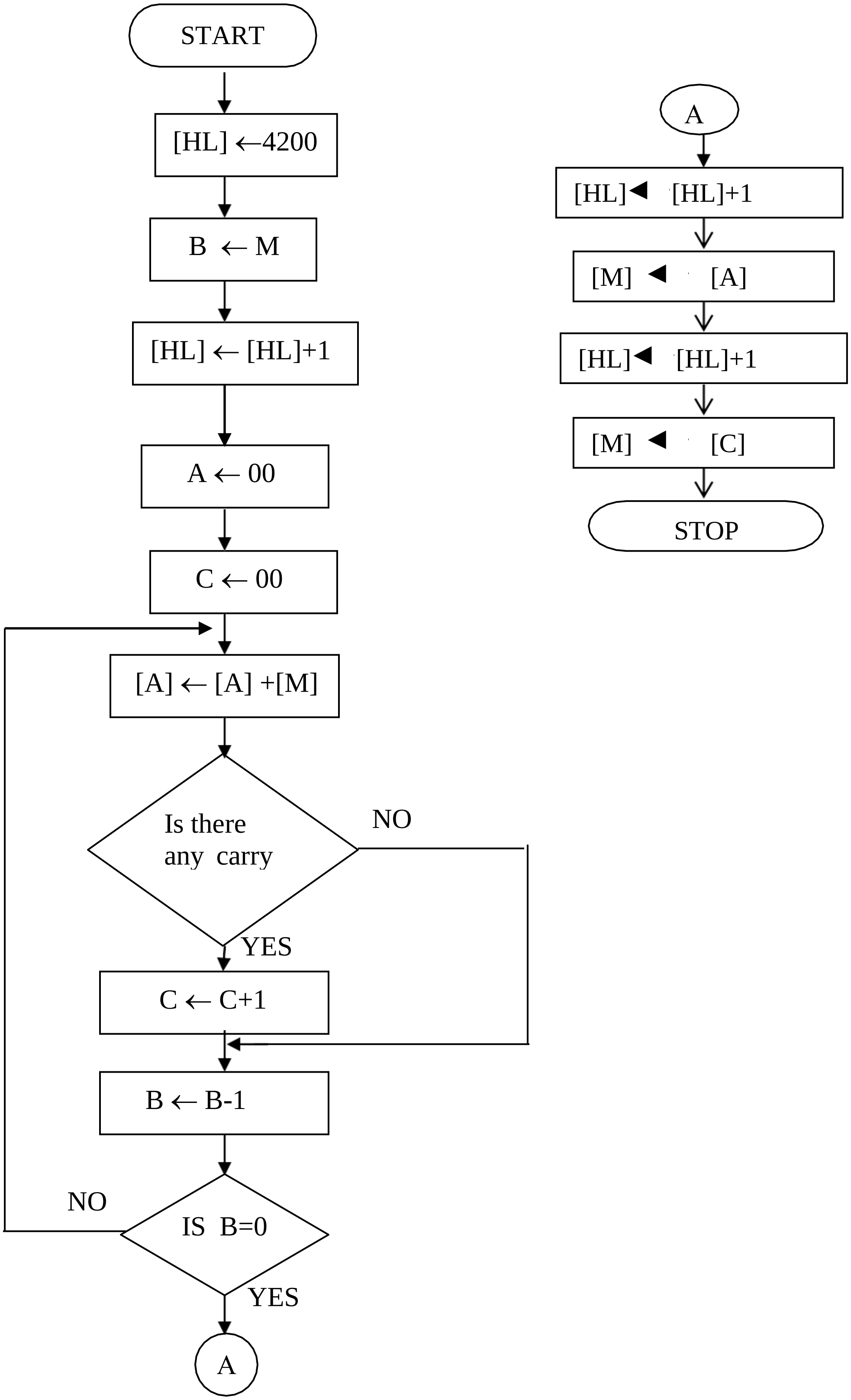
START
[HL] ←4200
B ← M
[HL] ← [HL]+1
A ← 00
C ← 00
[A] ← [A] +[M]
Is there any carry
NO
YES
C ← C+1
B ← B-1
IS B=0
NO
YES
A
A
[HL]◀ [HL]+1
[M] ◀ [A]
[HL]◀ [HL]+1
[M] ◀ [C]
STOP

1(C) 8-BIT DATA MULTIPLICATION

AIM:

To multiply two 8 bit numbers stored at consecutive memory locations and also to verify the result .

APPARATUS REQUIRED:

8085 microprocessor kit ,key board

ALGORITHM:

1. Initialize memory pointer to data location.
2. Move multiplicand to a register.
3. Move the multiplier to another register.
4. Clear the accumulator.
5. Add multiplicand to accumulator
6. Decrement multiplier
7. Repeat step 5 till multiplier comes to zero.
8. The result, which is in the accumulator, is stored in a memory location.

PROGRAM:

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENT
4100		START	LXI	H, 4200	Initialize HL reg. to 4500
4101					
4102					
4103			MOV	B, M	Transfer first data to reg. B
4104			INX	H	Increment HL reg. to point next mem. Location.
4105			MVI	A, 00H	Clear the acc.
4106					
4107			MVI	C, 00H	Clear C reg for carry
4108					
4109		L1	ADD	M	Add multiplicand multiplier times.
410A			JNC	NEXT	Jump to NEXT if there is no carry
410B					
410C					
410D			INR	C	Increment C reg
410E		NEXT	DCR	B	Decrement B reg
410F			JNZ	L1	Jump to L1 if B is not zero.
4110					
4111					
4112			INX	H	Increment HL reg. to point next mem. Location.
4113			MOV	M, A	Transfer the result from acc. to memory.
4114			INX	H	Increment HL reg. to point next mem. Location.
4115			MOV	M, C	Transfer the result from C reg. to memory.
4116			HLT		Stop the program

OBSERVATION:

INPUT		OUTPUT	
4200		4202	
4201		4203	

RESULT:

Thus the 8-bit multiplication was done in 8085µp using repeated addition method and also the result is verified.

VIVA QUESTION:

1. Define two’s complement of an 8-bit numbers.
2. What is meant by instruction ADC M?
3. What is the use of the instruction MOV A,M
4. What is the function of program counter?
5. Mention the types of 8085 instruction set.
6. How will you perform multiplication using ADD instruction?
7. Describe about DAD B instruction.
8. What is the purpose of the instruction MOV M,A

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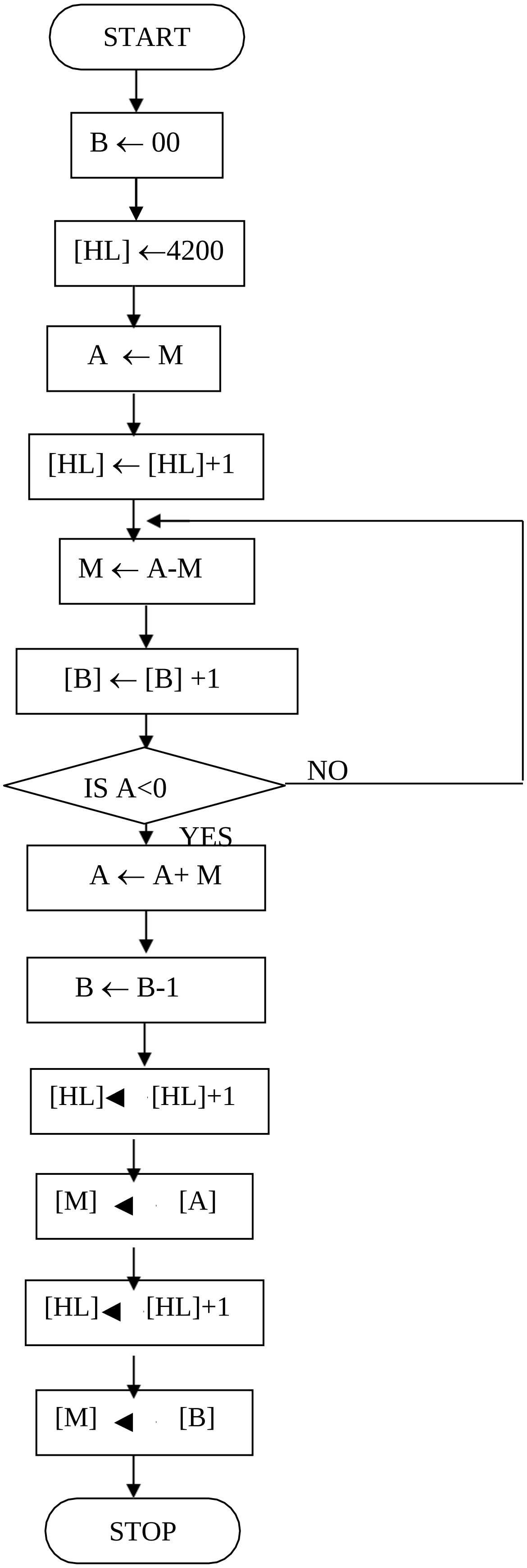
START
B ← 00
[HL] ←4200
A ← M
[HL] ← [HL]+1
M ← A-M
[B] ← [B] +1
IS A<0
NO
YES
A ← A+ M
B ← B-1
[HL]◄ [HL]+1
[M] ◄ [A]
[HL]◄ [HL]+1
[M] ◄ [B]
STOP

1(D) 8-BIT DIVISION

AIM:

To divide two 8-bit numbers stored in memory and also to verify the result.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board

ALGORITHM:

1. Load Divisor and Dividend.
2. Subtract divisor from dividend .
3. Count the number of times of subtraction which equals the quotient.
4. Stop subtraction when the dividend is less than the divisor .The dividend now becomes the remainder. Otherwise go to step 2.
5. Stop the program execution.

PROGRAM:

ADDRESS	**OPCODE**	**LABEL**	**MNEMONICS**	**OPERAND**	**COMMENTS**
4100			MVI	B,00	Clear B reg for quotient
4101					
4102			LXI	H,4200	Initialize HL reg. to 4500H
4103					
4104					
4105			MOV	A,M	Transfer dividend to acc.
4106			INX	H	Increment HL reg. to point next mem. Location.
4107		LOOP	SUB	M	Subtract divisor from dividend
4108			INR	B	Increment B reg
4109			JNC	LOOP	Jump to LOOP if result does not yield borrow
410A					
410B					
410C			ADD	M	Add divisor to acc.
410D			DCR	B	Decrement B reg
410E			INX	H	Increment HL reg. to point next mem. Location.
410F			MOV	M,A	Transfer the remainder from acc. to memory.
4110			INX	H	Increment HL reg. to point next mem. Location.
4111			MOV	M,B	Transfer the quotient from B reg. to memory.
4112			HLT		Stop the program

OBSERVATION:

INPUT		OUTPUT	
ADDRESS	DATA	ADDRESS	DATA
4200		4202	
4201		4203	

RESULT:

Thus an ALP was written for 8-bit division and also the result is also verified.

VIVA QUESTIONS:

1. What SUB M instruction will do?
2. Describe SBB M instruction
3. Express the use of SUI with an example
4. Where SBI can be used?
5. Give the purpose of the instruction LDAX D
6. How will you perform Division using ADD instruction ?
7. What is the need of ALE signal in 8085?
8. What are the addressing modes of 8085?
9. List the interrupt signals of 8085?

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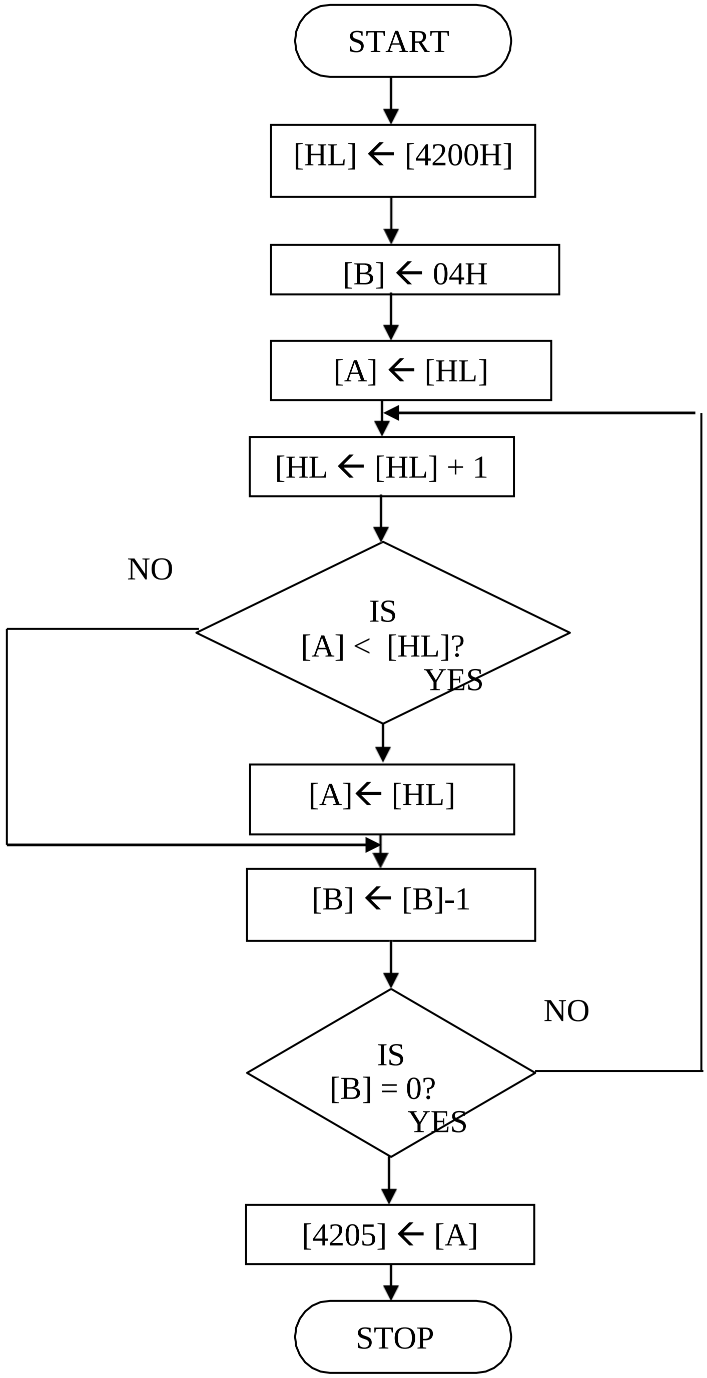
START
[HL] ← [4200H]
[B] ← 04H
[A] ← [HL]
[HL ← [HL] + 1
NO
IS
[A] < [HL]?
YES
[A]← [HL]
[B] ← [B]-1
NO
IS
[B] = 0?
YES
[4205] ← [A]
STOP

2(A) LARGEST ELEMENT IN AN ARRAY

AIM:

To find the largest element in an array of data stored in memory and also to verify the result.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board

ALGORITHM:

1. Place all the elements of an array in the consecutive memory locations.
2. Fetch the first element from the memory location and load it in the accumulator.
3. Initialize a counter (register) with the total number of elements in an array.
4. Decrement the counter by 1.
5. Increment the memory pointer to point to the next element.
6. Compare the accumulator content with the memory content (next element).
7. If the accumulator content is smaller, then move the memory content (largest element) to the accumulator. Else continue.
8. Decrement the counter by 1.
9. Repeat steps 5 to 8 until the counter reaches zero
10. Store the result (accumulator content) in the specified memory location.

PROGRAM:

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENTS
4100			LXI	H,4200	Initialize HL reg. to 8100H
4101					
4102					
4103			MVI	B,04	Initialize B reg with no. of comparisons(n-1)
4104					
4105			MOV	A,M	Transfer first data to acc.
4106		LOOP1	INX	H	Increment HL reg. to point next memory location
4107			CMP	M	Compare M & A
4108			JNC	LOOP	If A is greater than M then go to loop
4109					
410A					
410B			MOV	A,M	Transfer data from M to A reg
410C		LOOP	DCR	B	Decrement B reg
410D			JNZ	LOOP1	If B is not Zero go to loop1
410E					
410F					
4110			STA	4205	Store the result in a memory location.
4111					
4112					
4113			HLT		Stop the program

OBSERVATION:

INPUT		OUTPUT	
ADDRESS	DATA	ADDRESS	DATA
4200		4205	
4201			
4202			
4203			
4204			

RESULT:

Thus the largest number in the given array is found and it is stored at location 4205.

VIVA QUESTIONS:

1. What is meant by the instruction CMP M
2. What the instruction JNZ will do
3. State the logic behind the finding of largest element
4. List out the similarities b/w the CALL-RET and PUSH-POP instructions?
5. What is the need of ALE signal in 8085?
6. What are the addressing modes of 8085?

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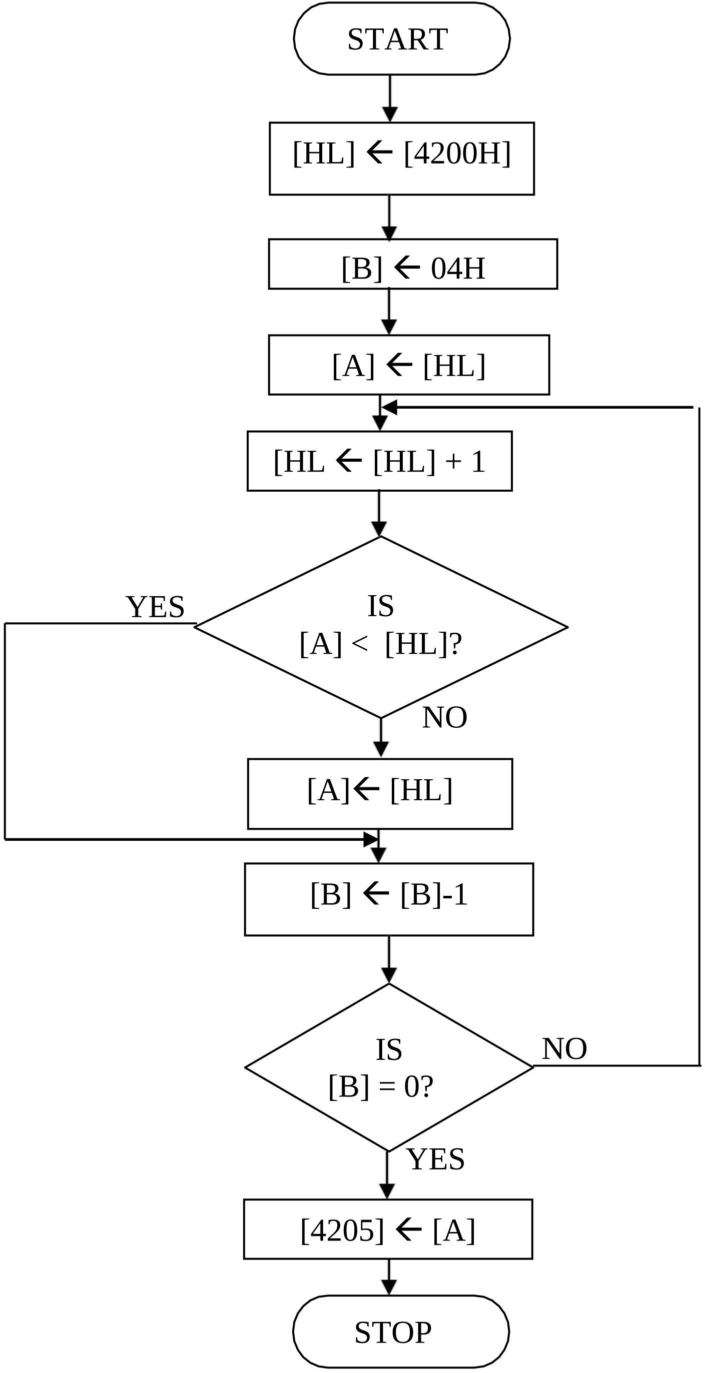

START
[HL] ← [4200H]
[B] ← 04H
[A] ← [HL]
[HL ← [HL] + 1
YES
IS
[A] < [HL]?
NO
[A]← [HL]
[B] ← [B]-1
IS
[B] = 0?
NO
YES
[4205] ← [A]
STOP

2(B) SMALLEST ELEMENT IN AN ARRAY

AIM:

To find the smallest element in an array of data stored in memory and also to verify the result.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board

ALGORITHM:

1. Place all the elements of an array in the consecutive memory locations.
2. Fetch the first element from the memory location and load it in the accumulator.
3. Initialize a counter (register) with the total number of elements in an array.
4. Decrement the counter by 1.
5. Increment the memory pointer to point to the next element.
6. Compare the accumulator content with the memory content (next element).
7. If the accumulator content is smaller, then move the memory content (largest element) to the accumulator. Else continue.
8. Decrement the counter by 1.
9. Repeat steps 5 to 8 until the counter reaches zero
10. Store the result (accumulator content) in the specified memory location.

PROGRAM:

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENTS
4100			LXI	H,4200	Initialize HL reg. to 8100H
4101					
4102					
4103			MVI	B,04	Initialize B reg with no. of comparisons(n-1)
4104					
4105			MOV	A,M	Transfer first data to acc.
4106		LOOP1	INX	H	Increment HL reg. to point next memory location
4107			CMP	M	Compare M & A
4108			JC	LOOP	If A is lesser than M then go to loop
4109					
410A					
410B			MOV	A,M	Transfer data from M to A reg
410C		LOOP	DCR	B	Decrement B reg
410D			JNZ	LOOP1	If B is not Zero go to loop1
410E					
410F					
4110			STA	4205	Store the result in a memory location.
4111					
4112					
4113			HLT		Stop the program

OBSERVATION:

INPUT		OUTPUT	
ADDRESS	DATA	ADDRESS	DATA
4200		4205	
4201			
4202			
4203			
4204			

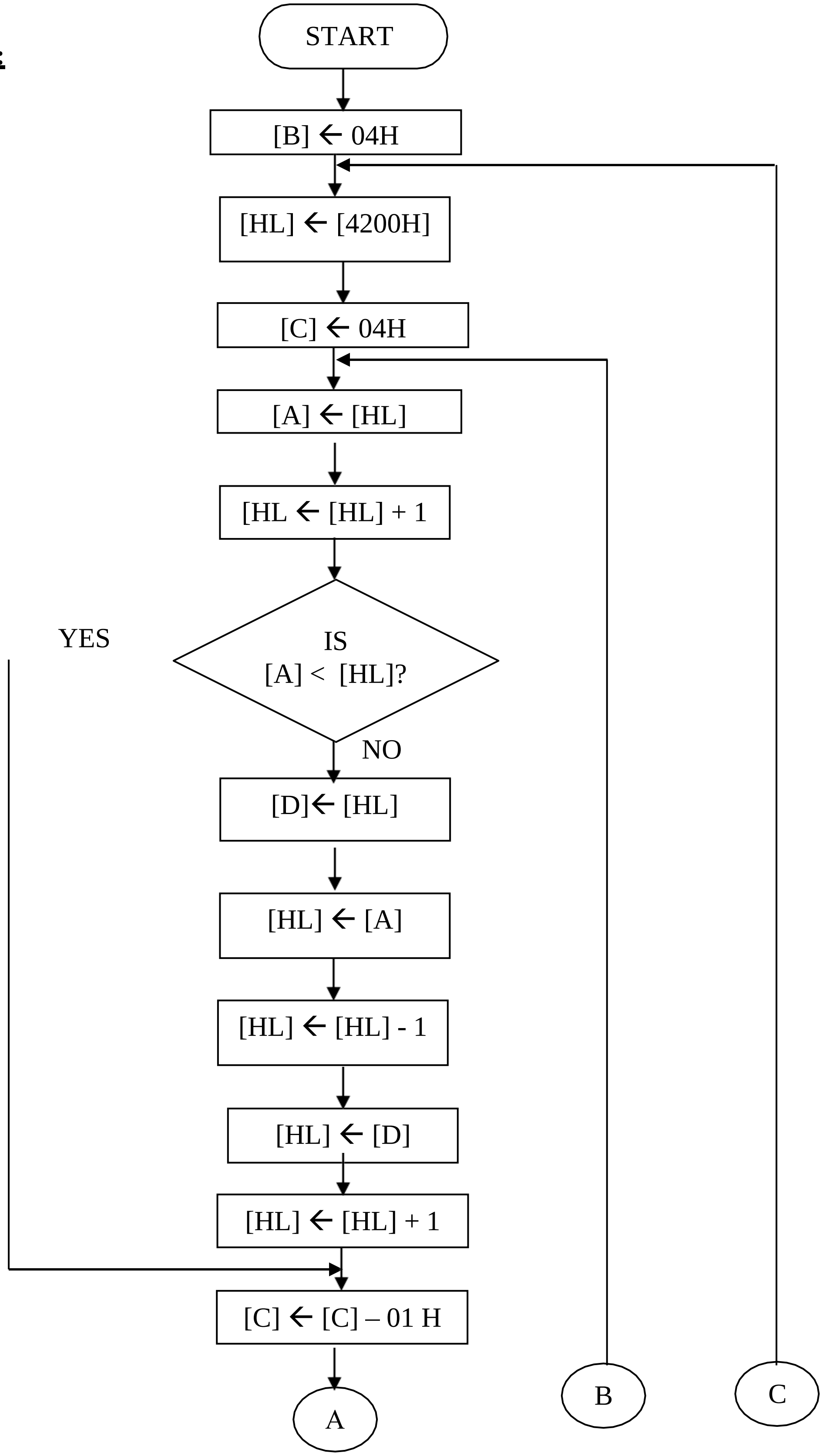
RESULT:

Thus the smallest number in the given array is found and it is stored at location 4205.

