Part A

Department: CSE Program: BSc in CSE

Course no: CSE3215 Course Title: Microcontroller Based System Design

Examination: Final Semester (Session): Fall 2019

Student no: 170104077 Signature and Date: Rafu
5/11/2020

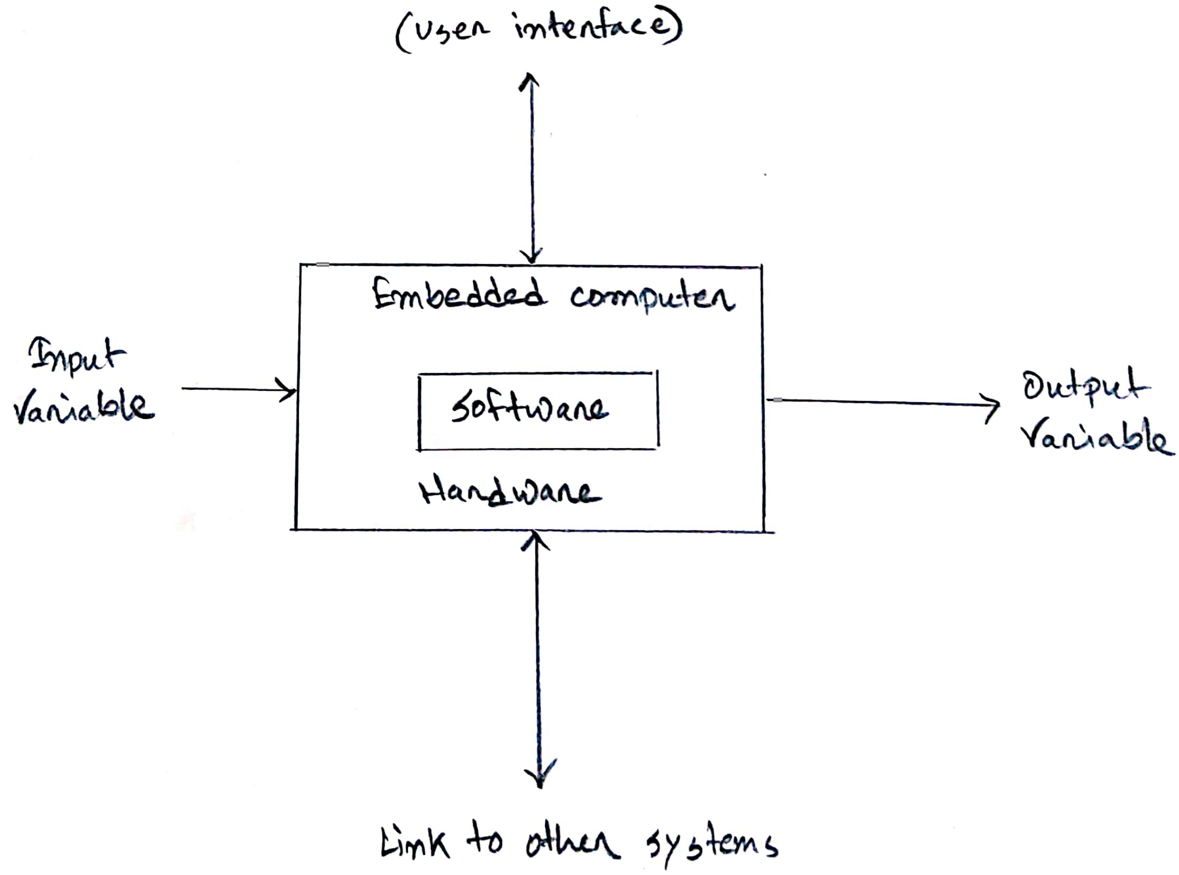
170104077

CSE 3215

Raju

Ans: to the Ques no 1 (a)

An embedded system is an electronic system that uses a CPU chip but that is not general purpose station. If we take any engineering product that need control, and if a computer is incorporated within that product to undertake the control, then we have an embedded system.



170104077
CSE3215

Raju

Characteristics of embedded system

1. Single function: Executes a single program repeatedly.

2. Tightly constrained: Low cost, low power, small, fast and so on.

3. Reactive and real time: Continually reacts to changes in the system's environment. Must compute certain results in real time, without delay.

Some of the embedded systems commonly used in home are:

- Home: Washing machine, answering machines, Microwave, central heating controller, sewing machine etc

- Office: Photocopier, printer, scanner, fax machine, security systems

170104077

CSE 3215

Rafiu

Ans: to the Ques no 1(b)

Interrupts provide a method to postpone or delay the current process, performs a sub-routine task and then restart the standard program again.

There two types of interrupts:

1. External interrupts
2. Internal interrupts

There are five sources of interrupts in 8051.

