P1-HFE TESTER

Design a microprocessor based transistor h_{FE} tester. The system has to display the h_{FE} value of NPN transistors. The transistor under test (TUT) is to be inserted in the socket, and its base is energized with a current from a device DI. The current I produced by the device DI, can be controlled by supplying it with a DC voltage V. The relationship is as follows.

$$I = V * 10^{-6} \quad A$$

The emitter of the transistor is grounded, and the collector is connected to a 1K resistor, whose other end is connected to the +5V supply. The Voltage drop across a 1K resistor is measured and this is related to the h_{FE} by the following relation:

$$h_{FE} * I * 1000 = \text{Voltage drop}$$

The h_{FE} value should be displayed on a seven segment display. If the h_{FE} value is less than 20, an alarm should be sounded.

For the transistor being tested current varying from 1-10μA is given as input in steps with a resolution of 1μA.

A switch is provided for the user -which has to be closed after the transistor has been placed in TUT Slot.

P2-VOICE DIGITIZER

Voice signal is to be digitized and reproduced with certain modification by the microprocessor. Output from a microphone is sampled and digitized using an 8- bit ADC at the rate of 1000 samples per second.

The output obtained from the microphone has been pre-processed inside the microphone to provide a signal varying in amplitude between 0 – 5 V.

The digitized signal is to be stored in RAM. The signal for a period of 6 seconds has to be digitized.

The voice stored has to be reproduced with delay when user closes a switch labelled ***sound replay.***

The delay to be entered by the user are numbers from 1-9, with the help of a key-pad. The keypad has digits 0-9, backspace and enter. A seven segment display has to be provided with the keypad to display the delay value entered by the user.

The delay is between samples – If value entered in is 5 then delay between two adjacent samples when reproduced is 5ms.

P3-IC TESTER

Design a Microprocessor based Tester to test the logical functioning of the following chips:

(i) 7400

(ii) 7402

(iii) 7410

The IC to be tested will be inserted in a 14 pin ZIF socket. The IC number is to be entered via a keyboard.

The keyboard has keys 0-9, backspace, enter and test.

The user places the IC in the ZIF socket closes it – then enters the IC No, followed by enter key. The IC No. is displayed on the 7-segment display. The testing will start once the user presses test key.

After Test the result PASS/FAIL must be displayed on the 7-segment display.

Design the necessary hardware and write the necessary ALP for implementing the above-mentioned task.

P4-RAM TESTER

Design a microprocessor based RAM tester. The tester should be able to test 6164 RAM chips. The tester tests each bit of the RAM individually. For a byte of RAM, the first bit (D0) is written as zero and read back, now a one is written into the bit and again it is read back. If the two read operations result in bit D0 to contain a zero and one respectively then the bit is inferred as good. Any other result indicates a faulty bit. The test is repeated for all bits of a byte and for all bytes of the RAM. The summary result, PASS/FAIL should be displayed.

User will place the 6164 chip in the zip socket, then press a switch labelled ***TEST.***

The RAM is tested and the result is displayed on the 7-segemnt display as PASS/FAIL.

[Pl note RAM to be tested cannot be directly connected to system bus of 8086 in case the RAM chip is damaged – the RAM here has to be treated as an IC under test- and corresponding interfacing has to be done]

P5- BATCH WEIGHING MACHINE

A microprocessor system is to be designed as a batch weighing machine. The system is interfaced to three load cells by means of an 8 bit A/D converter.

The conditioned output of the load cells is given by the equation: Vout = 0.025 x weight (Kgs.)

The system monitors the output of the load cells and finds out the total weight by taking the average of the three values that are sensed by each load cell.

This value is displayed on a seven-segment display.

When this value exceeds 99 kgs, an output port, which is connected to a relay, is switched on to sound an alarm.
Design the necessary hardware and software for implementing the above-mentioned task.

Once the objects are placed on the load cell user presses a switch labelled ***weigh.***

P6 – EPROM PROGRAMMER

Design a microprocessor based **EPROM Programmer** to program 2732.

The EPROM can be programmed by applying 25V at VPP and 5V at OE pin.

Initially all data of EPROM will be 1's. Before the EPROM location is programmed it must be checked for whether it is empty (data in location must be FF_H if the location is empty). All locations. must be checked. If not empty an LED labelled ***not empty*** should be glowed. Even if one location is not empty – the EPROM is not programmable.