VIVA QUESTION:

1. What is meant by instruction JC ?
2. Tell about the instruction SHLD .
3. Summarize the instruction STAX B.
4. State the logic behind the finding of smallest element .
5. Why address bus is unidirectional?
6. List few instructions to clear accumulator?
7. What is the function of NOP instruction?

FLOWCHART:


START
[B] ← 04H
[HL] ← [4200H]
[C] ← 04H
[A] ← [HL]
[HL ← [HL] + 1
IS
[A] < [HL]?
YES
NO
[D]← [HL]
[HL] ← [A]
[HL] ← [HL] - 1
[HL] ← [D]
[HL] ← [HL] + 1
[C] ← [C] – 01 H
A
B
C

3(A) ASCENDING ORDER

AIM:

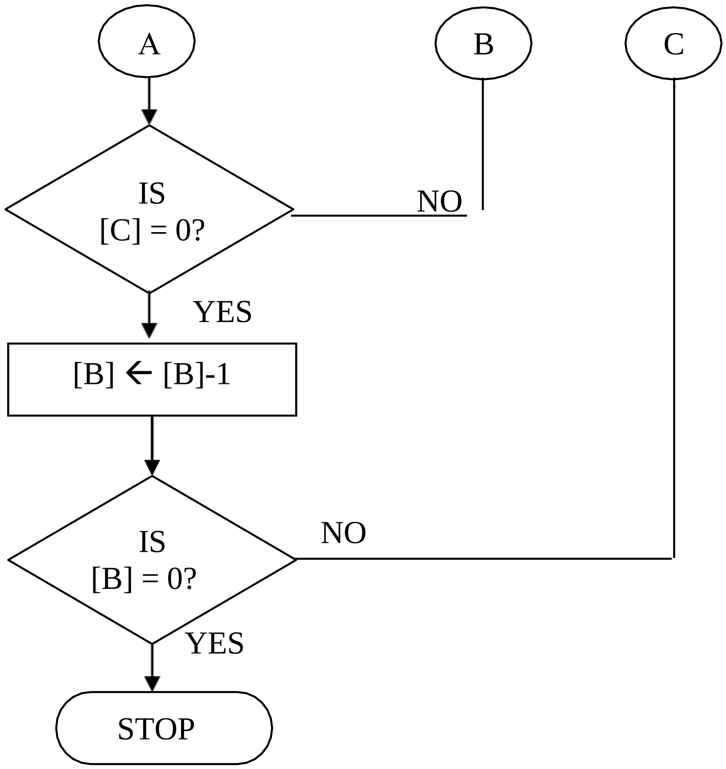
To sort the given numbers in the ascending order using 8085 microprocessor.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board

ALGORITHM:

1. Get the numbers to be sorted from the memory locations.
2. Compare the first two numbers and if the first number is larger than second then interchange the number.
3. If the first number is smaller, go to step 4
4. Repeat steps 2 and 3 until the numbers are in required order


A
B
C
IS
[C] = 0?
NO
YES
[B] ← [B]-1
IS
[B] = 0?
NO
YES
STOP

PROGRAM:

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENTS
4100			MVI	B,04	Initialize B reg with number of comparisons (n-1)
4101					
4102		LOOP 3	LXI	H,4200	Initialize HL reg. to 8100H
4103					
4104					
4105			MVI	C,04	Initialize C reg with no. of comparisons(n-1)
4106					
4107		LOOP2	MOV	A,M	Transfer first data to acc.
4108			INX	H	Increment HL reg. to point next memory location
4109			CMP	M	Compare M & A
410A			JC	LOOP1	If A is less than M then go to loop1
410B					
410C					
410D			MOV	D,M	Transfer data from M to D reg
410E			MOV	M,A	Transfer data from acc to M
410F			DCX	H	Decrement HL pair
4110			MOV	M,D	Transfer data from D to M
4111			INX	H	Increment HL pair
4112		LOOP1	DCR	C	Decrement C reg
4113			JNZ	LOOP2	If C is not zero go to loop2
4114					
4115					
4116			DCR	B	Decrement B reg
4117			JNZ	LOOP3	If B is not Zero go to loop3
4118					
4119					
411A			HLT		Stop the program

OBSERVATION:

INPUT		OUTPUT	
MEMORY LOCATION	DATA	MEMORY LOCATION	DATA
4200		4200	
4201		4201	
4202		4202	
4203		4203	
4204		4204	

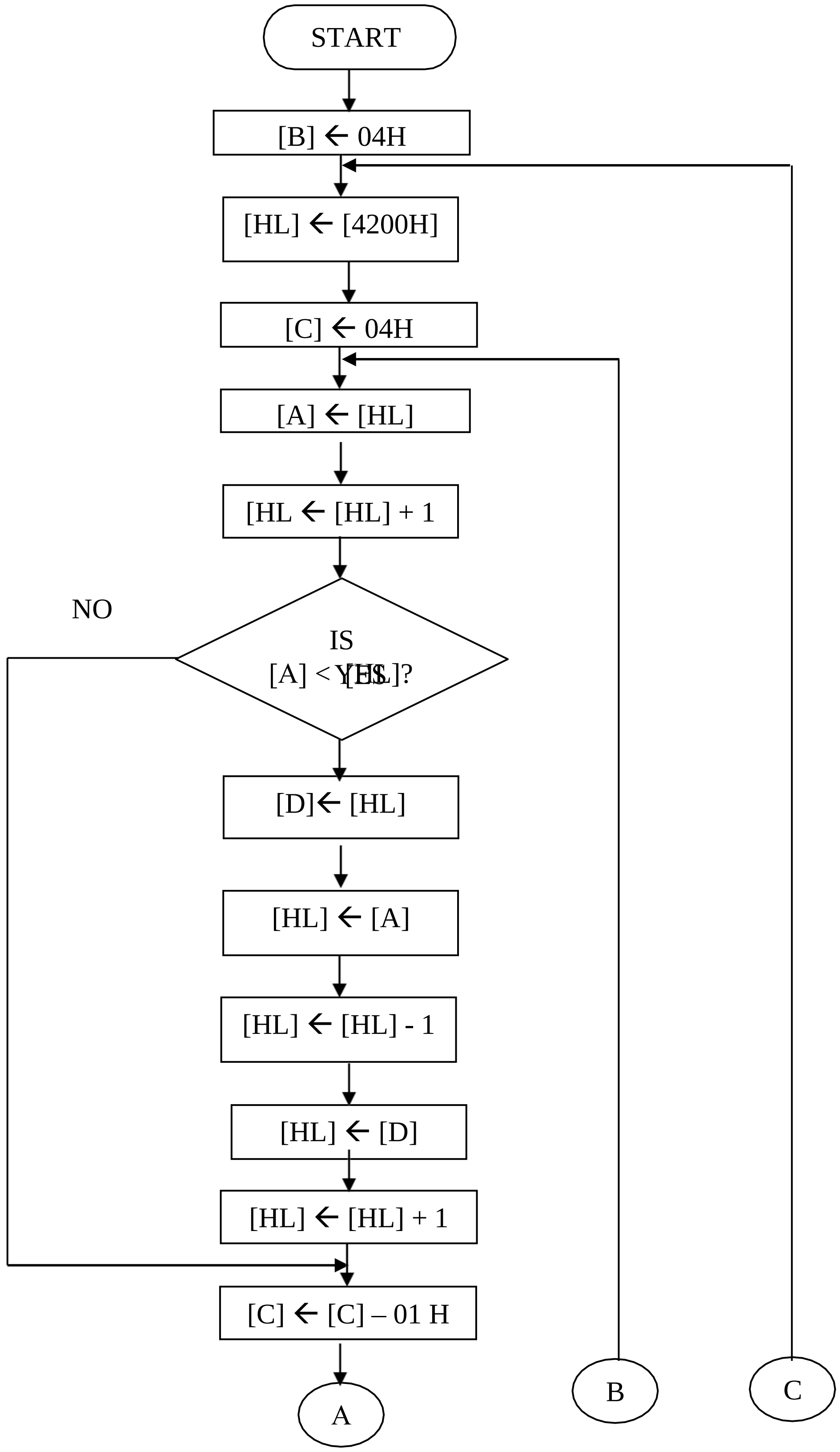
RESULT:

Thus the ascending order program is executed and the numbers are arranged in ascending order.

VIVA QUESTION:

1. Explain INX operation
2. State the logic behind the Sorting an array of data in Descending order
3. What are the advantages of using memory segmentation 8085?
4. What is the macro & when it is used?
5. What is the function of direction flag?
6. What is DMA?
7. Define machine cycle and instruction cycle?

FLOWCHART:


START
[B] ← 04H
[HL] ← [4200H]
[C] ← 04H
[A] ← [HL]
[HL ← [HL] + 1
NO
IS
[A] < [HL]?
YES
[D]← [HL]
[HL] ← [A]
[HL] ← [HL] - 1
[HL] ← [D]
[HL] ← [HL] + 1
[C] ← [C] – 01 H
A
B
C

3(B) DESCENDING ORDER

AIM:

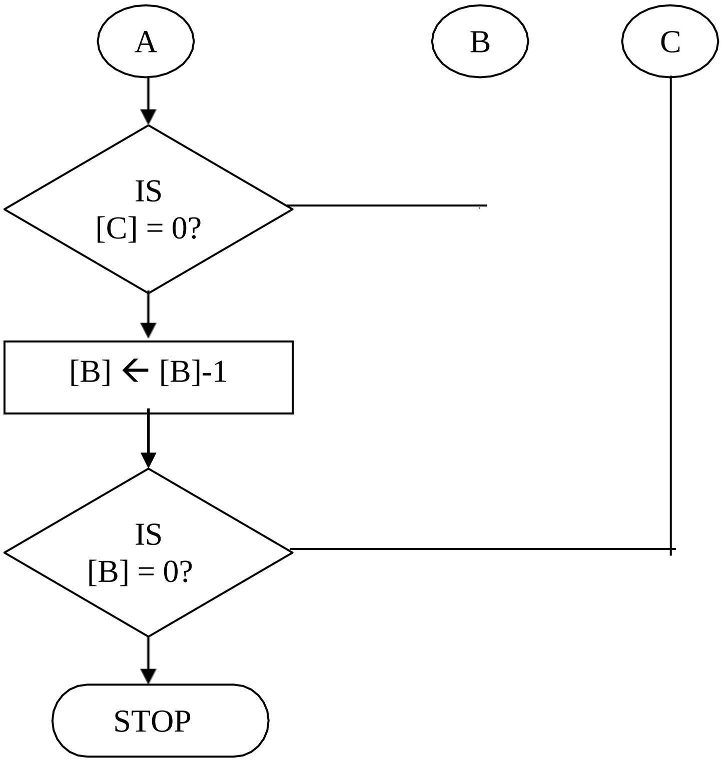
To sort the given numbers in the descending order using 8085 microprocessor.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board

ALGORITHM:

1. Get the numbers to be sorted from the memory locations.
2. Compare the first two numbers and if the first number is smaller than second then interchange the number.
3. If the first number is larger, go to step 4
4. Repeat steps 2 and 3 until the numbers are in required order


A
B
C
IS
[C] = 0?
[B] ← [B]-1
IS
[B] = 0?
STOP

PROGRAM:

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENTS
4100			MVI	B,04	Initialize B reg with number of comparisons (n-1)
4101					
4102		LOOP 3	LXI	H,4200	Initialize HL reg. to 8100H
4103					
4104					
4105			MVI	C,04	Initialize C reg with no. of comparisons(n-1)
4106					
4107		LOOP2	MOV	A,M	Transfer first data to acc.
4108			INX	H	Increment HL reg. to point next memory location
4109			CMP	M	Compare M & A
410A			JNC	LOOP1	If A is greater than M then go toloop1
410B					
410C					
410D			MOV	D,M	Transfer data from M to D reg
410E			MOV	M,A	Transfer data from acc to M
410F			DCX	H	Decrement HL pair
4110			MOV	M,D	Transfer data from D to M
4111			INX	H	Increment HL pair
4112		LOOP1	DCR	C	Decrement C reg
4113			JNZ	LOOP2	If C is not zero go to loop2
4114					
4115					
4116			DCR	B	Decrement B reg
4117			JNZ	LOOP3	If B is not Zero go to loop3
4118					
4119					
411A			HLT		Stop the program

OBSERVATION:

INPUT		OUTPUT	
MEMORY LOCATION	DATA	MEMORY LOCATION	DATA
4200		4200	
4201		4201	
4202		4202	
4203		4203	
4204		4204	

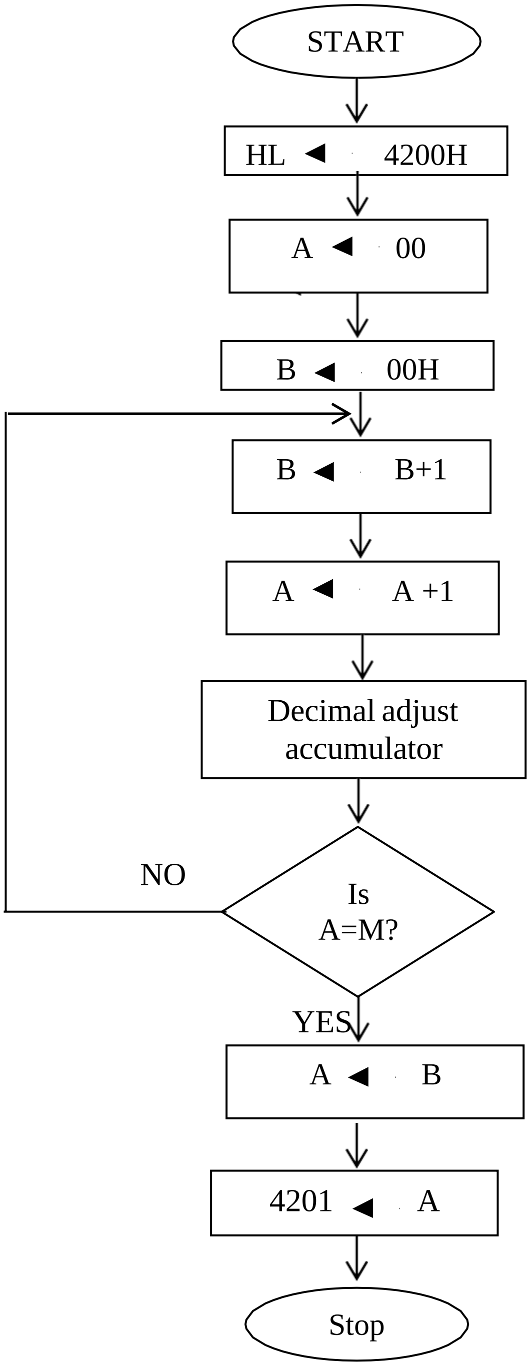
RESULT:

Thus the descending order program is executed and the numbers are arranged in descending order.

VIVA QUESTION:

1. Give out the purpose of the instruction DCX
2. What is meant by CALL instruction?
3. Briefly give out the LHLD instruction
4. State the logic behind the Sorting an array of data in Descending order
5. Name the various flag bits available in 8085 microprocessor?
6. Give the significance of SIM and RIM instructions available in 8085?
7. How do the address and data lines are demultiplexed in 8085?

FLOWCHART:


START
HL ◄ 4200H
A ◄ 00
B ◄ 00H
B ◄ B+1
A ◄ A +1
Decimal adjust accumulator
Is A=M?
NO
YES
A ◄ B
4201 ◄ A
Stop

4(A) CODE CONVERSION - DECIMAL TO HEXADECIMAL

AIM:

To convert a given decimal number to hexadecimal number.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board

ALGORITHM:

1. Initialize the memory location to the data pointer.
2. Increment B register.
3. Increment accumulator by 1 and adjust it to decimal every time.
4. Compare the given decimal number with accumulator value.
5. When both matches, the equivalent hexadecimal value is in B register.
6. Store the resultant in memory location.

PROGRAM:

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENTS
4100			LXI	H,4200	Initialize HL reg. to 4200H
4101					
4102					
4103			MVI	A,00	Initialize A register.
4104					
4105			MVI	B,00	Initialize B register..
4106					
4107		LOOP	INR	B	Increment B reg.
4108			ADI	01	Increment A reg
4109					
410A			DAA		Decimal Adjust Accumulator
410B			CMP	M	Compare M & A
410C			JNZ	LOOP	If acc and given number are not equal, then go to LOOP
410D					
410E					
410F			MOV	A,B	Transfer B reg to acc.
4110			STA	4201	Store the result in a memory location.
4111					
4112					
4113			HLT		Stop the program

OBSERVATION:

INPUT		OUTPUT	
ADDRESS	DATA	ADDRESS	DATA
4200		4201	

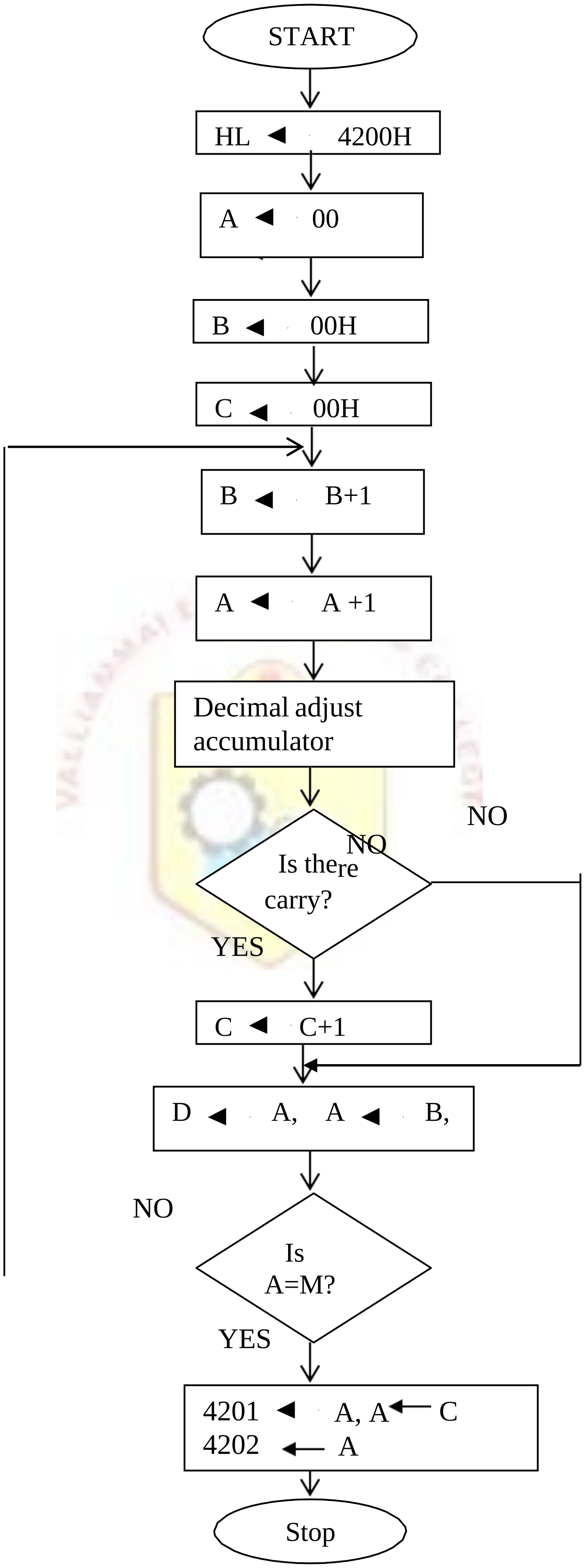
RESULT:

Thus an ALP program for conversion of decimal to hexadecimal was written and executed.

VIVA QUESTION:

1. What is meant by ADI instruction?
2. What is the function of DAA instruction?
3. What is the function of XCHG instruction?
4. How you can load 16-bit data in 8500H and 8501H memory locations?
5. What is the difference between LHLD and SHLD instructions?
6. What is physical address?
7. Define OFFSET address.

FLOWCHART:


START
HL ◄ 4200H
A ◄ 00
B ◄ 00H
C ◄ 00H
B ◄ B+1
A ◄ A +1
Decimal adjust accumulator
NO
NO
Is there carry?
YES
C ◄ C+1
D ◄ A, A ◄ B,
NO
Is A=M?
YES
4201 ◄ A, A← C
4202 ← A
Stop

4(B) CODE CONVERSION - HEXADECIMAL TO DECIMAL

AIM:

To convert a given hexadecimal number to decimal number and also to verify the result.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board.

ALGORITHM:

1. Initialize the memory location to the data pointer.
2. Increment B register.
3. Increment accumulator by 1 and adjust it to decimal every time.
4. Compare the given hexadecimal number with B register value.
5. When both match, the equivalent decimal value is in A register.
6. Store the resultant in memory location.

PROGRAM:

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENTS
4100			LXI	H,4200	Initialize HL reg. to 8100H
4103			MVI	A,00	Initialize A register.
4105			MVI	B,00	Initialize B register.
4106					
4107			MVI	C,00	Initialize C register for carry.
4108					
4109		LOOP	INR	B	Increment B reg.
410A			ADI	01	Increment A reg
410B					
410C			DAA		Decimal Adjust Accumulator
410D			JNC	NEXT	If there is no carry go to NEXT.
4110			INR	C	Increment c register.
4111		NEXT	MOV	D,A	Transfer A to D
4112			MOV	A,B	Transfer B to A
4113			CMP	M	Compare M & A
4114			MOV	A,D	Transfer D to A
4115			JNZ	LOOP	If acc and given number are not equal, then go to LOOP
4118			STA	4201	Store the result in a memory location.
411B			MOV	A,C	Transfer C to A
411C			STA	4202	Store the carry in another memory location.
411F			HLT		Stop the program

OBSERVATION:

INPUT		OUTPUT	
ADDRESS	DATA	ADDRESS	DATA
4200		4201	
		4202	

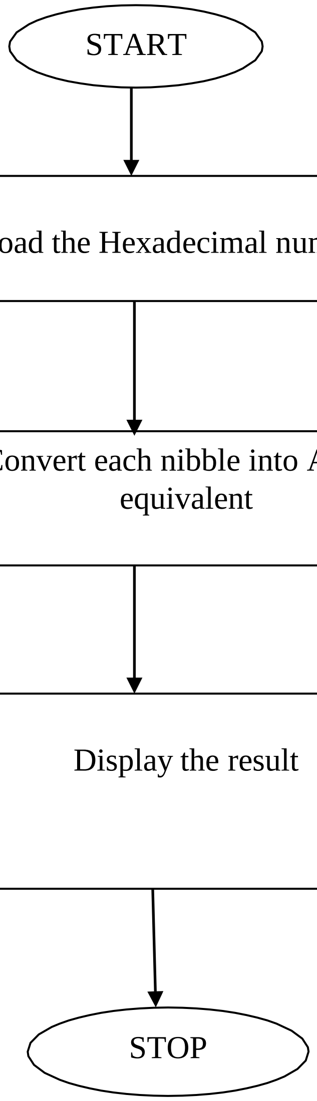
RESULT:

Thus an ALP program for conversion of hexadecimal to decimal was executed and the result is verified.