1. Timer 0 overflow interrupt - TF_0
2. External hardware interrupt - $\overline{INT_0}$
3. Timer 1 overflow interrupt - TF_1
4. External hardware interrupt - $\overline{INT_1}$
5. Serial communication interrupt - RI/TI

170104077
CSE3215

Raju

Upon activation of an interrupt, the micro controller goes through the following steps.

1. It finishes the instruction it is excuting and saves the address of the next instruction on the stack.

2. saves current status of all the interrupts internally

3. jumps to a fixed location in memory called interrupt vector table that holds the address of interrupt service routine.

4. The micro controller gets the address of the ISR and jumps to it. It starts to execute the interrupt service subroutine until it reaches the RETI instruction.

5. Upon executing RETI instruction, the microcontroller returns to the place where it was interrupted. It get the PC address from the stack. and starts to excute from there.

170104077

CSE3215

Raju

There is register in 8051 called Interrupt priority (IP) register. This register is used to set priority level of the interrupts. There are two priority level - High and ~~low~~ low. When a high priority interrupt is serviced it can not be interrupted by any other source. But a low priority interrupt can be interrupted by high priority interrupt.

If we give different priority to INT0, TF0 and INT1 they will get service based on their priority. But if the priority is same then the 8051 uses a mechanism called interval polling. It maintain a ~~hia~~ hierarchy.

High to low priority

INT0
TF0
INT1 ↓

170104077
CSE3215

Rajib

Ans: to the Ques no 2(a)

Difference between microprocessor and micro controller is stated below.

Microcontroller	Microprocessor
1. Computer on a chip	1. CPU on a chip
2. Used in automatically controlled device	2. Mainly used in designing general purpose systems.
3. Less computation capacity compared to microprocessor.	3. Computation capacity is very high
4. Usually used for simpler tasks.	4. Can perform complex tasks.
5. Microcontroller based systems can perform single or very tasks.	5. performs numerous tasks.
6. No need for external ~~comput~~ components to make a system.	6. For a complete system, external components need to be connected.
7. less costly	~~8~~ 7. Cost is high.
8. Less power consumption.	8. High power consumption
9. Use more special function register	9. Use less special function register.

170104077
CSE3215
Raju

Ans: to the Ques no 2(b)

The working procedure of LCALL is stated below:

1. This a 3-byte instruction. 1st byte is the opcode and 2nd, 3rd bytes are used for the address of the target subroutine.

2. LCALL can be used to call subroutines located anywhere the 64K byte address space of the 8051.

3. After the excution of called subroutine the 8051 knows where to come back to, the processor automatically saves on the stack the address of the instruction immediately below the LCALL.

4. When a subroutine is called, control is transferred to that subroutine and the processor saves PC on the stack and begins to fetch instructions from the new location.

170104077
CSE3215

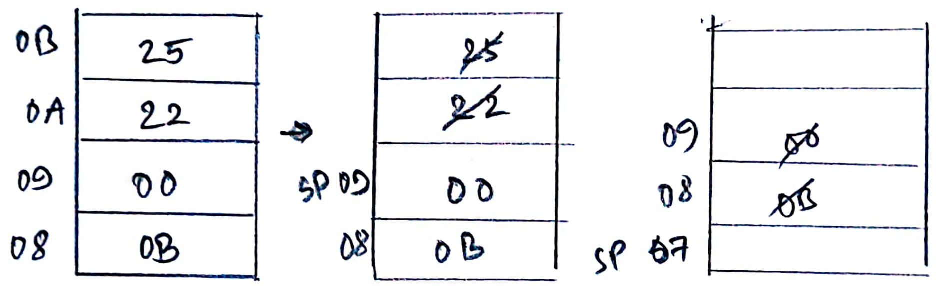
Raju

5. After finishing execution of the subroutine, the instruction RET transfers control back to the caller.

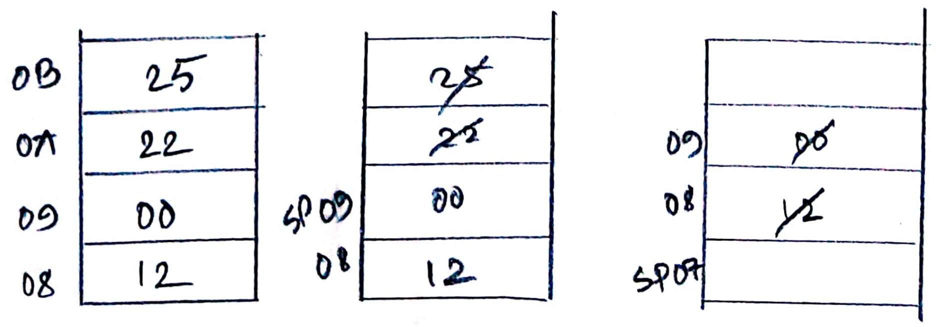
In the given program,

First LCALL instruction is at location 0008. and second LCALL instruction is at location 0012