VIVA QUESTIONS:

1. What is meant by instruction DAA ?
2. Why data bus is bi-directional?
3. Specifies the function of address bus and the direction of address bus?
4. How many memory location can be addressed by a microprocessor with the 14 address lines?
5. List various instructions that can be used to clear accumulator in 8085?
6. When the Ready signal of 8085 is sampled by the processor?
7. List out the similarities b/w the CALL_RET and PUSH_POP instructions?

FLOWCHART:


START
Load the Hexadecimal number
Convert each nibble into ASCII equivalent
Display the result
STOP

4(C). CODE CONVERSION –HEXADECIMAL TO ASCII

Aim

To write an assembly language program to covert the given Hexadecimal number into its ASCII equivalent and to verify the result.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board.

Algorithm:

Step 1: Load the Hexadecimal number from the location

Step 2: Separate the nibbles

Step 3: Convert each nibble to its ASCII Equivalent.

Step 4: Add the two converted values

Step 5: Display the result

Step 6: Stop

PROGRAM:

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENTS
4100			LDA	4200	Get the data
4101					
4102					
4103			MOV	B,A	
4104			ANI	OF	Mask upper nibble
4105					
4106			CALL	SUB	Get ASCII code for upper nibble
4107					
4108					
4109			STA	4201	Store the value of accumulator
410A					
410B					
410C			MOV	A,B	Mov B reg content to Acc
410D			ANI	F0	Mask lower nibble
410E					
410F			RLC		Rotate left with out carry 4 times
4110			RLC		
4111			RLC		
4112			RLC		
4113			CALL	SUB	Get the ASCII code
4114					
4115					
4116			STA	4202	Store the accumulator
4117					
4118					
4119			HLT		Stop
411A		SUB	CPI	0A	Compare with OA
411B					
411C			JC	SKP	Skip if carry
411D					
411E					
411F			ADI	07	Add 07 to Acc
4120					
4121		SKP	ADI	30	Add 30 to Acc
4122					
4123			RET		Return

OBSERVATION:

INPUT		OUTPUT	
ADDRESS	DATA	ADDRESS	DATA
4200		4201	
		4202	

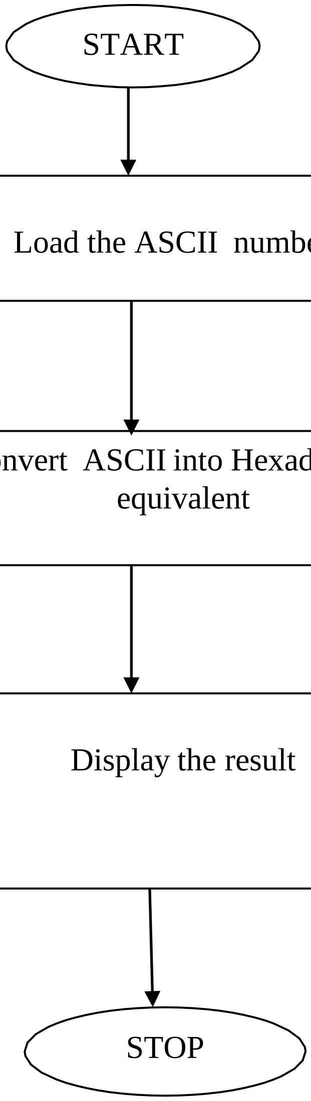
Result :

Thus assembly language program to covert the given Hexadecimal number into its ASCII equivalent is completed and also the result is verified.

VIVA QUESTIONS:

1. What is ASCII number for OAH?
2. What is difference between byte and word?
3. What is the immediate addressing mode?
4. What are data transfer instructions?
5. What is the use of immediate addressing mode?
6. What are branching instructions?
7. What is DMA ?

FLOW CHART:


START
Load the ASCII number
Convert ASCII into Hexadecimal equivalent
Display the result
STOP

4(D). CODE CONVERSION –ASCII TO HEXADECIMAL

AIM :

To write an assembly language program to covert the given ASCII number into its Hexadecimal equivalent and to verify the result.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board.

ALGORITHM:

Step 1: Load the ASCII number from the location

Step 2: Check for the digit or alphabet

Step 3: Using suitable logic and instructions convert the ASCIII number into Hexadecimal

Step 4: Add the two converted values

Step 5: Display the result

Step 6: Stop

PROGRAM:

ADDRESS	OPCODE	LABEL	MNEMONICS	OPERAND	COMMENTS
4100			LDA	4500	Load the memory content to Accumulator
4102					
4102					
4103			SUI	30	Subtract with 30
4104					
4105			CPI	0A	Compare with OA
4106					
4107			JC	SKP	If carry skip
4108					
4109					
410A			SUI	07	Subtract with 07
410B					
410C		SKP	STA	4201	Store Accumulator content
410D					
410E					
410F			HLT		Stop

OBSERVATION:

INPUT		OUTPUT	
ADDRESS	DATA	ADDRESS	DATA
4200		4201	

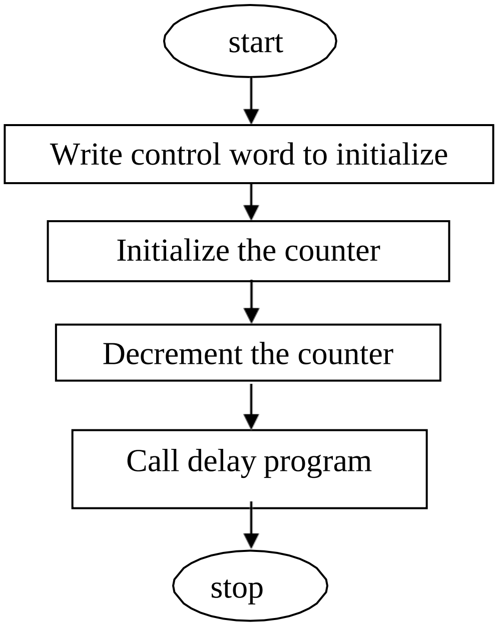
Result :

Thus assembly language program to covert the given ASCII number into its Hexadecimal equivalent is completed and also the result is verified.

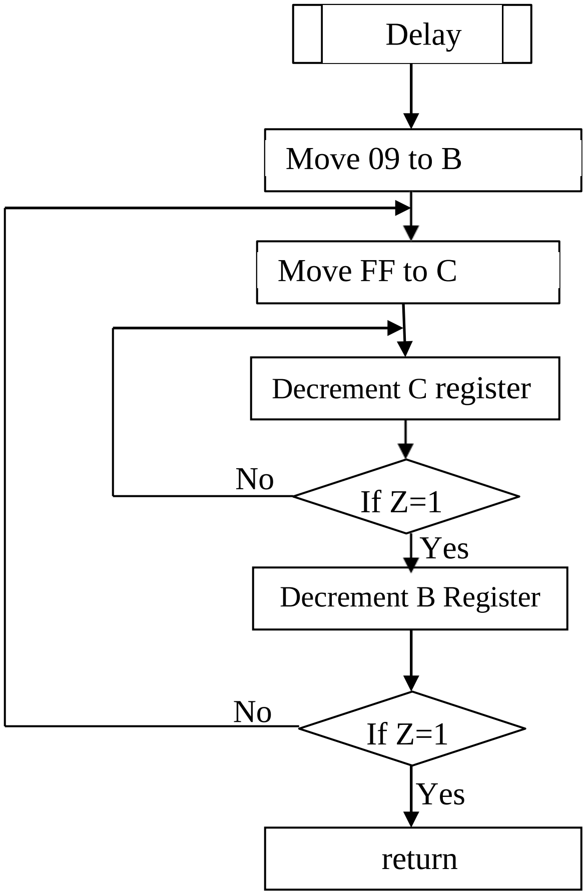
VIVA QUESTIONS:

1. What is the Hexadecimal for $(35)_{\text{ASCII}}$?
2. What is the purpose of branch instructions in 8085 microprocessor?
3. Define one’s complement of an 8-bit numbers
4. What is the function of CMA instruction?
5. What is the logic behind the conversion of ASCII number into Hexadecimal number.
6. Give example for Machine control instruction?
7. What is the need of code conversion?

LOW CHART:



Delay Subroutine:



5 . TRAFFIC LIGHT CONTROLLER - INTERFACING PPI 8255 WITH 8085

AIM:

To design traffic light controller using 8085 microprocessor through programmable peripheral interface 8255.

APPARATUS REQUIRED:

8085 μp kit, 8255 Interface board, DC regulated power supply, VXT parallel bus, Traffic light controller interface board.

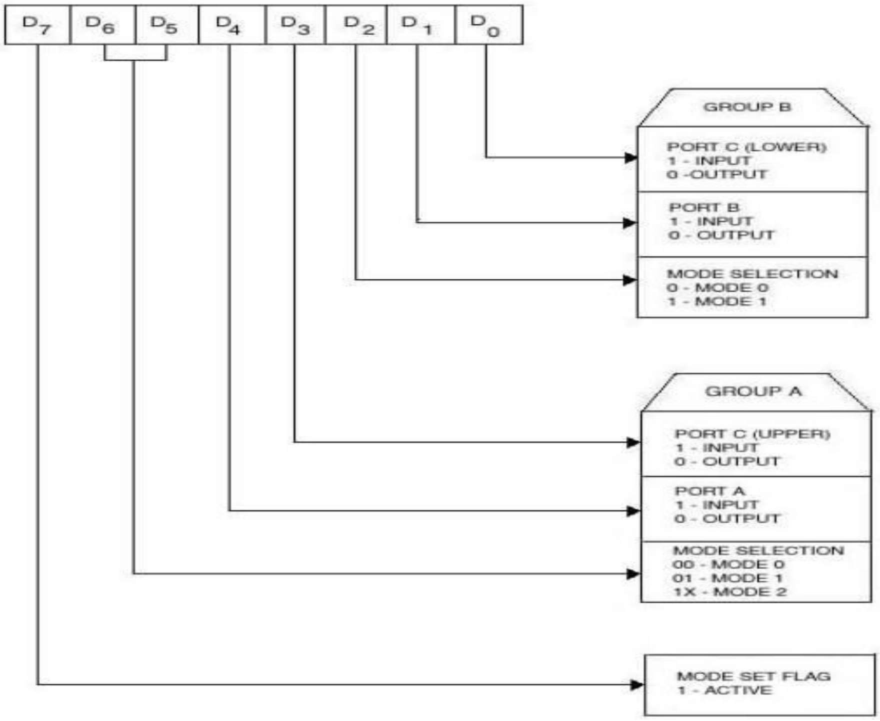
I/O MODES:

MODE 0 – SIMPLE I/O MODE:

This mode provides simple I/O operations for each of the three ports and is suitable for synchronous data transfer. In this mode all the ports can be configured either as input or output port.

Let us initialize port A as input port and port B as output port

Control Word:



PROGRAM:

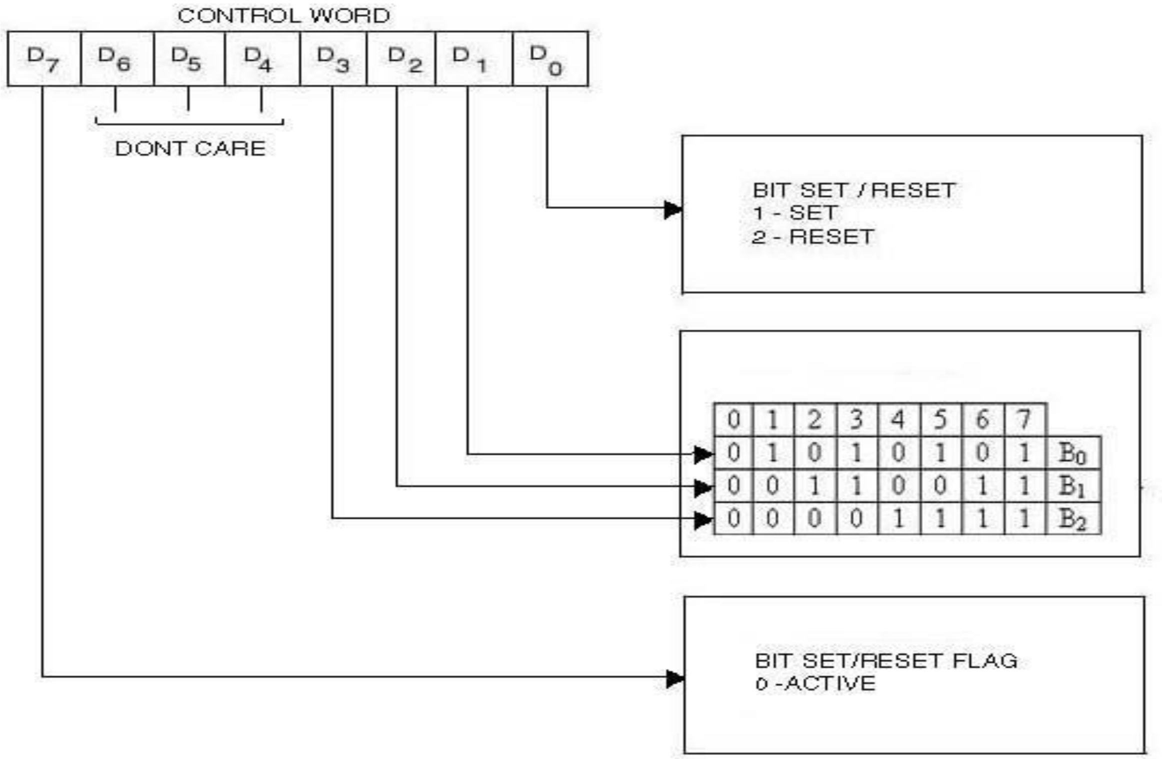
ADDRESS	OPCODES	LABEL	MNEMONICS	OPERAND	COMMENTS
4100			LXI	H, Data	Load the data in HL register pair
4103			MVI	C,04	Move 04 to c register
4105			MOV	A,M	Move M to A
4106			OUT	CNT	Out tocontrol register
4108			INX	H	Increment HL register pair
4109		LOOP1	MOV	A,M	Move M to A
410A			OUT	CPRT	Send control status word
410C			INX	H	Increment h register
410D			MOV	A,M	Move M to A
410E			OUT	BPRT	Send control status word
4110			INX	H	Increment h register
4111			MOV	A,M	Move M to A
4112			OUT	APRT	Send control status word
4114			CALL	DELAY	Call subroutine
4117			INX	H	Increment h register
4118			DCR	C	Decrement C register
4119			JNZ	LOOP1	Jump on nozero to loop1
411C			JMP	START	Jump to start
411F		DELAY	PUSH	B	
4120			MVI	C.0D	Move OD to C register
4122		LOOP3	LXI	D,FF,FF	Load Dregister with FF
4125		LOOP2	DCX	D	Decrement Dregister
4126			MOV	A,D	Move D contents to A register
4127			ORA	E	OR the content of A with E
4128			JNZ	LOOP2	Jump on nozero to loop2
412C			JNZ	LOOP3	Jump on nozero to loop3
412F			POP	B	Do pop operation
4130			RET		Return to main program

MODE 1 STROBED I/O MODE:

In this mode, port A and port B are used as data ports and port C is used as control signals for strobed I/O data transfer.

Let us initialize port A as input port in mode1

BSR MODE (Bit Set Reset mode



0	1	2	3	4	5	6	7	
0	1	0	1	0	1	0	1	B_0
0	0	1	1	0	0	1	1	B_1
0	0	0	0	1	1	1	1	B_2

Any lines of port c can be set or reset individually without affecting other lines using this mode. Let us set PC0 and PC3 bits using this mode.

ALGORITHM:-

1. Start.
2. Write the control word to initialize 8255.Obtain the data for each direction and store in the memory.
3. Initialize a counter to indicate the number of directions.
4. Initialize HL Pair to the starting address of the data..
5. Check the result.
6. Decrement the counter and repeat step 3 till counter becomes 0
7. Stop

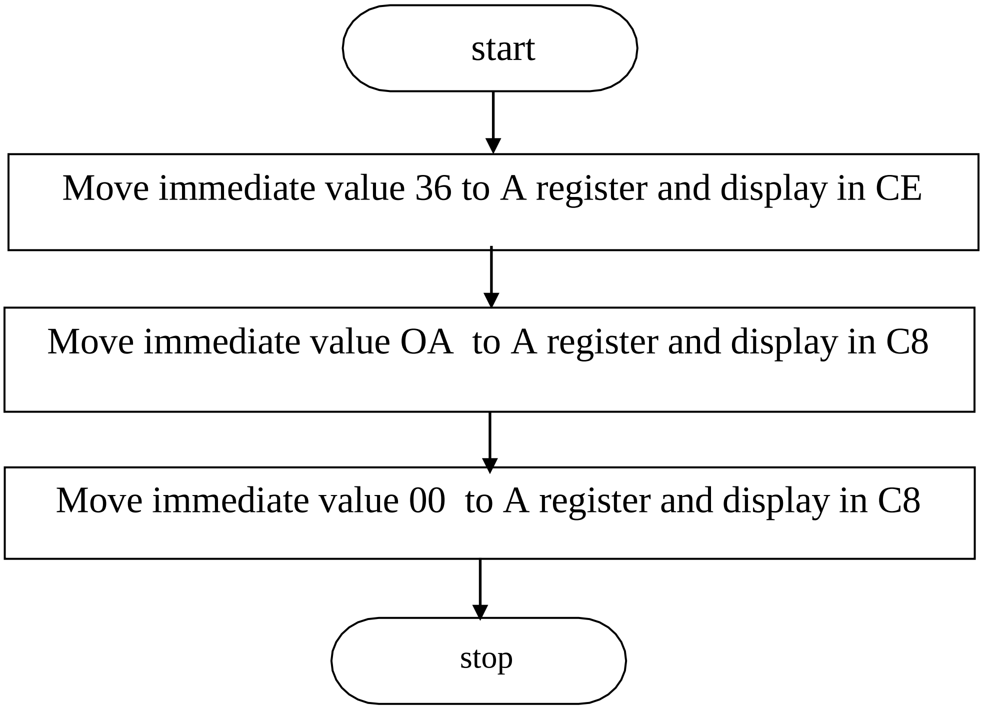
RESULT:

Thus the design of traffic light controller using 8085 microprocessor through programmable peripheral interface 8255is done and also the output is verified.

VIVA QUESTIONS:

1. When the 82C55 is reset, its I/O ports are all initializes as what?
2. If the programmable counter timer 8254 is set in mode 1 and is to be used to count six events, the output will remain at logic 0 for how many number of counts ?
3. The devices that provide the means for a computer to communicate with the user or other computers are referred to as:
4. What is the maximum number of I\o devices which can be interfaced in the memory mapped I\O technique?
5. Interaction between a CPU and a peripheral device that takes place during and input output operation is known as what?
6. What is the other name for Programmable peripheral input-output port?
7. All the functions of the ports of 8255 are achieved by programming the bits of an internal register called what?
8. What is the port that is used for the generation of handshake lines in mode 1 or mode 2 ?
9. What is the pin that clears the control word register of 8255 when enabled?
10. In 8255 if A1=0, A0=1 then the input read cycle is performed from where?

FLOW CHART:


start
Move immediate value 36 to A register and display in CE
Move immediate value OA to A register and display in C8
Move immediate value 00 to A register and display in C8
stop

Mode 0 – Interrupt on terminal count:

Program:

Address	Opcodes	Label	Mnemonic	Operands	Comments
4100		START:	MVI	A, 36	Channel 0 in mode 0
4102			OUT	CE	Send Mode Control word
4104			MVI	A, 0A	LSB of count
4106			OUT	C8	Write count to register
4108			MVI	A, 00	MSB of count
410A			OUT	C8	Write count to register
410C			HLT		

Mode 1 – Programmable ONE-SHOT:
Program:

Address	Opcodes	Label	Mnemonic	Operands	Comments
4100		START:	MVI	A, 32	Channel 0 in mode 1
4102			OUT	CE	Send Mode Control word
4104			MVI	A, 05	LSB of count
4106			OUT	C8	Write count to register
4108			MVI	A, 00	MSB of count
410A			OUT	C8	Write count to register
410C			OUT	D0	Trigger Gate0
4100			HLT		

6. INTERFACING 8253 TIMER WITH 8085

AIM:

To interface 8253 Interface board to 8085 μp and verify the operation of 8253 in six different modes.

APPARATUS REQUIRED:

8085 μp kit, 8253 Interface board, DC regulated power supply, VXT parallel bus, CRO.

Mode 0 – Interrupt on terminal count:

The output will be initially low after mode set operations. After loading the counter, the output will be remaining low while counting and on terminal count; the output will become high, until reloaded again.

Let us set the channel 0 in mode 0. Connect the CLK 0 to the debounce circuit by changing the jumper J3 and then execute the following program.
It is observed in CRO that the output of Channel 0 is initially LOW. After giving six clock pulses, the output goes HIGH.

Mode 1 – Programmable ONE-SHOT:

After loading the counter, the output will remain low following the rising edge of the gate input. The output will go high on the terminal count. It is retriggerable; hence the output will remain low for the full count, after any rising edge of the gate input.

Example:

The following program initializes channel 0 of 8253 in Mode 1 and also initiates triggering of Gate 0. OUT 0 goes low, as clock pulse after triggering the goes back to high level after 5 clock pulses. Execute the program, give clock pulses through the debounce logic and verify using CRO.

Mode 2 – Rate Generator:

It is a simple divide by N counter. The output will be low for one period of the input clock. The period from one output pulse to the next equals the number of input counts in the count register. If the count register is reloaded between output pulses the present period will not be affected but the subsequent period will reflect the new value

Example:

Using Mode 2, Let us divide the clock present at Channel 1 by 10. Connect the CLK1 to PCLK.

In CRO observe simultaneously the input clock to channel 1 and the output at Out1.

Mode 3 Square wave generator:

It is similar to Mode 2 except that the output will remain high until one half of count and go low for the other half for even number count. If the count is odd, the output will be high for (count + 1)/2 counts. This mode is used of generating Baud rate for 8251A (USART).

Example:

We utilize Mode 0 to generate a square wave of frequency 150 KHz at channel 0.

Mode 2 – Rate Generator:
Program:

Address	**Opcodes**	**Label**	**Mnemonic**	**Operands**	**Comments**
4100	3E 74	START:	MVI	A, 74	Channel 1 in mode 2
4102	D3 CE		OUT	CE	Send Mode Control word
4104	3E 0A		MVI	A, 0A	LSB of count
4106	D3 CA		OUT	CA	Write count to register
4108	3E 00		MVI	A, 00	MSB of count
410A	D3 CA		OUT	CA	Write count to register
410C	76		HLT		

Mode 3 Square wave generator:
Program:

Address	**Opcode**	**Label**	**Mnemonic**	**Operands**	**Comments**
4100	3E 36	START:	MVI	A, 36	Channel 0 in mode 3
4102	D3 CE		OUT	CE	Send Mode Control word
4104	3E 0A		MVI	A, 0A	LSB of count
4106	D3 C8		OUT	C8	Write count to register
4108	3E 00		MVI	A, 00	MSB of count
410A	D3 C8		OUT	C8	Write count to register
410C	76		HLT		

Mode 4: Software Triggered Strobe:
Program:

Address	**Opcode**	**Label**	**Mnemonic**	**Operands**	**Comments**
4100		START:	MVI	A, 36	Channel 0 in mode 0
4102			OUT	CE	Send Mode Control word
4104			MVI	A, 0A	LSB of count
4106			OUT	C8	Write count to register
4108			MVI	A, 00	MSB of count
410A			OUT	C8	Write count to register
410C			MVI	A, B8	Channel 2 in Mode 4
410E			OUT	CE	Send Mode control Word
4110			MVI	A, 98	LSB of Count
4112			OUT	CC	Write Count to register
4114			MVI	A, 3A	MSB of Count
4116			OUT	CC	Write Count to register
4118			HLT		

Set the jumper, so that the clock 0 of 8253 is given a square wave of frequency 1.5 MHz. This program divides this PCLK by 10 and thus the output at channel 0 is 150 KHz.

Vary the frequency by varying the count. Here the maximum count is FFFF H. So, the square wave will remain high for 7FFF H counts and remain low for 7FFF H counts. Thus with theinput clock frequency of 1.5 MHz, which corresponds to a period of 0.067 microseconds, the resulting square wave has an ON time of 0.02184 microseconds and an OFF time of 0.02184 microseconds.

To increase the time period of square wave, set the jumpers such that CLK2 of 8253 is connected to OUT 0. Using the above-mentioned program, output a square wave of frequency 150 KHz at channel 0. Now this is the clock to channel 2.

Mode 4: Software Triggered Strobe:

The output is high after mode is set and also during counting. On terminal count, the output will go low for one clock period and becomes high again. This mode can be used for interrupt generation.

The following program initializes channel 2 of 8253 in mode 4.

Example:

Connect OUT 0 to CLK 2 (jumper J1). Execute the program and observe the output OUT 2. Counter 2 will generate a pulse after 1 second.

Mode 5 Hardware triggered strobe:

Counter starts counting after rising edge of trigger input and output goes low for one clock period when terminal count is reached. The counter is retriggerable.

Example:

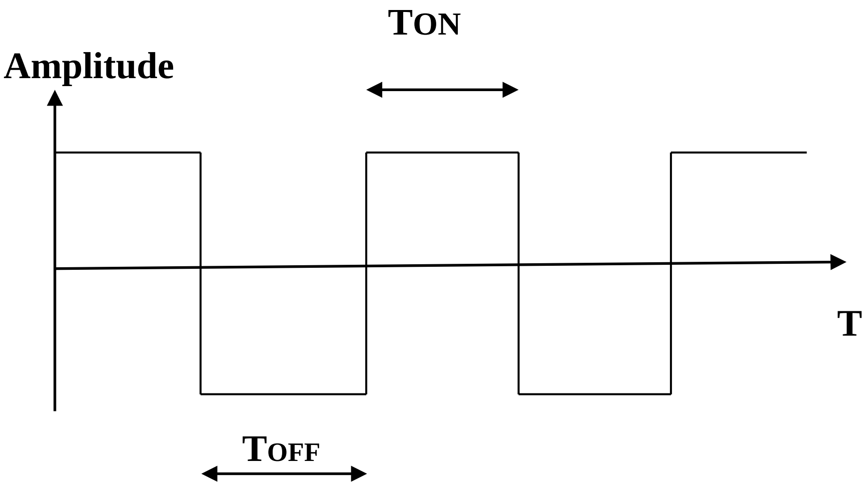
The program that follows initializes channel 0 in mode 5 and also triggers Gate 0. Connect CLK 0 to debounce circuit.

Execute the program. After giving Six clock pulses, you can see using CRO, the initially HIGH output goes LOW. The output (OUT 0 pin) goes high on the next clock pulse.

Mode 5 Hardware triggered strobe:
Program:

Address	Opcode	Label	Mnemonic	Operands	Comments
4100		START:	MVI	A, 1A	Channel 0 in mode 5
4102			OUT	CE	Send Mode Control word
4104			MVI	A, 05	LSB of count
4106			OUT	C8	Write count to register
4108			MVI	A, 00	MSB of count
410A			OUT	D0	Trigger Gate 0
410C			HLT		

OUTPUT:
SQUARE WAVE:



Observation:

TON:

TOFF:

T=TON+TOFF

FREQUENCY=1/T

RESULT:

Thus the 8253 has been interfaced to 8085 μp and six different modes of 8253 have been studied.

VIVA QUESTIONS:

1. If the crystal oscillator is operating at 15 MHz, what is the PCLK output of 8283 **?**

2. By what factor does the 8284A clock generator divide the crystal oscillator's output frequency ?

3. What is number of counters that are present in the programmable timer device 8254 ?

4**.** What is the operation that can be performed on control word register?

5**.** What is the mode that is used to interrupt the processor by setting a suitable terminal count?

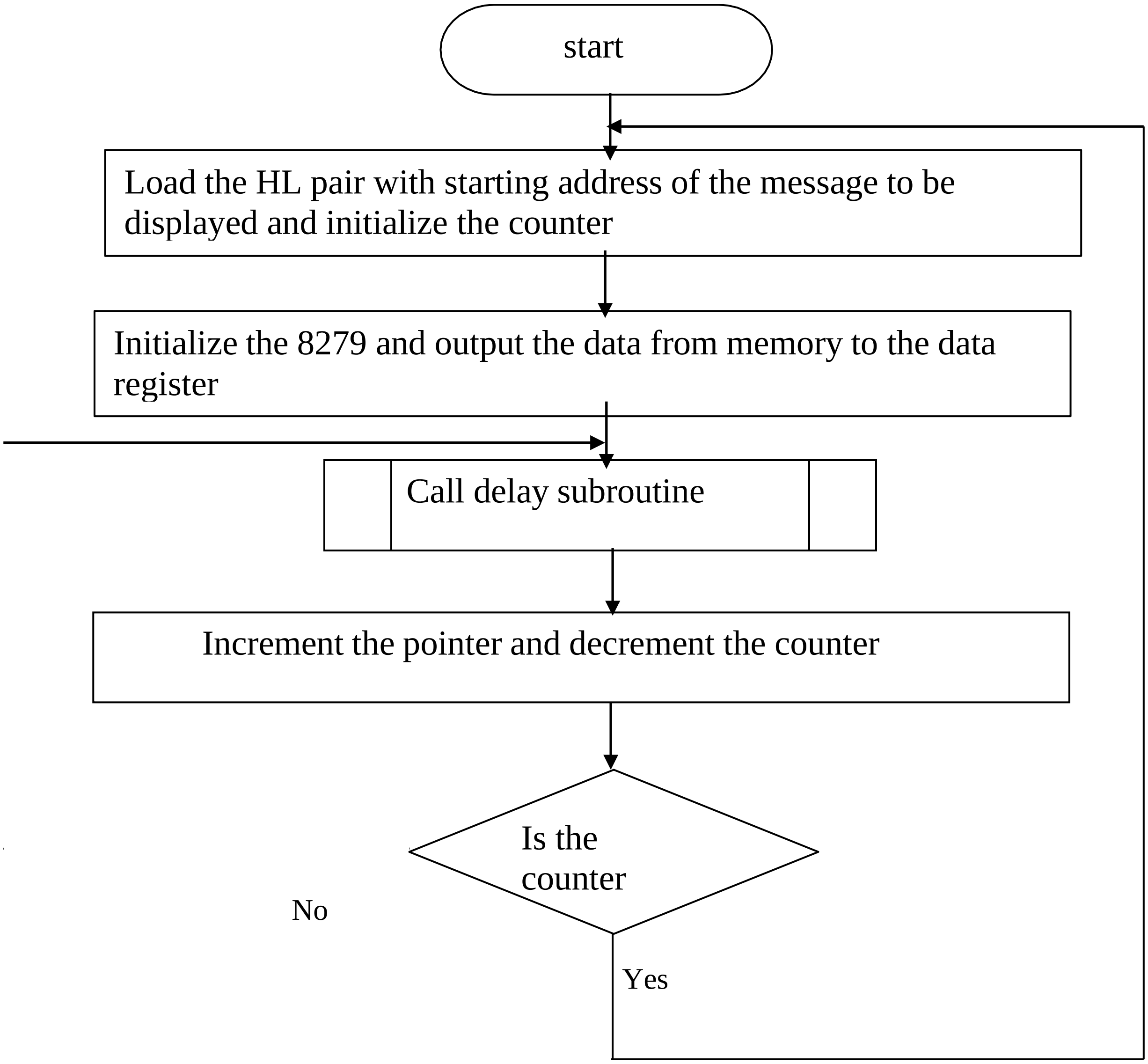
6**.** In mode 2, if N is loaded as the count value, then after (N-1) cycles, the output becomes low for how many cycles ?

7. In which mode the generation of square wave is possible ?

8. In control word register, if SC1=0 and SC0=1, then the counter selected is what?

9**.** In control word format, if RL1=1, RL0=1 then the operation performed is what?10.
If BCD=0, then the operation is what in 8253?

FLOW CHART:


start
Load the HL pair with starting address of the message to be displayed and initialize the counter
Initialize the 8279 and output the data from memory to the data register
Call delay subroutine
Increment the pointer and decrement the counter
Is the counter
No
Yes

7 INTERFACING 8279 – KEYBOARD / DISPLAY CONTROLLER WITH 8085 MICROPROCESSOR

AIM:

To write an assembly language program to interface keyboard and display controller IC 8279 with 8085 microprocessor.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board.and 8279 kit.

ALGORITHM:

1. Start
2. Initialize the accumulator.
3. Load the appropriate command words in control register.
4. Load the appropriate words for the characters to be displayed, in the accumulator in analog form.
5. Send the converted data to 8279 display.
6. Stop.

PROGRAM:

MEMORY	OPCODE	LABEL	MNEMONICS	COMMENTS
4100		JMP1	LXI H, 412C	Load pointer address to HL register
4103			MVI D,0F	Move look up table count value to D register
4105			MVI A,10	Set display mode to right entry
4107			OUT C2	Load control word into control register
4109			MVI A,CC	Clear Display RAM
410B			OUT C2	Load control word into control register
410D			MVI A,90	Read data to display memory
410F			OUT C2	Load control word into control register
4111		LOOP	MOV A,M	Move HL memory content to accumulator
4112			OUT C0	Move to LED segment register
4114			CALL DELAY	Move program control to 411F-delay loop
4117			INX H	Increment HL by one memory location
4118			DCR D	Decrement count value of look up table
4119			JNZ LOOP	Jump to 4111 till count value reaches zero
411C			JMP JMP1	Display the look up table values continually
411F		DELAY	MVI B, 0A	Load outer delay count value to B register
4121		JMP3	MVI C,FF	Load inner delay count value to C resister
4123		JMP2	DCR C	Decrement C register content
4124			JNZ JMP2	Jump to 4123 till count value reaches zero
4127			DCR B	Decrement B register content
4128			JNZ JMP3	Jump to 4121 till count value reaches zero
412B			RET	Return to main program

LOOK UP TABLE:

MEMORY	INPUT	MEMORY	INPUT
412C	FF	4134	FF
412D	FF	4135	98
412E	FF	4136	68
412F	FF	4137	7C
4130	FF	4138	C8
4131	FF	4139	FF
4132	FF	413A	FF
4133	FF	413B	FF

OUTPUT: HELP US

RESULT:

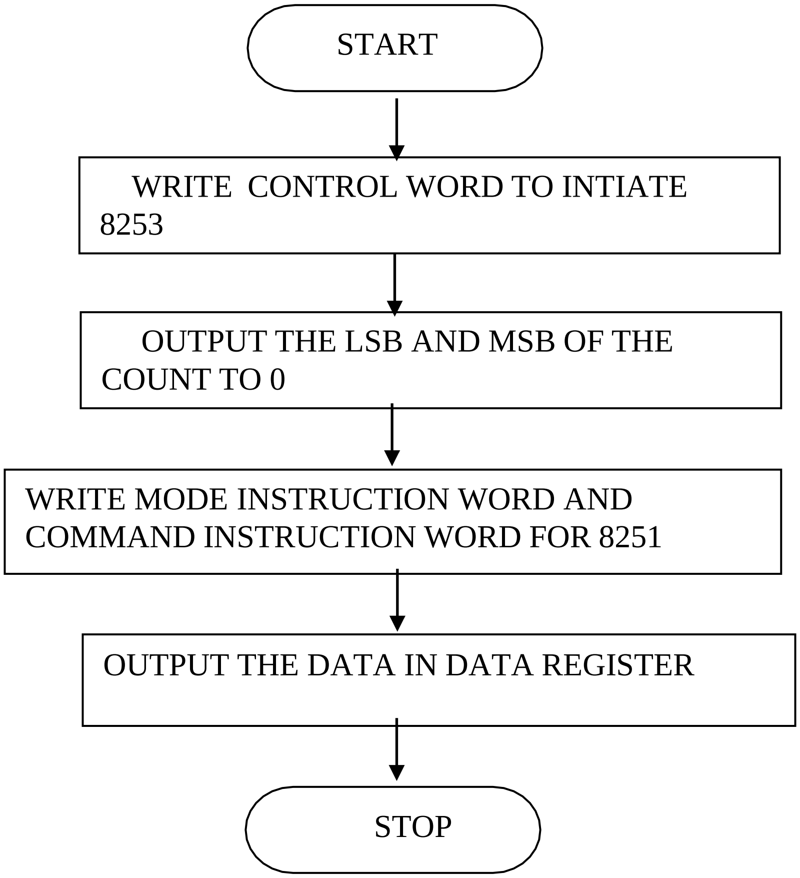
Thus an assembly language program for rolling display was written and is executed and verified by interfacing 8279 with 8085 microprocessor.

VIVA QUESTIONS:

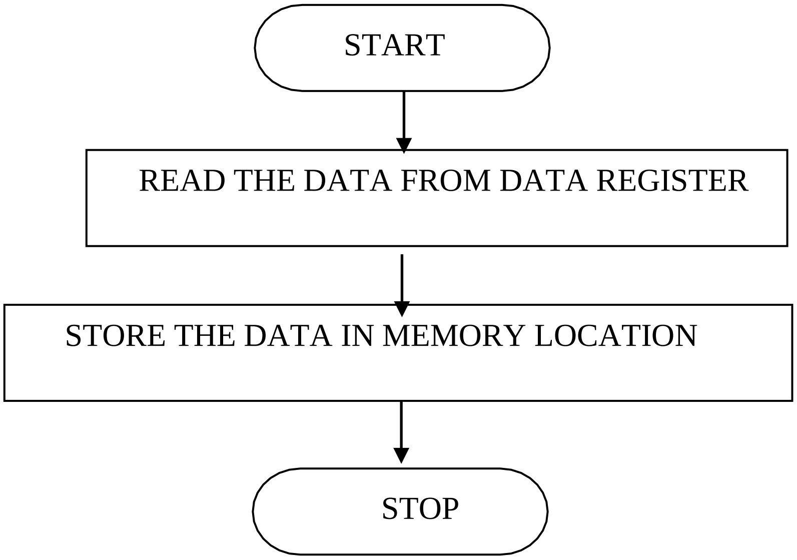
1. What are the registers that store the keyboard and display modes and operations programmed by CPU ?
2. The sensor RAM acts as 8-byte first-in-first-out RAM in which mode?
3. What are the registers that holds the address of the word currently being written by the CPU from the display RAM ?
4. When a key is pressed, a debounce logic comes into operation in ___________________
5. What is the mode that is programmed using “end interrupt/error mode set command” ?
6. When a key is pressed, the debounce circuit waits for 2 keyboard scans and then checks whether the key is still depressed in ___________________
7. In which mode the data that is entered from the left side of the display
8. The FIFO status word is used to indicate the error in which mode?
9. What is the flag that increments automatically after each read or write operation to the display RAM is

11. If any change in sensor value is detected at the end of a sensor matrix scan, then the IRQ line goes_______________

FLOW CHART-TRANSMITTER SIDE


START
WRITE CONTROL WORD TO INTIATE 8253
OUTPUT THE LSB AND MSB OF THE COUNT TO 0
WRITE MODE INSTRUCTION WORD AND COMMAND INSTRUCTION WORD FOR 8251
OUTPUT THE DATA IN DATA REGISTER
STOP

RECIEVER SIDE


START
READ THE DATA FROM DATA REGISTER
STORE THE DATA IN MEMORY LOCATION
STOP

8 INTERFACING 8251 USART TO 8085 MICROPROCESSOR

AIM

To write an assembly language program to interface 8251 with 8085 Microprocessor and to transmit and receive data serially through 8251.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board and8251 kit.

ALGORITHM

1. To Transmit Data serially, initialize a counter.
2. Load the 16-bit count in the counter.
3. Load the control word in 8251.
4. Send the data to 8251.
5. Halt.
6. To receive data serially, get the data from 8251.
7. Save the data in memory.
8. Halt

INTERFACING 8251 USART

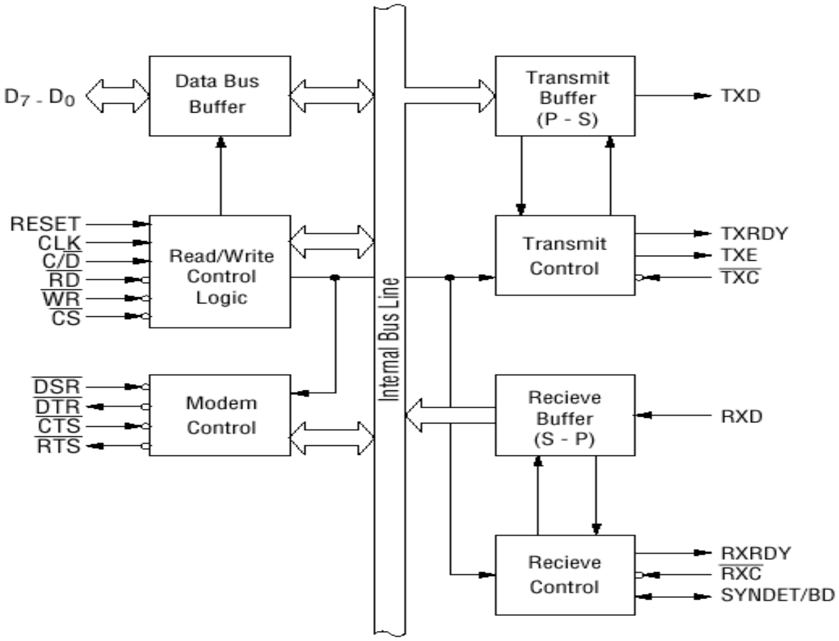


Fig.1 Block Diagram of 8251

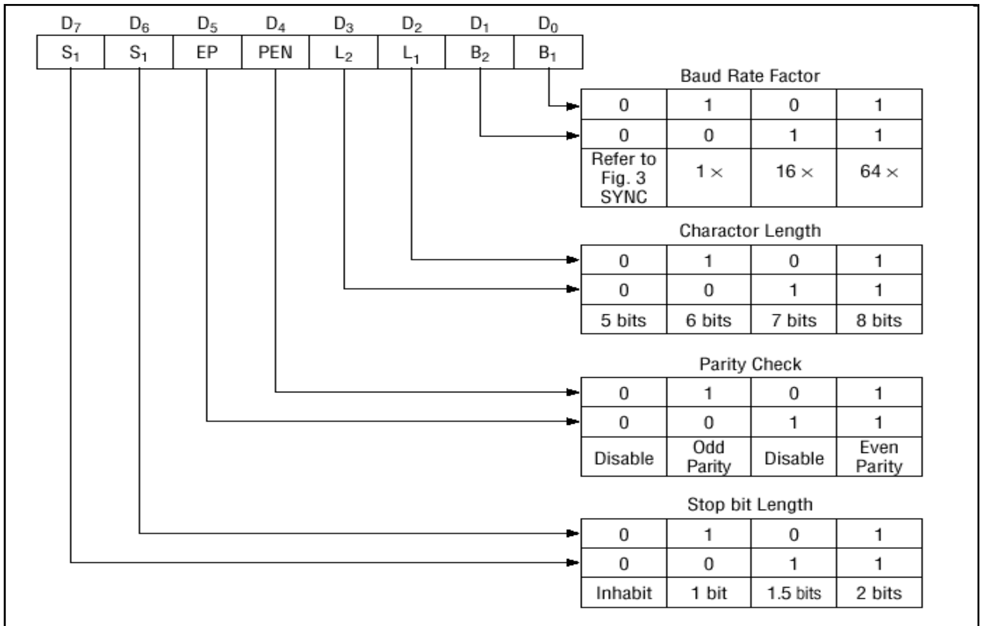
PROGRAM
Transmitter Side

MEMORY	OPCODE	MNEMONICS	COMMENTS
4100		MVI A,36H	Configure 8253 to count binary,mode3, read / load LSB first then MSB, counter 0
4102		OUT CE	Load control word to control register of 8253
4104		MVI A, 0AH	Move lower 8 bit count value to accumulator
4106		OUT C8H	Load count to channel 0 of 8253
4108		MVI A,00H	Move upper 8 bit count value to accumulator
410A		OUT C8H	Load count to counter 0 of 8253
410C		MVI A, 4E	Configure mode instruction of 8251
410E		OUT C2H	Load control word to control register of 8251
4110		MVI A,37	Configure command instruction of 8251
4112		OUT C2	Load control word to control register of 8251
4114		MVI A,41H	Move serial data to be transmitted
4116		OUT C0H	Load the serial data to data register
4118		HLT	Stop the process

Receiver Side

MEMORY	OPCODE	MNEMONICS	COMMENTS
4200		IN C0	Get the serial data from data register
4202		STA 4150	Store in 4150 memory location of 8085
4205		HLT	Stop the process

Bit Configuration of Mode Instruction-Asynchronous



D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
S_1	S_1	EP	PEN	L_2	L_1	B_2	B_1

Baud Rate Factor

0	1	0	1
0	0	1	1
Refer to Fig. 3 SYNC	1 ×	16 ×	64 ×

Charactor Length

0	1	0	1
0	0	1	1
5 bits	6 bits	7 bits	8 bits

Parity Check

0	1	0	1
0	0	1	1
Disable	Odd Parity	Disable	Even Parity

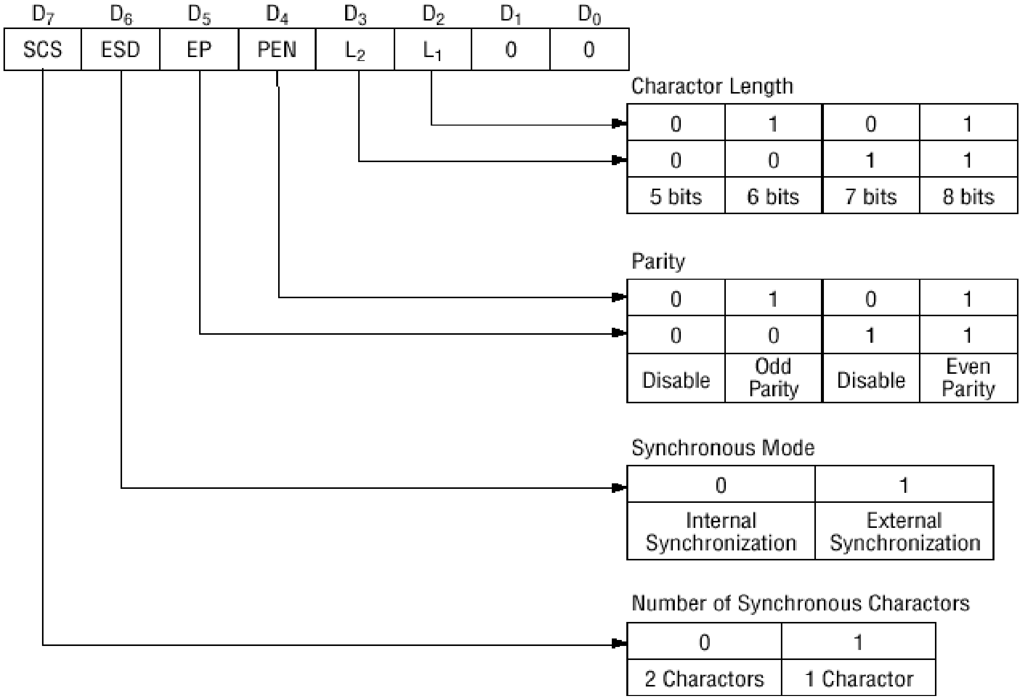
Stop bit Length

0	1	0	1
0	0	1	1
Inhabit	1 bit	1.5 bits	2 bits

Fig. 2 Bit Configuration of Mode Instruction (Asynchronous)

Bit Configuration of Mode Instruction -Synchronous

-



D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
SCS	ESD	EP	PEN	L_2	L_1	0	0

Charactor Length

0	1	0	1
0	0	1	1
5 bits	6 bits	7 bits	8 bits

Parity

0	1	0	1
0	0	1	1
Disable	Odd Parity	Disable	Even Parity

Synchronous Mode

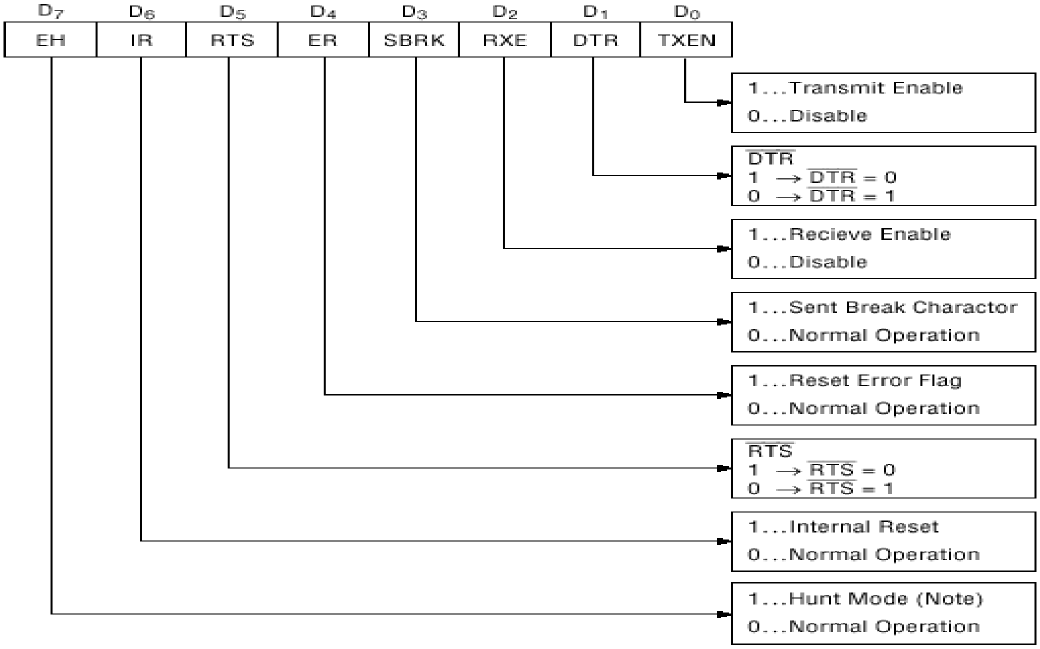
0	1
Internal Synchronization	External Synchronization

Number of Synchronous Charactors

0	1
2 Charactors	1 Charactor

Fig. 3 Bit Configuration of Mode Instruction (Synchronous)

Bit Configuration of Mode Instruction-Command



Note: Seach mode for synchronous charactors in synchronous mode.