Stack after 1st Lcall instruction



Stack after 2nd Lcall instruction



ID: 170104077

Raju

Course no: CSE3215

Ans: to the Ques no 4 (a)

Given that,

$R_1 = R_2 = R_3 = 100\ K\Omega$

$R_f = 33\ K\Omega$

$V_1 = +5V$

$V_2 = +5V$

$V_3 = -1V$

$$V_0 = -\frac{R_f}{R_{in}}(V_1 + V_2 + V_3)$$

$$= -\frac{33}{100}(5+5-1)$$

$$= -2.97V$$

Again,

$R_f = 350K$

$R_{in} = 20K$

$V_{in} = -0.75V$

$$I = \frac{E_i}{R_i} = \frac{-0.75V}{20K} = -0.0375\,mA$$

$$V_0 = \cancel{R_f} \; -\frac{R_f}{R_{in}} \times V_{in} = -\frac{350}{20} \times (-0.75\,V)$$

$$= 13.125V$$

(Ans:)

ID: 170104077

Course no: CSE3215

Raju

Now,

$$V_f = I_f R_f$$

$$\Rightarrow V_f = 0.0375 \times 350$$

$$= 13.125$$

$\therefore$ Voltage ~~across~~ across R_f is 13.125

ID : 170104077 Rajib

Course no: CSE3215

Ans: to the Ques no 4(b)

A sonar sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording elapsed time between the sound wave being generated and ~~a~~ sound wave being bounced back, it is possible to calculate the distance between the sonar sensor and the object.

To find the distance to object, simply divide the "round trip" distance in half

$$\text{distance} = \frac{\text{speed of sound} \times \text{time taken}}{2}$$

Round trip means that the sound wave traveled 2 times the distance to object before it was detected by the sensor; it includes 'trip' from the sensor to the

ID:170104077

Course no: CSE3215

Raju

object and 'trip' from the object to sonar sensor.

Given,

distance, $d = 710m$

speed of sound, $v = 344 m/s$

$\therefore$ time $= \frac{710m}{344 m/s} = 2.06s$

Again,

distance reading underwater ~~is~~ requires 760.65 miliseconds.

$\therefore$ speed of sound underwater $= \frac{2 \times 710 m}{760.65 \times 10^{-3} s}$

$= 1866.844 m/s$

ID: 170104077

Course no: CSE 3215

Rajib

Ans: to the Ques no 3(a)

The status register

I	T	H	S	V	N	Z	C
7	6	5	4	3	2	1	0

Bit 7 (I): Global Interrupt - Used for enable/disable all interrupt.

Bit 6 (T): Bit copy storage.
copies a bit or stores from/to register.

Bit 5 (H): Half carry flag

Bit 4 (S): Sign bit - Exclusive or of N and V

Bit 3 (V): Overflow flag

Bit 2 (N): Negative flag - The MSB of the result.
If 1, result is negative, else positive.

Bit 1 (Z): Zero flag - Indicates if the result is 0 or not

Bit 0 (C): Carry flag - Set if there was any carry from the MSB of the result.

ID: ~~1701~~ 170104077 Raju

Course no: CSE 3215

Now, given R20 contains value 1110 1101

CBR R20, ~~0b01001101001~~ 0b 0100 110D

BST R20, 4

These are the instructions required to do the stated task.

After ~~exeatuti~~ execution, R20 becomes

~~R20 = 1110 1101~~
~~0100 1100~~

~~R20 = 0100110~~

R20 = 1110 1101
1011 0011

R20 = 1010 0001 (AND)

So, the value of T flag is 0

Rajiu

Ans: to the Ques no 3 (b)

Five basic characteristics of sensor are given below.

Range: It is the minimum and maximum value of physical variable that the sensor can measure.

Span: It is the difference between maximum and minimum values of input.

Accuracy: The error in measurement is specified in terms of accuracy. It is defined as the difference between measured value and true value.

Precision: It is defined as the closeness among a set ~~x~~ of values.

Sensitivity: It is ratio of change in output to change in input.

$$s = \frac{dY}{dX} = \frac{\Delta Y}{\Delta X}$$

1701040 77

~~R~~ CSE3215

Rafi

From the ~~se~~ scenario described in the question, we came to know that a black car is coming towards a white wall. To measure it's speed we need ultrasonic sensor. Infrared sensor emits infrared light which will be absorbed by the black car. Because black objects do not reflect light. As a result the IR receiver will not receive any light, thus infrared sensor will fail in the given ~~sc~~ scenario. But sonar sensor sends a sound to object and after hitting the object the sound comes back to the sensor. There is no issues of getting absorbed by black colour.

From the above discussion, we can say that Ultra sonic sensor is the best option for ~~the~~ given ~~sce~~ scenario.