Fig. 4 Bit Configuration of Command

OUTPUT

Memory address	Output value
4150	

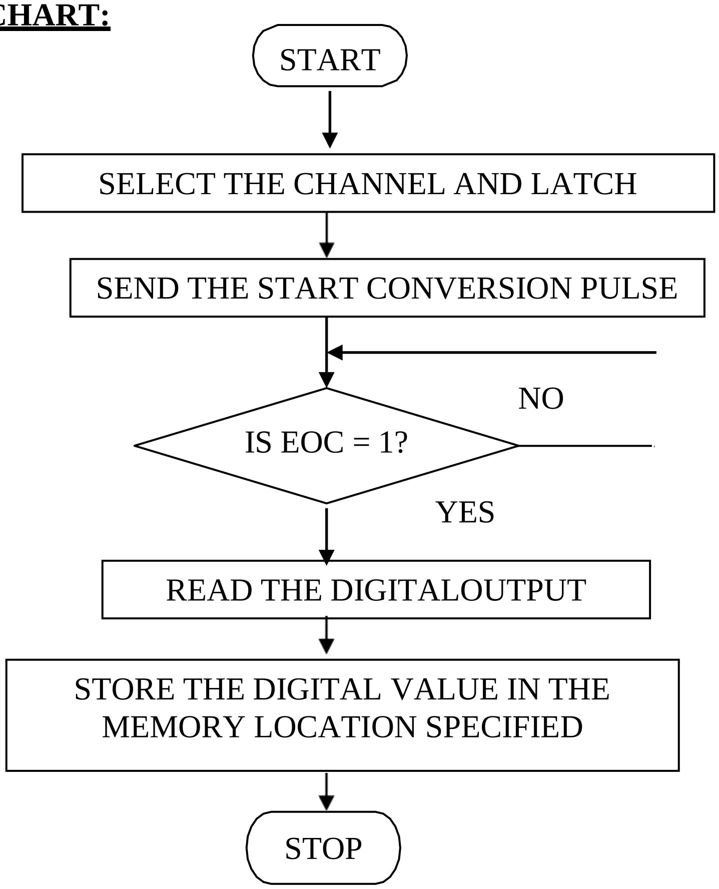
RESULT:

Thus an assembly language program was written to interface 8251with 8085 microprocessor. It was executed and the output was verified.

VIVA QUESTIONS:

1. What is meant by 8251?
2. Which of the following is not a mode of data transmission?____________________
   a) simplex b) duplex c) semi duplex d) half duplex
3. If the data is transmitted only in one direction over a single communication channel, then it is of__________________________mode.
4. If the data transmission takes place in either direction, but at a time data may be transmitted only in one direction then, it is of____________________mode.
5. In 8251A, what is the pin that controls the rate at which the character is to be transmitted.
6. TXD(Transmitted Data Output) pin carries serial stream of the transmitted data bits along with ____________________________
7. The signal that may be used either to interrupt the CPU or polled by the CPU is
8. What are the disadvantage of RS-232C?
9. The USB supports the signaling rate of _________________
10. What is the bit packet that commands the device either to receive data or transmit data in transmission of USB asynchronous communication?

FLOW CHART:


START
SELECT THE CHANNEL AND LATCH
SEND THE START CONVERSION PULSE
NO
IS EOC = 1?
YES
READ THE DIGITALOUTPUT
STORE THE DIGITAL VALUE IN THE MEMORY LOCATION SPECIFIED
STOP

9 INTERFACING ANALOG TO DIGITAL CONVERTER

AIM:

To write an assembly language program to convert an analog signal into a digital signal using an ADC interfacing.

APPARATUS REQUIRED:

SL.NO	ITEM	SPECIFICATION	QUANTITY
1.	Microprocessor kit	8085	1
2.	Power Supply	+5 V dc,+12 V dc	1
3.	ADC Interface board	-	1

PROBLEM STATEMENT:

The program is executed for various values of analog voltage which are set with the help of a potentiometer. The LED display is verified with the digital value that is stored in a memory location.

THEORY:

An ADC usually has two additional control lines: the SOC input to tell the ADC when to start the conversion and the EOC output to announce when the conversion is complete. The following program initiates the conversion process, checks the EOC pin of ADC 0809 as to whether the conversion is over and then inputs the data to the processor. It also instructs the processor to store the converted digital data at RAM location.

ALGORITHM:

1. Select the channel and latch the address.
2. Send the start conversion pulse.
3. Read EOC signal.
4. If EOC = 1 continue else go to step (3)
5. Read the digital output.
6. Store it in a memory location.

PROGRAM:

ADDRESSS	LABEL	OPCODE	PROGRAM	COMMENTS
4100			MVI A,10H	Select channel
4102			OUT C8	Send through output port
4103			MVI A,18H	Load accumulator with value for ALE low
4105			OUT C8	Send through output port
4106			MVI A,01H	Store the value to make SOC high in the accumulator
4108			OUT 00H	Send through output port
4109			XRA A	Introduce delay
410A			XRA A	
410B			XRA A	
410C			MVI A,00	Store the value to make SOC low the accumulator
410E			OUT D0H	Send through output port
410F	L1		IN D8H	Read the EOC signal from port & check for end of conversion
4110			ANI 01	
4112			CPI 01	
4114			JNZ L1	If the conversion is not yet completed, read EOC signal from port again
4117			IN C0H	Read data from port
4118			STA 4150H	Store the data
411B			HLT	Stop

OBSERVATION:

ANALOG VOLTAGE (V)	DIGITAL DATA ON LED DISPLAY	HEX CODE IN MEMORY LOCATION
5	1111 1111	FF
0	0000 0000	00
2.5	1000 0000	80

RESULT:

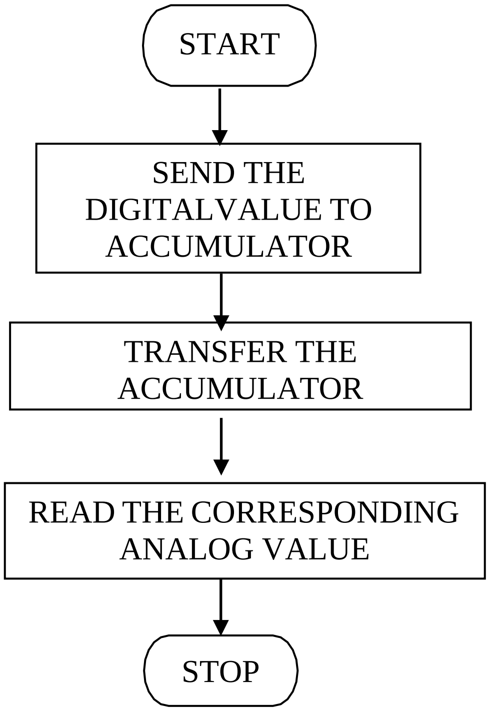
Thus the ADC was interfaced with 8085and the given analog inputs were converted into its digital equivalent.

VIVA QUESTIONS:

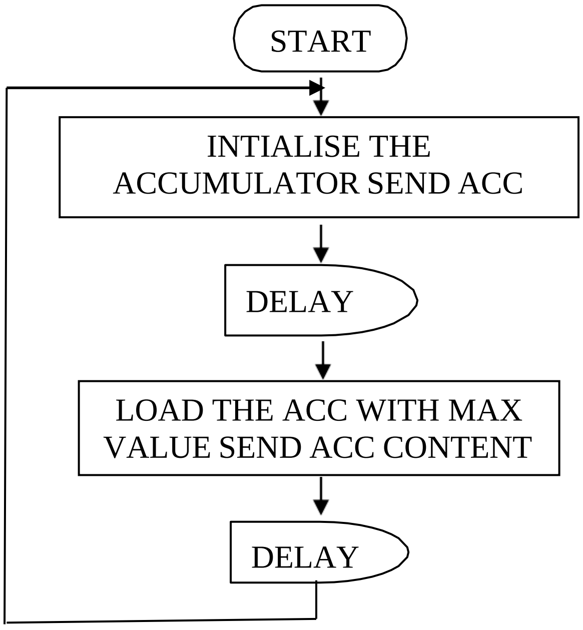
1. What is the name given to time taken by the ADC from the active edge of SOC(start of conversion) pulse till the active edge of EOC(end of conversion) signal ?
2. What are the popular technique that is used in the integration of ADC chips ?
3. The procedure of algorithm for interfacing ADC contain______________.
4. Which is the ADC among the following?
   a) AD 7523 b) 74373 c) 74245 d) ICL7109
5. The conversion delay in successive approximation of an ADC 0808/0809 is_____________.
6. The number of inputs that can be connected at a time to an ADC that is integrated with successive approximation is___________.
7. ADC 7109 integrated by Dual slope integration technique is used for ____________________
8. Which of the following is not one of the phase of total conversion cycle?
9. Which of the following phase contain feedback loop in it?________________
   a) auto zero phase b) signal integrate phase
   c) deintegrate phase d) none
10. In the signal integrate phase, the differential input voltage between IN LO(input low) and IN HI(input high) pins is integrated by the internal integrator for a fixed period of___________.

FLOWCHART:

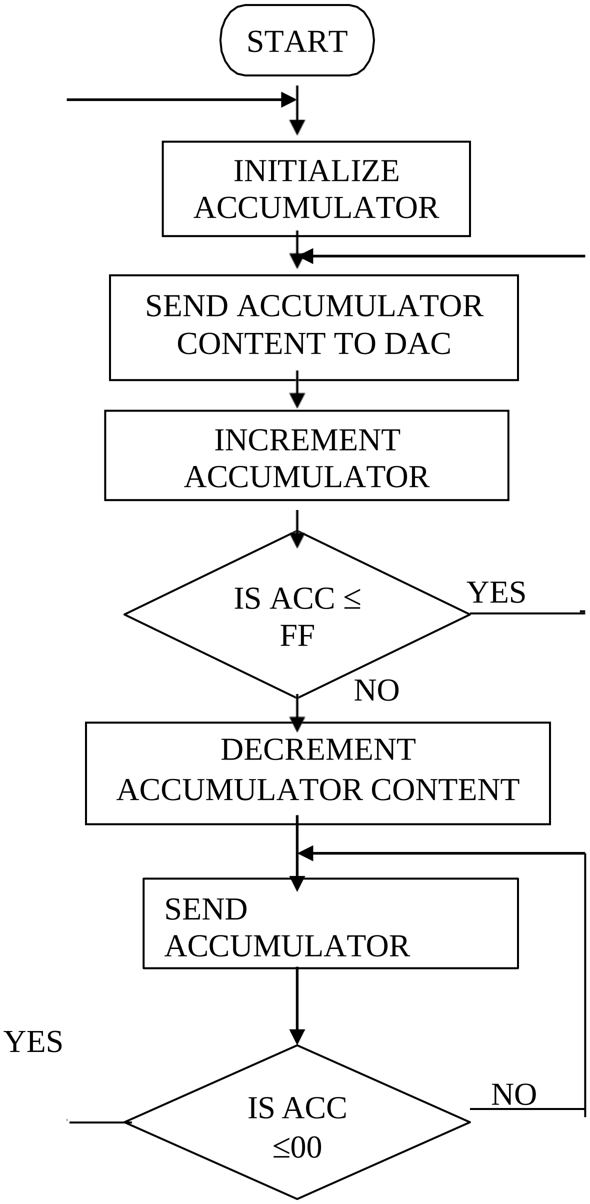
MEASUREMENT OF ANALOG VOLTAGE


START
SEND THE DIGITALVALUE TO ACCUMULATOR
TRANSFER THE ACCUMULATOR
READ THE CORRESPONDING ANALOG VALUE
STOP

SQUARE WAVE FORM


START
INTIALISE THE ACCUMULATOR SEND ACC
DELAY
LOAD THE ACC WITH MAX VALUE SEND ACC CONTENT
DELAY

TRIANGULAR WAVE FORM



10 INTERFACING DIGITAL TO ANALOG CONVERTER

AIM:

1. To write an assembly language program for digital to analog conversion
2. To convert digital inputs into analog outputs & to generate different waveforms

APPARATUS REQUIRED:

SL.NO	ITEM	SPECIFICATION	QUANTITY
1.	**Microprocessor kit**	8086 Vi Microsystems	1
2.	**Power Supply**	+5 V, dc,+12 V dc	1
3.	**DAC Interface board**	-	1

PROBLEM STATEMENT:

The program is executed for various digital values and equivalent analog voltages are measured and also the waveforms are measured at the output ports using CRO.

THEORY:

Since DAC 0800 is an 8 bit DAC and the output voltage variation is between –5v and +5v. The output voltage varies in steps of 10/256 = 0.04 (approximately). The digital data input and the corresponding output voltages are presented in the table. The basic idea behind the generation of waveforms is the continuous generation of analog output of DAC. With 00 (Hex) as input to DAC2 the analog output is –5v. Similarly with FF H as input, the output is +5v. Outputting digital data 00 and FF at regular intervals, to DAC2, results in a square wave of amplitude 5v.Output digital data from 00 to FF in constant steps of 01 to DAC2. Repeat this sequence again and again. As a result a saw-tooth wave will be generated at DAC2 output. Output digital data from 00 to FF in constant steps of 01 to DAC2.Output digital data from FF to 00 in constant steps of 01 to DAC2. Repeat this sequence again and again. As a result a triangular wave will be generated at DAC2 output.

ALGORITHM:

Measurement of analog voltage:

1. Send the digital value of DAC.
2. Read the corresponding analog value of its output.

Waveform generation:

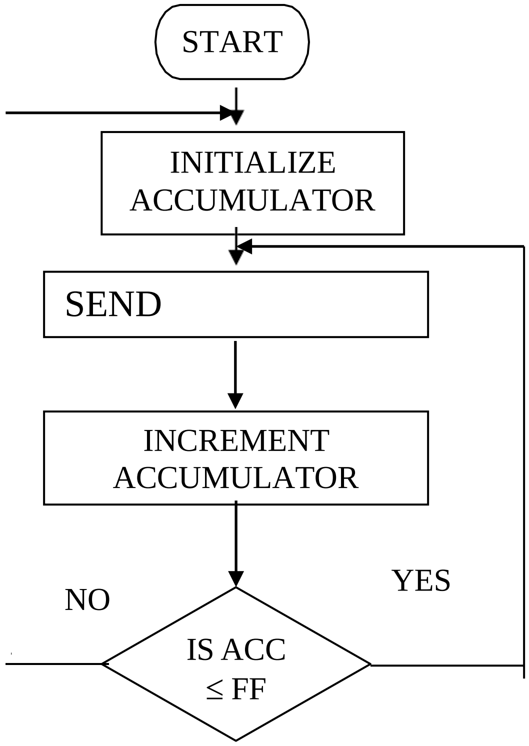
Square Waveform:

1. Send low value (00) to the DAC.
2. Introduce suitable delay.
3. Send high value to DAC.
4. Introduce delay.
5. Repeat the above procedure.

Saw-tooth waveform:

1. Load low value (00) to accumulator.
2. Send this value to DAC.
3. Increment the accumulator.
4. Repeat step (2) and (3) until accumulator value reaches FF.
5. Repeat the above procedure from step 1.

SAWTOOTH WAVEFORM



PROGRAM: Measurement of Analog Voltage

PROGRAM	COMMENTS
MOV A,7FH	Load digital value 00 in accumulator
OUT C0	Send through output port
HLT	Stop

OBSERVATION: Measurement of Analog Voltage

DIGITAL DATA	ANALOG VOLTAGE
FF	**5V**
00	**0V**

Triangular waveform:

1. Load the low value (00) in accumulator.
2. Send this accumulator content to DAC.
3. Increment the accumulator.
4. Repeat step 2 and 3 until the accumulator reaches FF, decrement the accumulator and send the accumulator contents to DAC.
5. Decrementing and sending the accumulator contents to DAC.
6. The above procedure is repeated from step (1)

PROGRAM: Square Wave

ADDRESSS	LABEL	PROGRAM	COMMENTS
4100	START	MVI A,00H	Load 00 in accumulator
4102		OUT C8	Send through output port
4103		CALL DELAY	Give a delay
4105		MVI A,0FH	Load 0F in accumulator
4107		OUT C8	Send through output port
4108		CALL DELAY	Give a delay
4109		JMP START	Go to starting location
410A	DELAY	MVI B,05	Load count value 05 in B register
410B	L1	MVI C,0F	Load count value 0F in B register
410C	L2	DCR C	Decrement C register
410E		JNZ L2	Return to loop2
410F		DCR B	Decrement B register
4110		JNZ L1	Return to loop1
4112		RET	Return to main program

PROGRAM: Saw tooth Wave

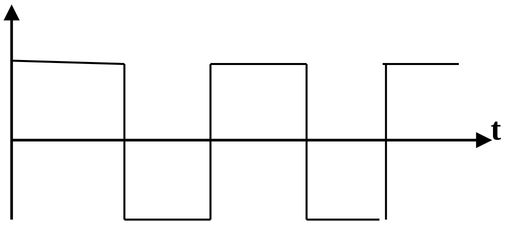
ADDRESSS	LABEL	PROGRAM	COMMENTS
4100	START	MVI A,00H	Load 00 in accumulator
4102	L1	OUT C0	Send through output port
4103		INR A	Increment contents of accumulator
4104		JNZ L1	Send through output port until it reaches FF
4107		JMP START	Go to starting location

PROGRAM: **Triangular Wave**

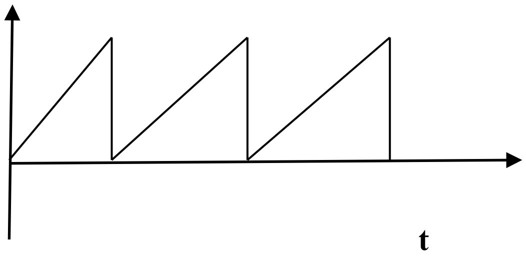
ADDRESSS	LABEL	PROGRAM	COMMENTS
4100	START	MVI L,00H	Load 00 in accumulator
4102	L1	MOV A ,L	Move contents of L to A
4103		OUT C8	Send through output port
4104		INR C	Increment contents of accumulator
4105		JNZ L1	Send through output port until it reaches FF
4108		MVI C,FFH	Load FF in accumulator
4109	L2	MOV A,L	Move contents of L to A
410A		OUT C8	Send through output port
410B		DCR C	Decrement contents of accumulator
410C		JNZ L2	Send through output port until it reaches 00
410F		JMP START	Go to starting location

MODEL GRAPH:

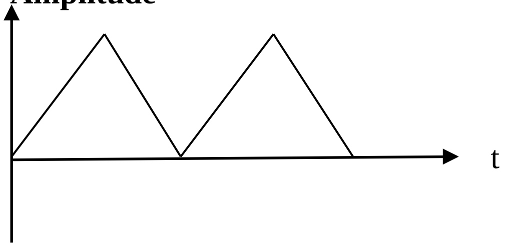
Square Waveform
Amplitude



Saw-tooth waveform
Amplitude



Triangular waveform
Amplitude



RESULT OF WAVEFORM GENERATION:

WAVEFORMS	AMPLITUDE	TIMEPERIOD
Square Waveform		
Saw-tooth waveform		
Triangular waveform		

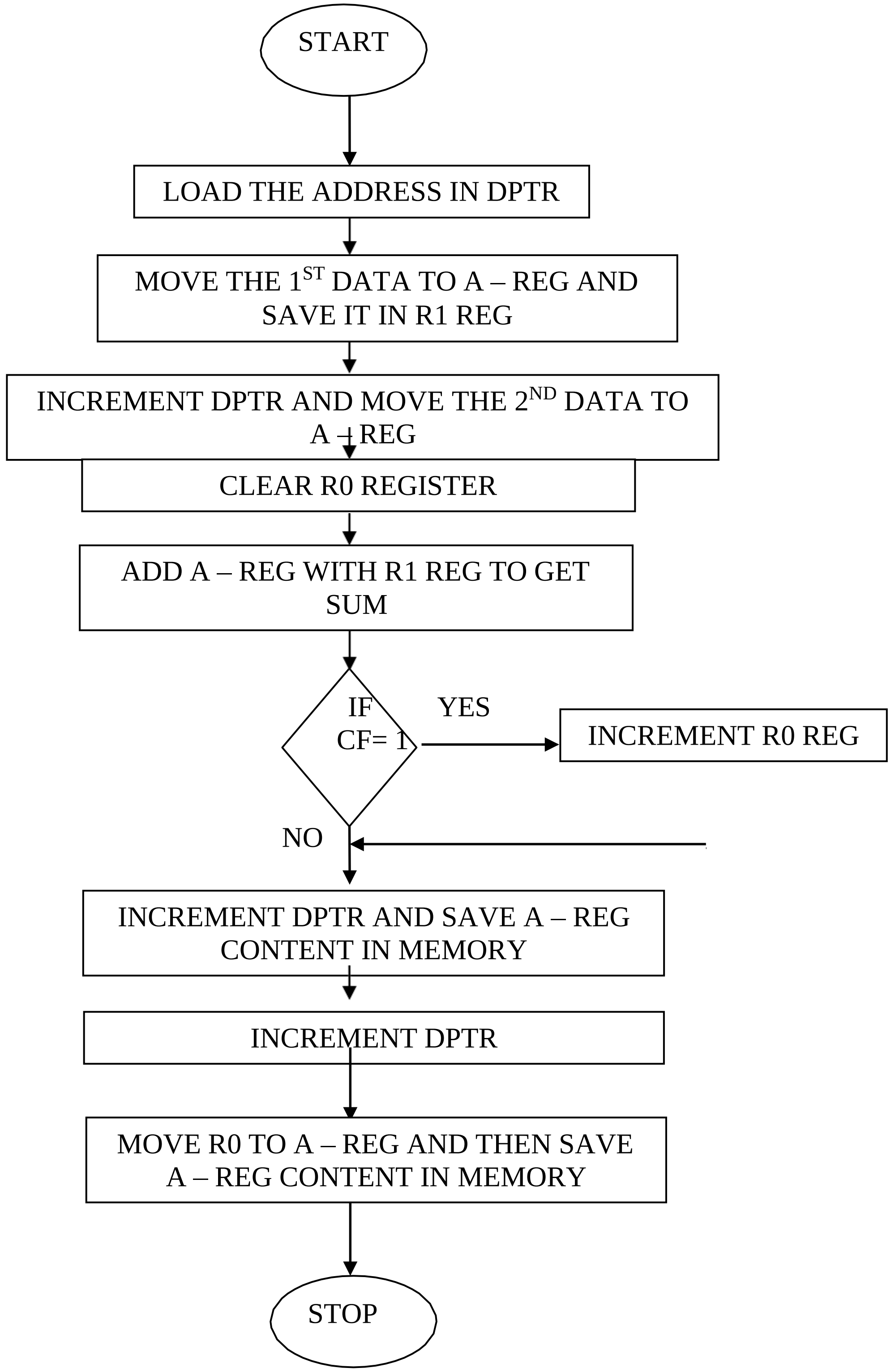
RESULT:

Thus digital to analog conversion is done and different waveforms such as square wave, sawtooth wave and triangular wave are generated by interfacing DAC with 8085

VIVA QUESTIONS:

1. DAC (Digital to Analog Converter) finds application in (digitally controlled gains,motor speed controls, programmable gain amplifiers)
2. To save the DAC from negative transients the device connected between OUT1 and OUT2 of AD 7523 is _______________
3. An operational amplifier connected to the output of AD 7523 is used (to convert current output to output voltage , to provide additional driving capability, as current-to-voltage converter)
4. The DAC 0800 has a settling time of (100 milliseconds).
5. What is meant by the instruction OUT C8
6. Give examples for various DAC ICs?

FLOW CHART:


START
LOAD THE ADDRESS IN DPTR
MOVE THE 1ST DATA TO A – REG AND SAVE IT IN R1 REG
INCREMENT DPTR AND MOVE THE 2ND DATA TO A – REG
CLEAR R0 REGISTER
ADD A – REG WITH R1 REG TO GET SUM
IF CF= 1
YES
INCREMENT R0 REG
NO
INCREMENT DPTR AND SAVE A – REG CONTENT IN MEMORY
INCREMENT DPTR
MOVE R0 TO A – REG AND THEN SAVE A – REG CONTENT IN MEMORY
STOP

11(A) 8-BIT ADDITION

AIM:

To write a program to add two 8-bit numbers using 8051 microcontroller and also to verify the result.

APPARATUS REQUIRED:

8051 microcontroller kit ,key board.

ALGORITHM:

1. Clear Program Status Word.
2. Select Register bank by giving proper values to RS1 & RS0 of PSW.
3. Load accumulator A with any desired 8-bit data.
4. Load the register R_0 with the second 8- bit data.
5. Add these two 8-bit numbers.
6. Store the result.
7. Stop the program.

PROGRAM:

ADDRESS	LABEL	MNEMONIC	OPERAND	HEX CODE	COMMENTS
4100		CLR	C		Clear CY Flag
4101		MOV	A,# data1		Get the data1 in Accumulator
4103		ADDC	A, # data 2		Add the data1 with data2
4105		MOV	DPTR, # 4500H		Initialize the memory location
4108		MOVX	@ DPTR, A		Store the result in memory location
4109	L1	SJMP	L1		Stop the program

OBSERVATION:

OUTPUT	
MEMORY LOCATION	**DATA**
4500	

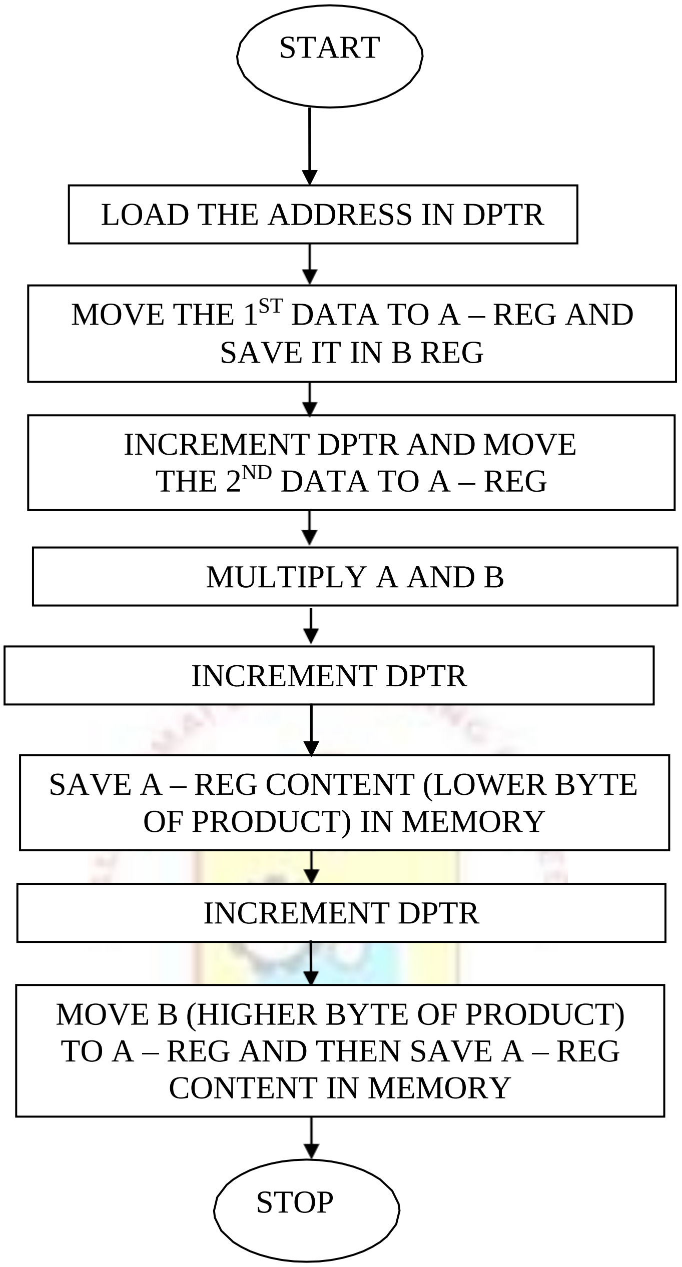
RESULT:

Thus the 8051 ALP for addition of two 8 bit numbers is executed and the result is verified.

VIVA QUESTIONS:

1. Which type of addressing mode is MOV A,# data1 ?
2. Explain SJMP ?
4. Explain ADDC A,# data1 ?
5. If RS1=1, RS0=0, then the register bank selected is (register bank 2) ?
6. What are the various ways to clear the carry flag?

FLOWCHART:


START
LOAD THE ADDRESS IN DPTR
MOVE THE 1ST DATA TO A – REG AND SAVE IT IN B REG
INCREMENT DPTR AND MOVE THE 2ND DATA TO A – REG
MULTIPLY A AND B
INCREMENT DPTR
SAVE A – REG CONTENT (LOWER BYTE OF PRODUCT) IN MEMORY
INCREMENT DPTR
MOVE B (HIGHER BYTE OF PRODUCT) TO A – REG AND THEN SAVE A – REG CONTENT IN MEMORY
STOP

11(B) 8-BIT SUBTRACTION

AIM:

To perform subtraction of two 8 bit data using the 8051 microcontroller and store the result in memory.

APPARATUS REQUIRED:

8051 microcontroller kit ,key board.

ALGORITHM:

1. Clear the carry flag.
2. Initialize the register for borrow.
3. Get the first operand into the accumulator.
4. Subtract the second operand from the accumulator.
5. If a borrow results increment the carry register.
6. Store the result in memory.

PROGRAM:

ADDRESS	**LABEL**	**MNEMONIC**	**OPERAND**	**HEXCODE**	**COMMENTS**
4100		CLR	C		Clear CY flag
4101		MOV	A, # data1		Store data1 in accumulator
4103		SUBB	A, # data2		Subtract data2 from data1
4105		MOV	DPTR, # 4500		Initialize memory location
4108		MOVX	@ DPTR, A		Store the difference in memory location
4109	L1	SJMP	L1		Stop

OBSERVATION:

OUTPUT	
MEMORY LOCATION	**DATA**
4500	07

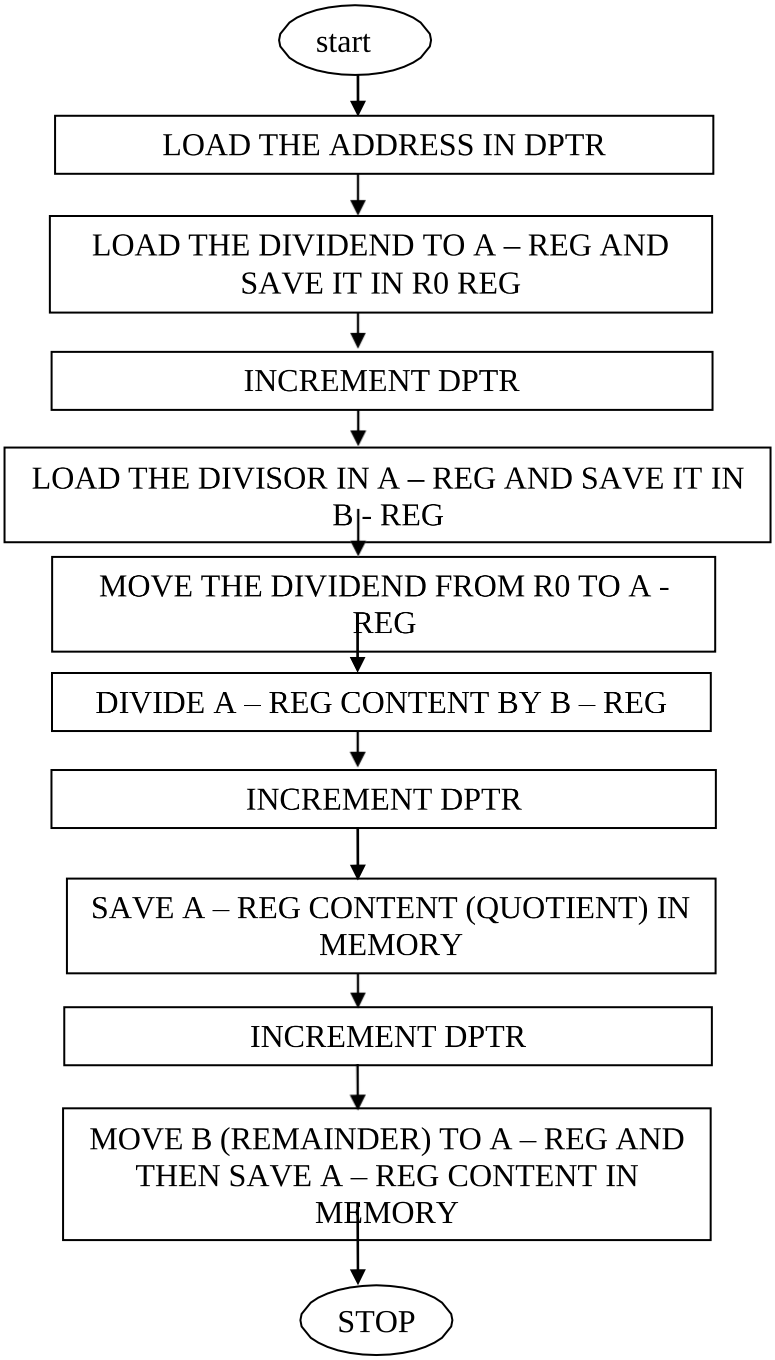
RESULT:

Thus the 8051 ALP for subtraction of two 8 bit numbers is executed and the result is verified.

VIVA QUESTIONS:

1. How SUBB instruction works?
2. The instruction, ADD A, R7 is an example of____________________instruction
3. What is meant by PSW ?
4. List out the difference between MOV and MOVX instructions
5. What is the use of DPTR
6. Tell about counter mode in8051.
7. What is the SCON register in 8051?

FLOWCHART:


start
LOAD THE ADDRESS IN DPTR
LOAD THE DIVIDEND TO A – REG AND SAVE IT IN R0 REG
INCREMENT DPTR
LOAD THE DIVISOR IN A – REG AND SAVE IT IN B - REG
MOVE THE DIVIDEND FROM R0 TO A - REG
DIVIDE A – REG CONTENT BY B – REG
INCREMENT DPTR
SAVE A – REG CONTENT (QUOTIENT) IN MEMORY
INCREMENT DPTR
MOVE B (REMAINDER) TO A – REG AND THEN SAVE A – REG CONTENT IN MEMORY
STOP

11(C) 8-BIT MULTIPLICATION

AIM:

To perform multiplication of two 8 bit data using 8051 microcontroller and to store the result in memory.

APPARATUS REQUIRED:

8051 microcontroller kit ,key board.

ALGORITHM:

1. Get the multiplier in the accumulator.
2. Get the multiplicand in the B register.
3. Multiply A with B.
4. Store the product in memory.

PROGRAM:

ADDRESS	**LABEL**	**MNEMONIC**	**OPERAND**	**HEX CODE**	**COMMENTS**
4100		MOV	A ,#data1		Store data1 in accumulator
4102		MOV	B, #data2		Store data2 in B reg
4104		MUL	A,B		Multiply both
4106		MOV	DPTR, # 4500H		Initialize memory location
4109		MOVX	@ DPTR, A		Store lower order result
401A		INC	DPTR		Go to next memory location
410B		MOV	A,B		Store higher order result
410D		MOV	@ DPTR, A		
410E	STOP	SJMP	STOP		Stop

OBSERVATION:

OUTPUT	
MEMORY LOCATION	**DATA**
4500	
4501	

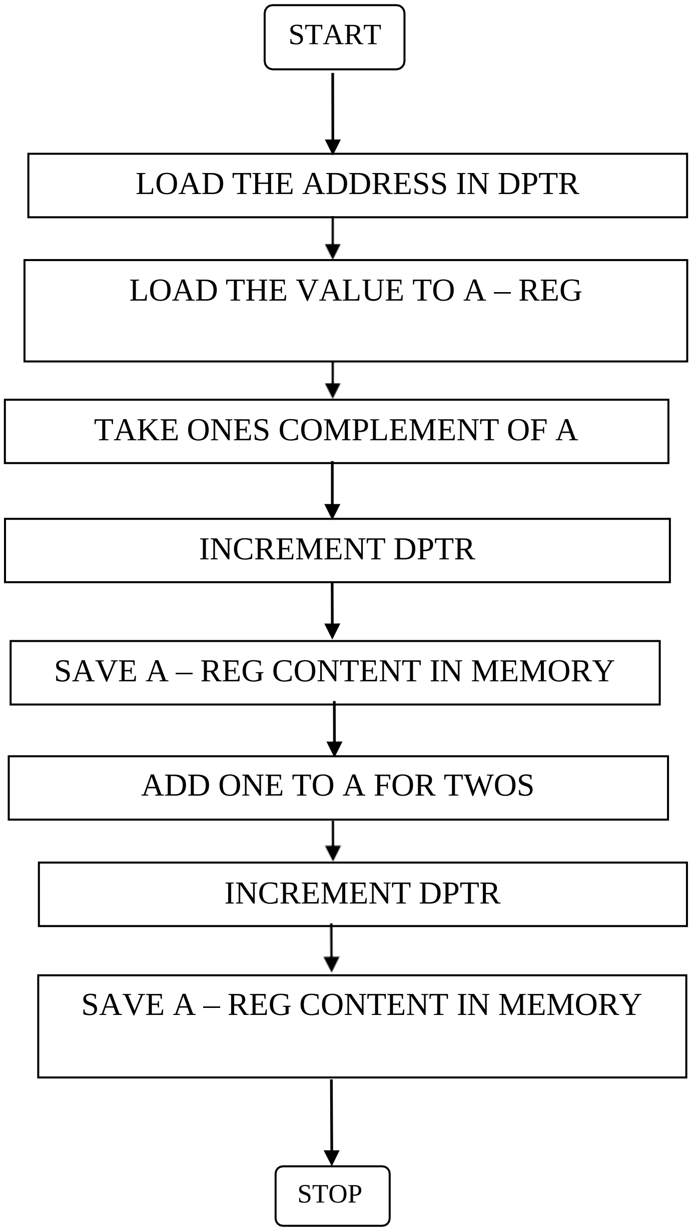
RESULT:

Thus the 8051 ALP for multiplication of two 8 bit numbers is executed and the result is verified.

VIVA QUESTIONS:

1. Give the syntax of multiplication instruction.
2. What is the use of INC DPTR instruction ?
3. What is the use of EA signal in 8051?
4. What is the role of RS0,RS1 bits?
5. What is the use of PSEN pin in 8051?
6. What is the syntax of Division instruction?
7. What is the difference between the SJMP and LJMP?

FLOWCHART:


START
LOAD THE ADDRESS IN DPTR
LOAD THE VALUE TO A – REG
TAKE ONES COMPLEMENT OF A
INCREMENT DPTR
SAVE A – REG CONTENT IN MEMORY
ADD ONE TO A FOR TWOS
INCREMENT DPTR
SAVE A – REG CONTENT IN MEMORY
STOP

1(D) 8-BIT DIVISION

AIM:

To perform division of two 8 bit data using 8051 microcontroller and to store the result in memory.

APPARATUS REQUIRED:

8051 microcontroller kit ,key board.

ALGORITHM:

1. Get the Dividend in the accumulator.
2. Get the Divisor in the B register.
3. Divide A by B.
4. Store the Quotient and Remainder in memory.

PROGRAM:

ADDRESS	LABEL	MNEMONIC	OPERAND	HEX CODE	COMMENTS
4100		MOV	A, # data1		Store data1 in accumulator
4102		MOV	B, # data2		Store data2 in B reg
4104		DIV	A,B		Divide
4015		MOV	DPTR, # 4500H		Initialize memory location
4018		MOVX	@ DPTR, A		Store remainder
4109		INC	DPTR		Go to next memory location
410A		MOV	A,B		Store quotient
410C		MOV	@ DPTR, A		
410D	STOP	SJMP	STOP		Stop

OBSERVATION:

OUTPUT	
MEMORY LOCATION	**DATA**
4500 (remainder)	
4501 (quotient)	

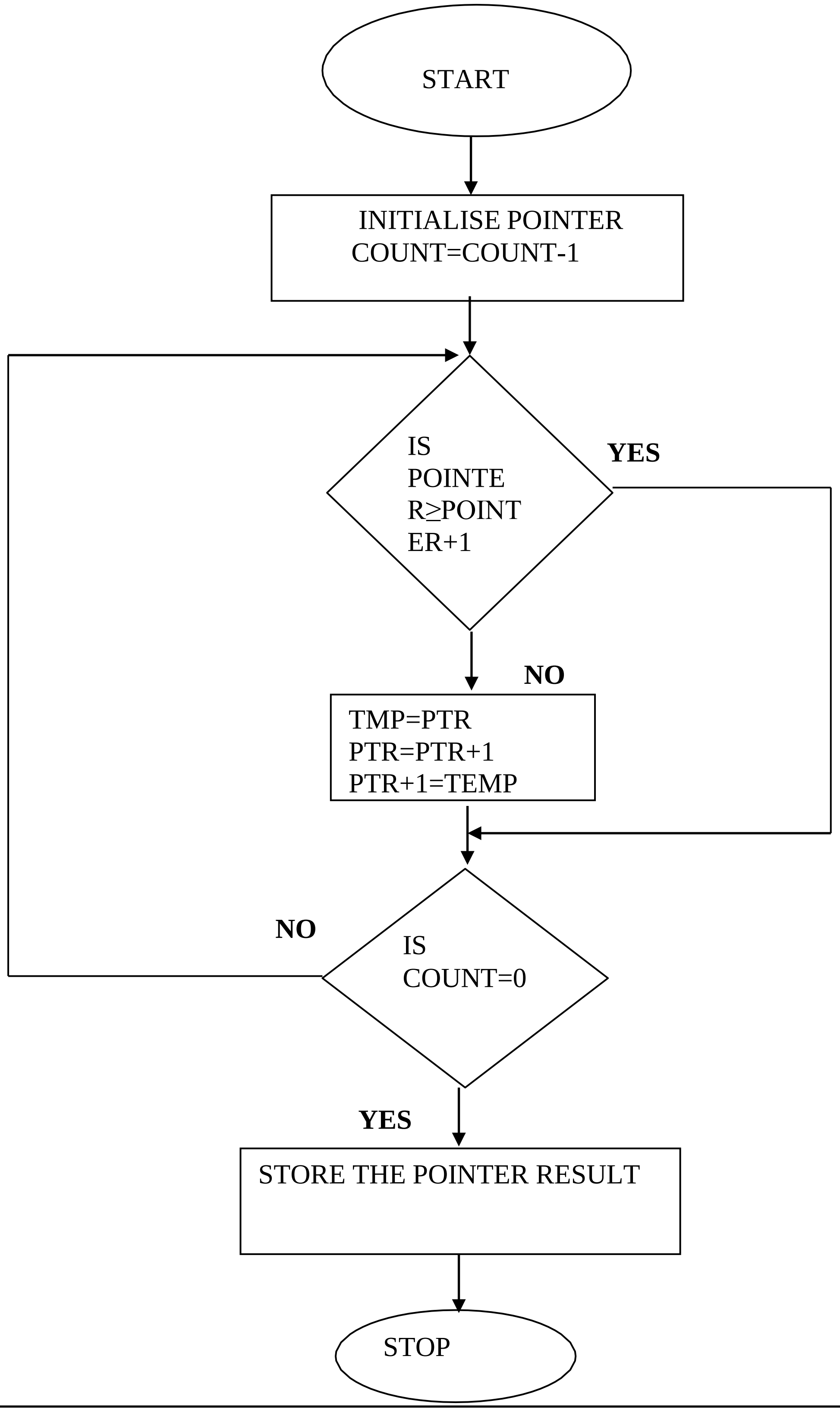
RESULT:

Thus the 8051 ALP for division of two 8 bit numbers is executed and the result is verified.

VIVA QUESTIONS:

1. How division is performed in microcontroller?
2. In which register quotient and remainder is stored?
3. What is SJMP?
4. What is the syntax of Division instruction?
5. What are control and status register?
6. DIV AB is an______________bit instruction?
7. What is the meant by the instruction DPTR, # 4500H ?

FLOW CHART:


START
INITIALISE POINTER
COUNT=COUNT-1
IS
POINTE
R≥POINT
ER+1
YES
NO
TMP=PTR
PTR=PTR+1
PTR+1=TEMP
NO
IS
COUNT=0
YES
STORE THE POINTER RESULT
STOP

12(A) LARGEST ELEMENT IN AN ARRAY

AIM:

To write an assembly language program to find the largest element in an array and to execute it using 8051 .

APPARATUS REQUIRED:

8051 microcontroller kit ,key board.

.

ALGORITHM

1. Start.
2. Load the array count in a register
3. Get the first two numbers.
4. Compare the numbers and swap them so that the two numbers are in ascending order.
5. Repeat steps 3 and 4 till the array is completed.
6. Repeat the steps 3, 4 and 5 and store the largest number as the result in memory.
7. Stop.

PROGRAM:

MEMORY ADDRESS	OPCODE	LABEL	MNEMONICS	COMMENTS
4100			MOV DPTR,#4200	Load location 4200 to DPTR
4103			MOV 40,#00	Load zero to memory 40H
4106			MOV R5, #07	Move array size to R5
4108		LOOP2	MOVX A,@DPTR	Accumulator is moved to16 bit External Memory address indicated by DPTR
4109			CJNE A,40 LOOP1	Compare A with contents of location 40H and Jump if Not Equal to LOOP1
410C		LOOP3	INC DPTR	Increment DPTR content
410D			DJNZ R5,LOOP2	Decrement Register R5 and Jump if Not Zero to LOOP2
410F			MOV A,40	Move value in location 40H to Accumulator
4111			MOVX @DPTR,A	Accumulator is moved to16 bit External Memory address indicated by DPTR
4112		HLT	SJMP HLT	Stop the execution
4114		LOOP1	JC LOOP3	Jump if Carry Set to LOOP3
4116			MOV 40,A	Move A to location 40H
4118			SJMP LOOP2	Perform short jump to location LOOP2

OUTPUT:

MEMORY ADDRESS	INPUT VALUES	MEMORY ADDRESS	OUTPUT VALUES
4200		4207	
4201			
4202			
4203			
4204			
4205			
4206			

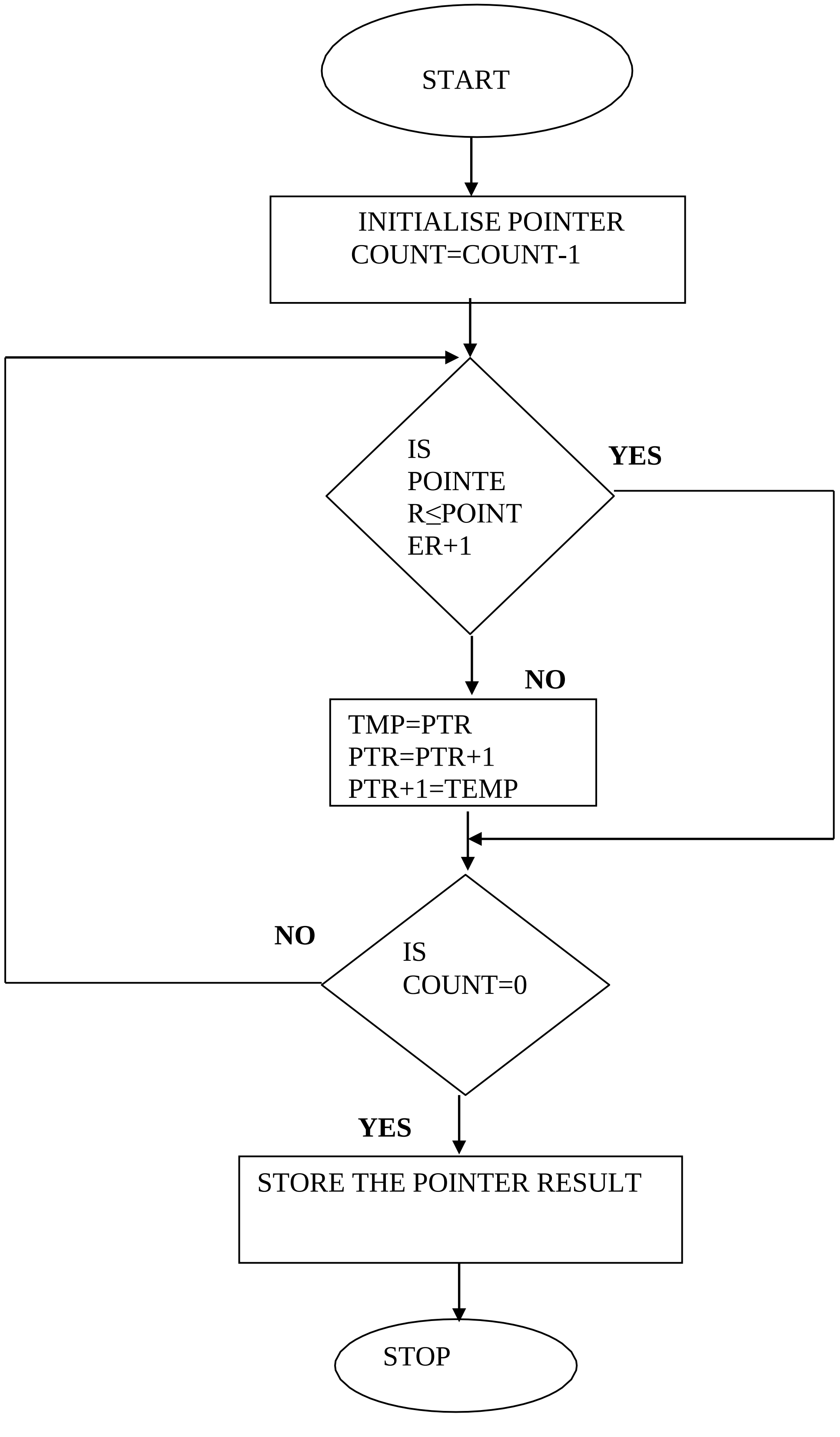
RESULT:

Thus an assembly language program written to find the largest element in an array was executed using 8051 microcontroller and the output was verified.

VIVA QUESTIONS:

1. Explain CJNE A,40 LOOP1
2. The instruction, RLA performs -------------------------------
3. What does the instruction, ADD A, #100 performs?
4. What does the instruction, DJNZ performs?
5. Give example for jump instruction ?
6. What is use of the instruction MOVX @DPTR,A
7. What are one byte instruction in 8051 ?

FLOW CHART:


START
INITIALISE POINTER
COUNT=COUNT-1
IS
POINTE
R≤POINT
ER+1
YES
NO
TMP=PTR
PTR=PTR+1
PTR+1=TEMP
NO
IS
COUNT=0
YES
STORE THE POINTER RESULT
STOP

12(B) SMALLEST ELEMENT IN AN ARRAY

AIM:

To write an assembly language program to find the largest element in an array and to execute it using 8051 microprocessor.

APPARATUS REQUIRED:

8051 microcontroller kit ,key board.

ALGORITHM

1. Start.
2. Load the array count in a register
3. Get the first two numbers.
4. Compare the numbers and swap them so that the two numbers are in ascending order.
5. Repeat steps 3 and 4 till the array is completed.
6. Repeat the steps 3, 4 and 5 and store the largest number as the result in memory.
7. Stop.

PROGRAM:

MEMORY ADDRESS	OPCODE	LABEL	MNEMONICS	COMMENTS
4100			MOV DPTR,#4200	Load location 4200 to DPTR
4103			MOV 40,#FF	Load zero to memory 40H
4106			MOV R5,#07	Move Array size to R5
4108		LOOP2	MOVX A,@DPTR	Accumulator is moved to16 bit External Memory address indicated by DPTR
4109			CJNE A,40 LOOP1	Compare A with contents of location 40H and Jump if Not Equal to LOOP1
410C		LOOP3	INC DPTR	Increment DPTR content
410D			DJNZ R5,LOOP2	Decrement Register R5 and Jump if Not Zero to LOOP2
410F			MOV A,40	Move value in location 40H to Accumulator
4111			MOVX @DPTR,A	Accumulator is moved to16 bit External Memory address indicated by DPTR
4112		HLT	SJMP HLT	Stop the execution
4114		LOOP1	JC LOOP3	Jump if Carry Set to LOOP3
4116			MOV 40,A	Move A to location 40H
4118			SJMP LOOP2	Perform short jump to location LOOP2

OUTPUT:

MEMORY ADDRESS	INPUT VALUES	MEMORY ADDRESS	OUTPUT VALUES
4200		4207	
4201			
4202			
4203			
4204			
4205			
4206			

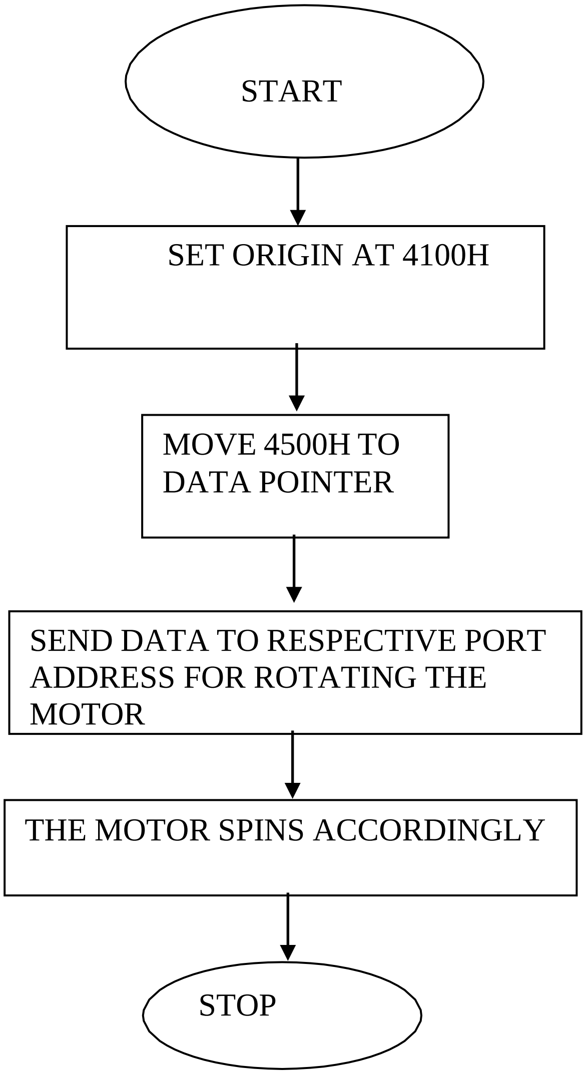
RESULT:

Thus an assembly language program written for finding the smallest element in an array was executed using 8051 microcontroller and the output was verified.

VIVA QUESTIONS:

1. Explain the instruction MOVX DPTR,A
2. How internal RAM is accessed?
3. Which location is used for bit manipulation instruction?
4. What happens upon execution of the instruction MOV 40,A _____________
5. What is the need of the instruction INC DPTR?
6. Expand IP and IE ?
7. How many ports are available in 8051?

FLOW CHART:


START
SET ORIGIN AT 4100H
MOVE 4500H TO DATA POINTER
SEND DATA TO RESPECTIVE PORT ADDRESS FOR ROTATING THE MOTOR
THE MOTOR SPINS ACCORDINGLY
STOP

13 STEPPER MOTOR INTERFACING WITH 8051

AIM:

To operate stepper motor by interfacing with 8051 microcontroller.

THEORY:

A motor in which the rotor is able to assume only discrete stationary angular position is a stepper motor. The rotary motion occurs in a step-wise manner from one equilibrium position to the next. Stepper Motors are used very wisely in position control systems like printers, disk drives, process control machine tools, etc.

The basic two-phase stepper motor consists of two pairs of stator poles. Each of the four poles has its own winding. The excitation of any one winding generates a North Pole. A South Pole gets induced at the diametrically opposite side. The rotor magnetic system has two end faces. It is a permanent magnet with one face as South Pole and the other as North Pole.

The Stepper Motor windings A1, A2, B1, B2 are cyclically excited with a DC current to run the motor in clockwise direction. By reversing the phase sequence as A1, B2, A2, B1, anticlockwise stepping can be obtained.

2-PHASE SWITCHING SCHEME:

In this scheme, any two adjacent stator windings are energized. The switching scheme is shown in the table given below. This scheme produces more torque.

ANTICLOCKWISE						**CLOCKWISE**					
STEP	**A1**	**A2**	**B1**	**B2**	**DATA**	**STEP**	**A1**	**A2**	**B1**	**B2**	**DATA**
1	1	0	0	1	9h	1	1	0	1	0	Ah
2	0	1	0	1	5h	2	0	1	1	0	6h
3	0	1	1	0	6h	3	0	1	0	1	5h
4	1	0	1	0	Ah	4	1	0	0	1	9h

ADDRESS DECODING LOGIC:

The 74138 chip is used for generating the address decoding logic to generate the device select pulses, CS1 & CS2 for selecting the IC 74175.The 74175 latches the data bus to the stepper motor driving circuitry.

Stepper Motor requires logic signals of relatively high power. Therefore, the interface circuitry that generates the driving pulses use silicon darlington pair transistors. The inputs for the interface circuit are TTL pulses generated under software control using the Microcontroller Kit. The TTL levels of pulse sequence from the data bus is translated to high voltage output pulses usinga buffer 7407 with open collector.

PROGRAM :

Address	**Label**	**Mnemonics**	**Operand**	**Comments**
		ORG	4100h	
4100	START:	MOV	DPTR, #TABLE	Load the start address of switching scheme data TABLE into Data Pointer (DPTR)
4103		MOV	R0, #04	Load the count in R0
4105	LOOP:	MOVX	A, @DPTR	Load the number in TABLE into A
4106		PUSH	DPH	Push DPTR value to Stack
4108		PUSH	DPL	
410A		MOV	DPTR, #0FFC0h	Load the Motor port address into DPTR
410D		MOVX	@DPTR, A	Send the value in A to stepper Motor port address
410E		MOV	R4, #0FFh	Delay loop to cause a specific amount of time delay before next data item is sent to the Motor
4110	DELAY:	MOV	R5, #0FFh	
4112	DELAY1:	DJNZ	R5, DELAY1	
4114		DJNZ	R4, DELAY	
4116		POP	DPL	POP back DPTR value from Stack
4118		POP	DPH	
411A		INC	DPTR	Increment DPTR to point to next item in the table
411B		DJNZ	R0, LOOP	Decrement R0, if not zero repeat the loop
411D		SJMP	START	Short jump to Start of the program to make the motor rotate continuously
411F	TABLE:	DB	09 05 06 0Ah	Values as per two-phase switching scheme

PROCEDURE:

- Enter the above program starting from location 4100 and execute the same. The stepper motor rotates.
- By varying the count at R4 and R5 can vary the speed.
- By entering the data in the look-up TABLE in the reverse order can vary direction of rotation.

RESULT:

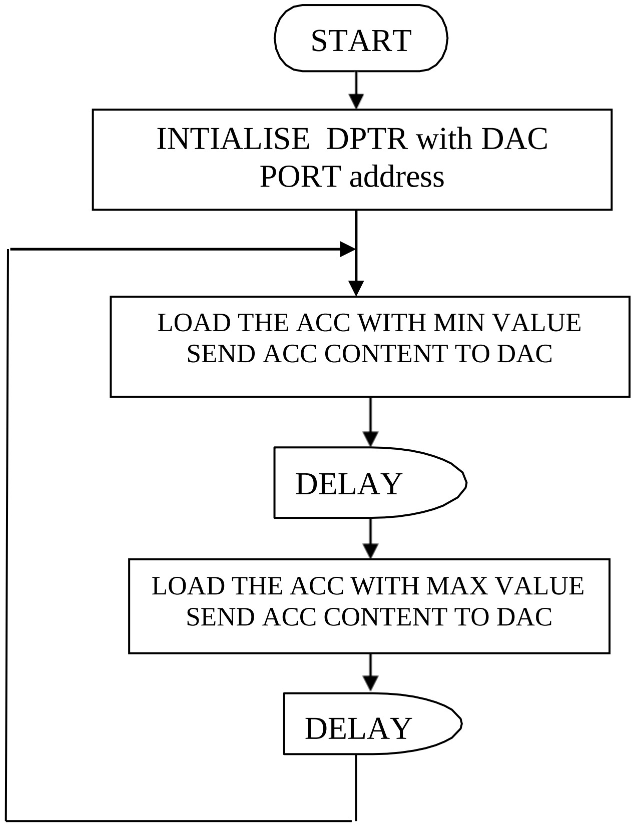
Thus a stepper motor was interfaced with 8051 and run in forward and reverse directions at various speeds.

VIVA QUESTIONS:

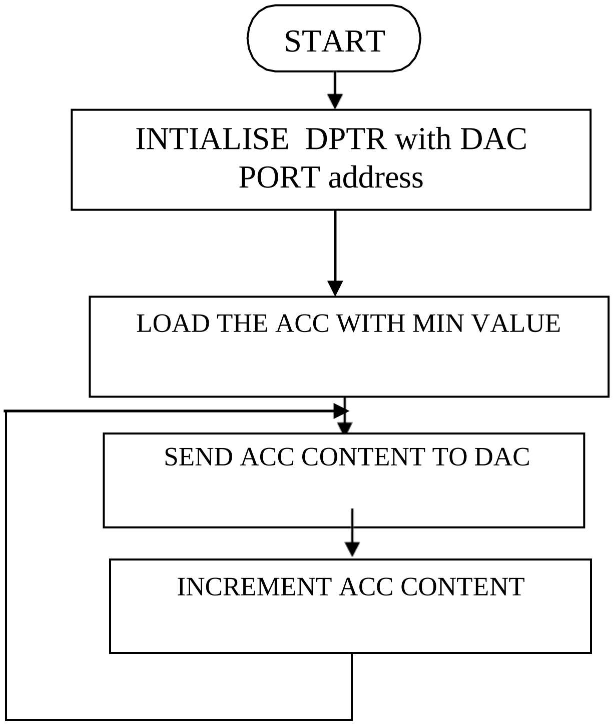
1. What are the application of stepper motor?
2. What is meant by step angle?
3. What are the methods to control the speed of stepper motor?
4. What is the formula for steps per revolution?
5. What is the use of DB instruction?
6. What is the use of PUSH and POP operation ?
7. How a stepper motor differs from DC motor?

FLOWCHART:

SQUARE WAVE FORM:


START
INTIALISE DPTR with DAC PORT address
LOAD THE ACC WITH MIN VALUE
SEND ACC CONTENT TO DAC
DELAY
LOAD THE ACC WITH MAX VALUE
SEND ACC CONTENT TO DAC
DELAY

SAWTOOTH WAVE FORM:


START
INTIALISE DPTR with DAC PORT address
LOAD THE ACC WITH MIN VALUE
SEND ACC CONTENT TO DAC
INCREMENT ACC CONTENT

14 INTERFACING DAC WITH 8051

AIM:

To interface DAC with 8051 to demonstrate the generation of square wave, triangular wave and sawtooth wave

APPARATUS REQUIRED:

8051 microcontroller kit ,key board.

APPARATUS REQUIRED:

8051 Trainer Kit, DAC interface board

ALGORITHM:

SQUARE WAVE GENERATION:

1. Move the port address of DAC to DPTR
2. load the initial value 00 TO accumulator and move it to DAC
3. CALL THE DELAY PROGRAM
4. Load the final value FF to accumulator and move it to DAC
5. Call the delay program
6. Repeat steps 2 to 5

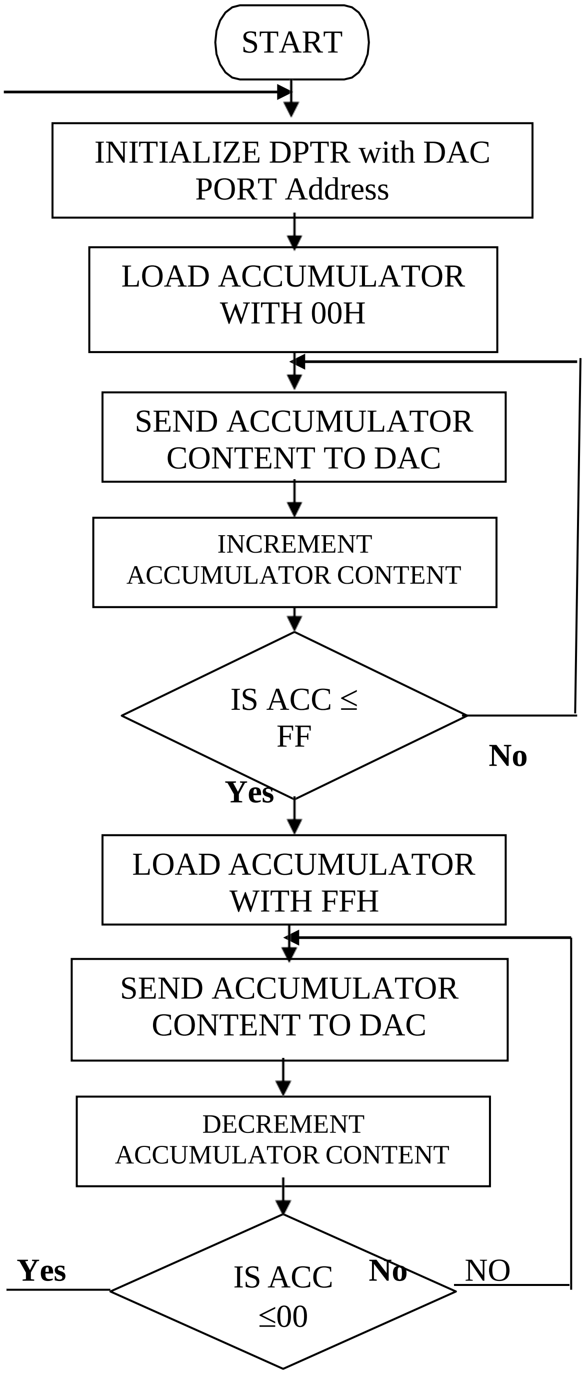
SAWTOOTH WAVE GENERATION:

1. Move the port address of DAC to DPTR
2. Load the initial value 00 TO accumulator
3. Move the accumulator content to DAC
4. Increment the accumulator content by 1.
5. Repeat Steps 3 and 4

TRIANGULAR WAVE GENERATION

1. Move the port address of DAC to DPTR
2. Load the initial value (00) to Accumulator
3. Move the accumulator content to DAC
4. Increment the accumulator content by 1.
5. If accumulator content is zero proceed to next step. Else go to step 3.

TRIANGULAR WAVEFORM


START
INITIALIZE DPTR with DAC PORT Address
LOAD ACCUMULATOR WITH 00H
SEND ACCUMULATOR CONTENT TO DAC
INCREMENT ACCUMULATOR CONTENT
IS ACC ≤ FF
No
Yes
LOAD ACCUMULATOR WITH FFH
SEND ACCUMULATOR CONTENT TO DAC
DECREMENT ACCUMULATOR CONTENT
Yes
IS ACC ≤00
No
NO

6. Load value (FF) to Accumulator
7. Move the accumulator content to DAC
8. Decrement the accumulator content by 1.
9. If accumulator content is zero go to step2. Else go to step 7.

PROGRAM:

(A) Square Wave Generation

Address	Label	Mnemonics	Opcode	Comments
		ORG 4100H		
		MOV DPTR,PORT		MOV DPTR,PORT ADDRESS OF DAC
4100	START	MOV A,#00		Clear Accumulator
4102		MOVX @DPTR,A		Move A → DPTR
4103		LCALL DELAY		Call delay
4104		MOV A,#FF		Load FF → A
4106		MOVX @DPTR,A		Move A → DPTR
4107		LCALL DELAY		Call delay
410A		LJUMP START		Jump to start
410D	DELAY:	MOV R1,#05		Delay loop
410F	LOOP:	MOV R2,#FF		
4111	HERE:	DJNZ R2,HERE		
4114		DJNZ R1,LOOP		
4117		RET		Return and jump to start
4118		SJMP START		

(B) Saw tooth Wave Generation

Address	Label	Mnemonics	Opcode	Comments
		ORG 4100H		
		MOV DPTR,PORT		MOV DPTR,PORT ADDRESS OF DAC
4100	START	MOV A,#00		Clear Accumulator
4103	LOOP	MOVX @DPTR,A		Move A → DPTR
4105		INC A		Increment A
		SJMP LOOP		Jump to location loop

(C) Triangular Wave Generation

Address	Label	Mnemonics	Opcode	Comments
		ORG 4100H		
		MOV DPTR,PORT		MOV DPTR,PORT ADDRESS OF DAC
4100	START	MOV A,#00		Clear Accumulator
4102	LOOP1	MOVX @DPTR,A		Move A → DPTR
4103		INC A		Increment A
4104		JNZ LOOP1		Jump not zero to location loop1
4107		MOV A,#FF		Load FF → A
4109	LOOP2:	MOVX @DPTR,A		Move A → DPTR
410A		DEC A		Decrement A
410B		JNZ LOOP2		Jump not zero to location loop2
411E		LJMP START		Delay loop

RESULT:

Thus the square, triangular and saw tooth wave form were generated by interfacing DAC with 8051 trainer kit.

VIVA QUESTIONS:

1. Briefly give the principle behind the triangular wave generation
2. What is settling or conversion time in DAC?
3. What are the internal devices of a typical DAC?.
4. What are Program and data memory size in 8051
5. How many 16 bit timers are available in 8051?
6. What is meant by SBUF?

15 INTERFACING OF LEDS AND SENSOR WITH ARDUINO /RASPBERRY PI MODULES

AIM:

To perform Interfacing of LEDs and sensor with arduino /raspberry pi modules

ARDUINO PROGRAMMING

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.

The key features are:

- Arduino boards are able to read analog or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many other actions.

- You can control your board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE (referred to as uploading software).

- Unlike most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. You can simply use a USB cable.

- Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.

- Finally, Arduino provides a standard form factor that breaks the functions of the microcontroller into a more accessible package.

Fig: Arduino Board

Here are the components that make up an Arduino board and what each of their functions are.

1. Reset Button – This will restart any code that is loaded to the Arduino board
2. AREF – Stands for “Analog Reference” and is used to set an external reference voltage
3. Ground Pin – There are a few ground pins on the Arduino and they all work the same
4. Digital Input/output – Pins 0-13 can be used for digital input or output
5. PWM – The pins marked with the (~) symbol can simulate analog output
6. USB Connection – Used for powering up your Arduino and uploading sketches
7. TX/RX – Transmit and receive data indication LEDs
8. ATmega Microcontroller – This is the brains and is where the programs are stored
9. Power LED Indicator – This LED lights up anytime the board is plugged in a power source

10.Voltage Regulator – This controls the amount of voltage going into the Arduino board 11.DC Power Barrel Jack – This is used for powering your Arduino with a power supply 12.3.3V Pin – This pin supplies 3.3 volts of power to your projects

13.5V Pin – This pin supplies 5 volts of power to your projects

14. Ground Pins – There are a few ground pins on the Arduino and they all work the same

15.Analog Pins – These pins can read the signal from an analog sensor and convert it to digital

SENSOR PROGRAMMING AND INTERFACE

```
void setup ()
  {
  // put your setup code here, to run once:
}
void loop ()
{
// put your main code here, to run repeatedly:
}
```

setup:

It is called only when the Arduino is powered on or reset. It is used to initialize variables andpin modes

loop:

The loop functions run continuously till the device is powered off. The main logic of the codegoes here. Similar to while (1) for micro-controller programming.

PinMode

- A pin on arduino can be set as input or output by using pinMode function.

  pinMode (13, OUTPUT); // sets pin 13 as output pinpinMode

  (13, INPUT); // sets pin 13 as input pin

Reading/writing digital values

digitalWrite(13, LOW);

// Makes the output voltage on pin 13 , 0V

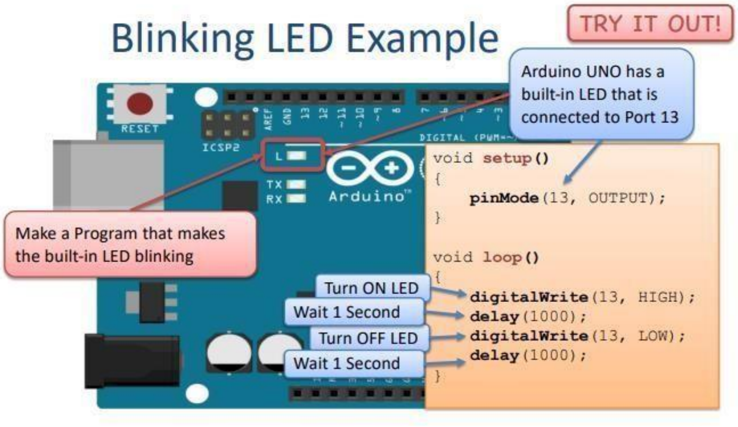
digitalWrite(13, HIGH);

// Makes the output voltage on pin 13 , 5Vint

buttonState = digitalRead(2); /

/ reads the value of pin 2 in buttonState

PROGRAMMING



Blinking LED Example

TRY IT OUT!

Arduino UNO has a built-in LED that is connected to Port 13

Make a Program that makes the built-in LED blinking

```
void setup()
{
    pinMode(13, OUTPUT);
}

void loop()
{
    digitalWrite(13, HIGH);
    delay(1000);
    digitalWrite(13, LOW);
    delay(1000);
}
```

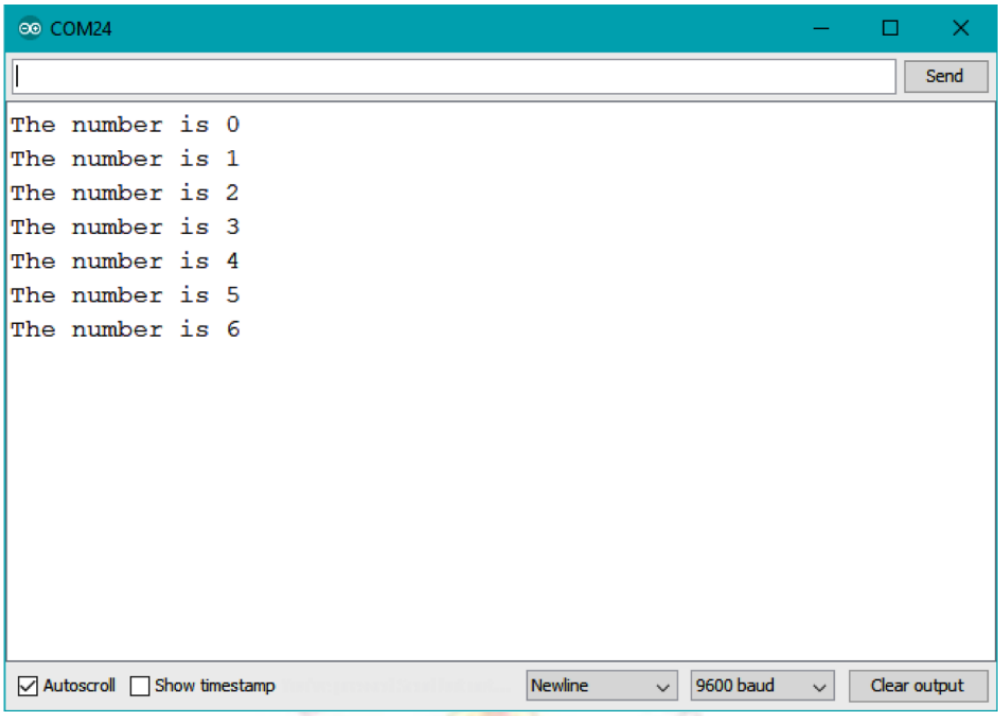
BLINKING OF LED IN ARDUINO BOARD

```
void setup()
{
   // initialize digital pin LED_BUILTIN as an output.
   pinMode(LED_BUILTIN, OUTPUT);
}
// the loop function runs over and over again forevervoid
loop()
{
   digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the voltage level)
   delay(1000);                     // wait for a second
   digitalWrite(LED_BUILTIN, LOW);  // turn the LED off by making the voltage LOW
   delay(1000);                     // wait for a second
}
```

SERIAL PROGRAMMING USING ARDUINO:

```
void setup()
{
Serial.begin(9600);
}
void loop()
{
int i;
for(i=0; i<10; i++)Serial.println(i);
}
```

OUTPUT



```
The number is 0
The number is 1
The number is 2
The number is 3
The number is 4
The number is 5
The number is 6
```

☑ Autoscroll □ Show timestamp Newline 9600 baud

Fig: Serial Monitor output for serial programming

PROGRAMMING USING ULTRASONIC SENSOR INTERFACE

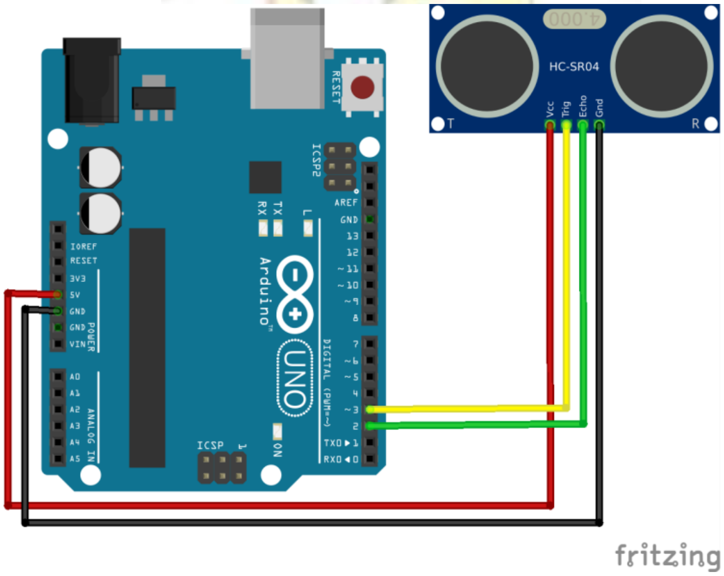


Fig: Ultrasonic Sensor Interface with Arduino

int trigPin= 9;

```
int echoPin= 10;void
setup ()
{
   pinMode(trigPin, OUTPUT);
   pinMode(echoPin, INPUT);
   Serial.begin(9600);
}
void loop ()
{
   //Serial.println("loop"); long
   duration, distance;
   digitalWrite(trigPin,HIGH);
   delayMicroseconds(1000);
   digitalWrite(trigPin, LOW);
   duration=pulseIn(echoPin, HIGH);
   distance =(duration/2)/29.1;
   Serial.print(distance);
   Serial.println("CM");
   delay(10);
}
```

PROGRAMMING USING IR SENSOR INTERFACE

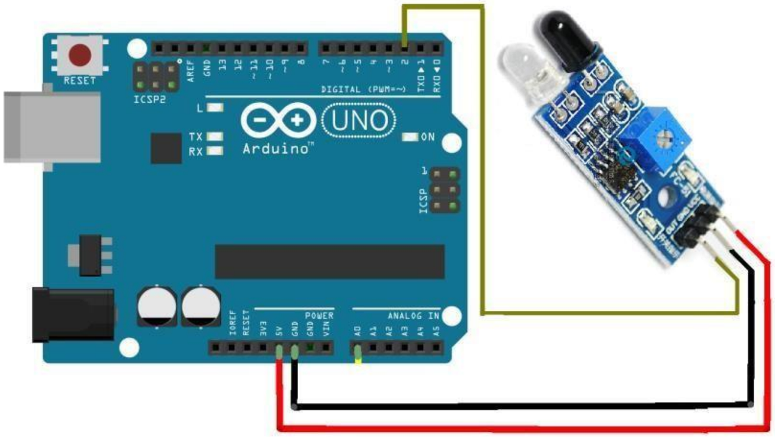


Fig:IR Sensor Interface with Arduino

```
#define s 7
#define led 13void
setup()
{
   pinMode(s,INPUT);
   pinMode(led, OUTPUT);
   // put your setup code here, to run once:
}
void on()
{
   digitalWrite(led,HIGH);
}
void off()
{
   digitalWrite(led,LOW);
}
```

```
void loop()
{
   if (digitalRead(s)==0)
   {
     on();
   }
   else
   {
     off();
   }
}
```

Result

Thus the Interfacing of LEDs and sensor with arduino /raspberry pi modules is done and the output is verified.

VIVA QUESTIONS:

1. What is Raspberry Pi?
2. How does the Raspberry Pi work?
3. Tell about any interesting project with Raspberry Pi.
4. How is Raspberry Pi used in IoT?
5. What are the different components of a Raspberry Pi board?
6. How many types of Arduino do we have?
7. What are the three important parts of Arduino *?
8. Why we should use Arduino?
9. What are the features of Arduino?

ADDITIONAL EXPERIMENTS

17 PROGRAMS TO VERIFY TIMER AND INTERRUPTS OPERATIONS IN 8051 MICROCONTROLLER

AIM:

To write ALP to generate a square wave of frequency, transfer a data serially from one kit to anotherand to verify the result.

APPARATUS REQUIRED:

8051 microcontroller kit ,key board.

a) Program to generate a square wave of frequency.

Steps to determine the count:

Let the frequency of sqaurewave to be generated be Fs KHz.

And the time period of the squarewave be Ts Sec.

Oscillator Frequency = 11.0592MHz.

One machine cycle = 12 clock periods

Time taken to complete one machine cycle=12*(1/11.0592MHz)= 1.085microsec.

Y(dec) = (Ts/2)/(1.085microsec)

Count(dec) = 65536(dec) – Y(dec)

= Count(hexa)

```
            MOV TMOD,#10h     ; To select timer1 & mode1 operation
L1:         MOV TL1,#LOWERORDER BYTE OF THE COUNT
            MOV TH1,#HIGHER ORDER BYTE OF THE COUNT
            SETB TR1          ; to start the timer (TCON.6)
BACK:       JNB TF1,BACK      ; checking the status of timerflag1(TCON.7) for
                               overflow
            CPL Px.x          ; get the square wave through any of the portpins
                              ; eg. P1.2 (second bit of Port 1)
            CLR TR1           ; stop timer
            CLR TF1           ; clear timer flag for the next cycle
```

```
                SJMP L1
```

b) Program to transfer a data serially from one kit to another.

Transmitter:

```
                MOV TMOD,#20H        ; Mode word to select timer1 & mode 2
                MOV TL1,#FDH         ; Initialize timer1 with the count
                MOV TH1,#FFH
                MOV SCON,#50H        ; Control word for serial communication to
                                      to select serial mode1
                SETB TR1             ; Start timer1
                MOV A,#06h
                MOV SBUF,A           ; Transfer the byte to be transmitted to serial
                                      Buffer register.
LOOP:           JNB TI, LOOP         ; checking the status of Transmit interrupt
                                     flag
                CLR TI
HERE:           SJMP HERE
```

Receiver:

```
                MOV TMOD,#20H
                MOV TL1,#FDH
                MOV TH1,#FFH
                MOV SCON,#50H
                SETB TR1
LOOP:           JNB RI,LOOP
                MOV A,SBUF
                MOV DPTR,#4500H
                MOVX @DPTR,A
                CLR RI
HERE:           SJMP HERE
```

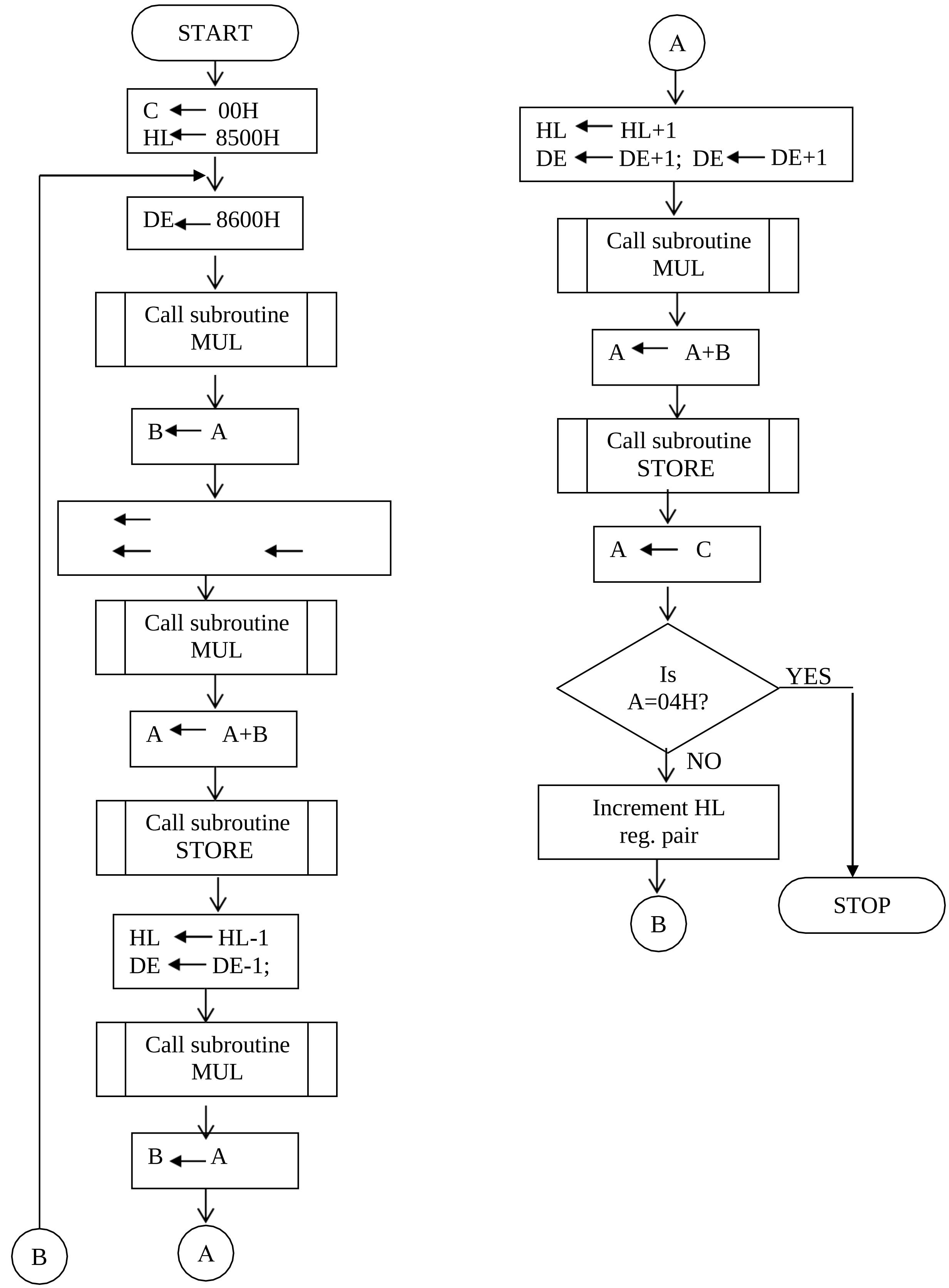
Result:

Thus ALP to generate a square wave of frequency, transfer a data serially from one kit to another and also the result is verified.

VIVA QUESTIONS:

1. What is the use of INT0,INT1?
2. What is the special function of the pin ALE/PROG
3. What is meant by memory interfacing?
4. What is meant by memory mapped IO and IO mapped IO?
5. What are the timer modes are available in 8051?
6. What are interrupt control register?
7. What is the function of IP register?

FLOW CHART:


START
C ← 00H
HL← 8500H
DE← 8600H
Call subroutine MUL
B← A
←
← ←
Call subroutine MUL
A ← A+B
Call subroutine STORE
HL ← HL-1
DE ← DE-1;
Call subroutine MUL
B ← A
B
A
A
HL ← HL+1
DE ← DE+1; DE← DE+1
Call subroutine MUL
A ← A+B
Call subroutine STORE
A ← C
Is A=04H?
YES
NO
Increment HL reg. pair
B
STOP

18 2 X 2 MATRIX MULTIPLICATION

AIM:

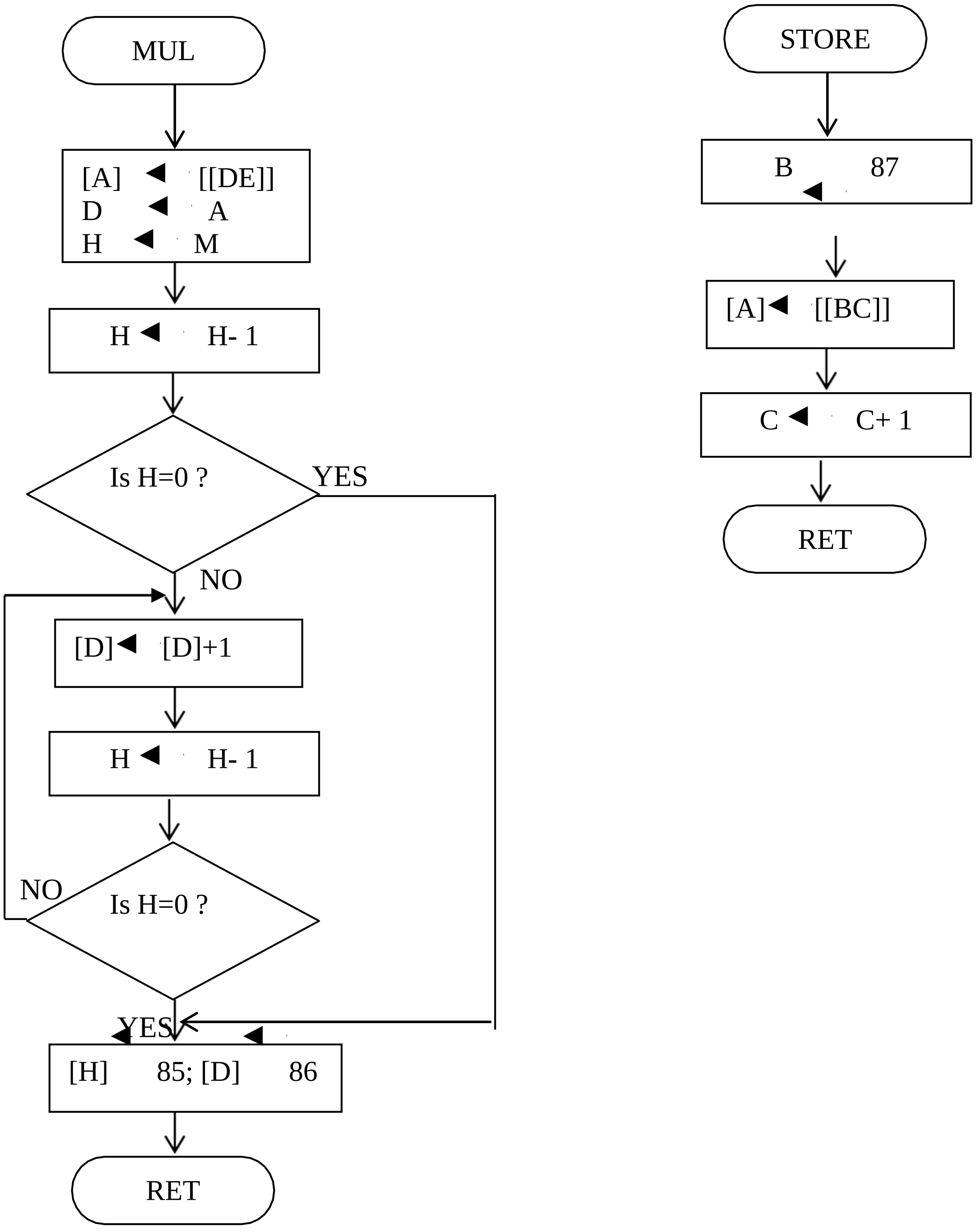
To perform the 2 x 2 matrix multiplication using 8085 microprocessor.

APPARATUS REQUIRED:

8085 microprocessor kit ,key board.

ALGORITHM:

1. Load the 2 input matrices in the separate address and initialize the HL and the DE register pair with the starting address respectively.
2. Call a subroutine for performing the multiplication of one element of a matrix with the other element of the other matrix.
3. Call a subroutine to store the resultant values in a separate matrix.
4. Halt


MUL
[A] ◀ [[DE]]
D ◀ A
H ◀ M
H ◀ H- 1
Is H=0 ?
YES
NO
[D]◀ [D]+1
H ◀ H- 1
NO
Is H=0 ?
YES
[H] ◀ 85; [D] ◀ 86
RET
STORE
B ◀ 87
[A]◀ [[BC]]
C ◀ C+ 1
RET

PROGRAM:

ADDRESS	OPCODE	LABEL	MNEMONCS	OPERAND	COMMENT
8100			MVI	C, 00	Clear C reg.
8101					
8102			LXI	H, 8500	Initialize HL reg. to 4500
8103					
8104					
8105		LOOP2	LXI	D, 8600	Load DE register pair
8106					
8107					
8108			CALL	MUL	Call subroutine MUL
8109					
810A					
810B			MOV	B,A	Move A to B reg.
810C			INX	H	Increment HL register pair .
810D			INX	D	Increment DE register pair
810E			INX	D	Increment DE register pair
810F			CALL	MUL	Call subroutine MUL
8110					
8111					
8112			ADD	B	Add [B] with [A]
8113			CALL	STORE	Call subroutine STORE
8114					
8115					
8116			DCX	H	Decrement HL register pair
8117			DCX	D	Decrement DE register pair
8118			CALL	MUL	Call subroutine MUL
8119					
811A					
811B			MOV	B,A	Transfer A reg content to B reg.
811C			INX	H	Increment HL register pair
811D			INX	D	Increment DE register pair
811E			INX	D	Increment DE register pair
811F			CALL	MUL	Call subroutine MUL
8120					
8121					
8122			ADD	B	Add A with B
8123			CALL	STORE	Call subroutine MUL
8124					
8125					
8126			MOV	A,C	Transfer C register content

					to Acc.
8127			CPI	04	Compare with 04 to check whether all elements are multiplied.
8128					
8129			JZ	LOOP1	If completed, go to loop1
812A					
812B					
812C			INX	H	Increment HL register Pair.
812D			JMP	LOOP2	Jump to LOOP2.
812E					
812F					
8130		LOOP1	HLT		Stop the program.
8131		MUL	LDAX	D	Load acc from the memory location pointed by DE pair.
8132			MOV	D,A	Transfer acc content to D register.
8133			MOV	H,M	Transfer from memory to H register.
8134			DCR	H	Decrement H register.
8135			JZ	LOOP3	If H is zero go to LOOP3.
8136					
8137					
8138		LOOP4	ADD	D	Add Acc with D reg
8139			DCR	H	Decrement H register.
813A			JNZ	LOOP4	If H is not zero go to LOOP4.
813B					
813C					
813D		LOOP3	MVI	H,85	Transfer 85 TO H register.
813E					
813F			MVI	D,86	Transfer 86 to D register.
8140					
8141			RET		Return to main program.
8142		STORE	MVI	B,87	Transfer 87 to B register.
8143					
8144			STAX	B	Load A from memory location pointed by BC pair.
8145			INR	C	Increment C register.
8146			RET		Return to main program.

OBSERVATION:

INPUT				OUTPUT	
4500		4600		4700	
4501		4601		4701	
4502		4602		4702	
4503		4603		4703	

RESULT:

Thus the 2 x 2 matrix multiplication is performed and the result is stored at 4700,4701 , 4702 & 4703.

VIVA QUESTIONS:

1. How many loops needed to perform matrix multiplication ?
2. What is the condition for two matrix is multipliable ?
3. What is the use of the instruction RET ?
4. What are conditional jump and unconditional jump instructions?
5. What is the next line will execute after Call instruction
6. Compare Call and DJNZ instructions?
7. If there is no RET statement after CALL instruction whether the program will come to end or not?