If the EPROM is empty, it can be programmed location by location.
The process for programming is as follows:

- The location to be programmed starting from 0000: FF is displayed on set of seven segment displays one by one. 0000 being the current address and FF being the current data. All display is in hex.
- The user will the enter the data he wants to program into location 0000 using a hex keypad – which has all hex digits as well as enter and backspace. The data entered by the user will now be updated on the seven segment display.
- The 8- bit parallel data is applied to the data pins of EPROM.
- The address to the EPROM is then provided. To program the address of each location to be programmed should be stable for 55ms.
- When address and data are stable, a 50ms active high pulse is applied to CE input.
- After programming the data is read back from location to check whether programming was successful – If not successful – an LED labelled ***fail*** should be glowed and the programming stopped
- This process is repeated for all locations.
- If all locations are programmed successfully a LED labelled ***programming completed*** glows.

(Note: the normal system bus of the processor cannot be used for providing address/data/CE during the process of programming)

P7 SCANNER

Design a microprocessor based scanner which will scan a black and white image and store it as binary data. The scanner has two stepper motors for motion along two orthogonal coordinates. The rotational motion is converted into transnational motion through a lead-screw mechanism.
Five paired LED photodiodes intended for B&W image scanning are placed 0.1 centimeter apart. The maximum size scannable is 10cm X 10cm.
The photodiode output is analog signal (between 0 to 5 Volts) which is to be digitized.
Image information is stored sequentially in the RAM.
The user presses a switch labelled ***Start Scan*** when he wants to scanning process to be completed. Once scanning is completed an LED labelled ***Scan Complete*** *I will glow.*

P8 EVM

Design a microprocessor Voting Machine which has provision for 8 candidates. It should keep the count of total votes polled and the count of votes polled for each candidate.

Before being put in use, it should check if all memory location allotted to candidates, and the total count are empty. If not, it should clear these as well as the display.

There are two keypads one for the polling officials and one for the voter. The Polling Officers Keypad also comes with a 16 character LCD Display.

To put the voter keypad in use, it needs to be enabled by 8 polling agents and the Presiding officer. If anyone is missing it should not be enabled.

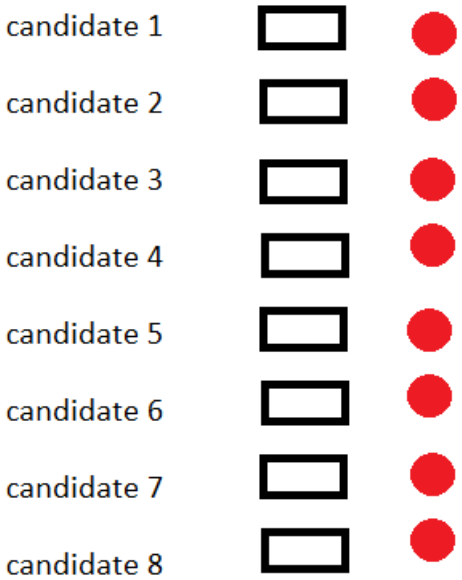
This enabling is done using the polling officers' keypad.

The polling officer's keypad has keys 0-9, backspace, enter, Poll count, Lock, Unlock, DisplayCount.

Each polling agent and Presiding officer have a unique 5-digit numeric code.

The system when turned on displays officer 1 on LCD. The polling officer then enters his numeric code. If correct then the n display is updated to officer 2 and so on and finally Presiding officer enters his code. Each person is allowed 2 retries – if there is a failure the voting is blocked.

The voting interface for the user will be as follows



The name of candidate followed by button followed by LED. Voter will press button against candidate's name – LED will glow for 2 seconds.

After 10 hours (7 a.m. to 5 p.m.) it should stop taking input from voter

There has to be a provision that the Presiding officer by pressing the Lock key followed by a 5-digit code can lock voting in between & then can restart it by pressing thr Unlock key followed separate 5-digit code. For retrieving the count of each candidate the Presiding Officer presses the Poll Count key followed by a 5-digit code. The Presiding officer then enters the Candidates Number Followed by Display Count Key – The count for the candidate is displayed. This is done for all candidates.

P9 – FLOUR PACKING MACHINE

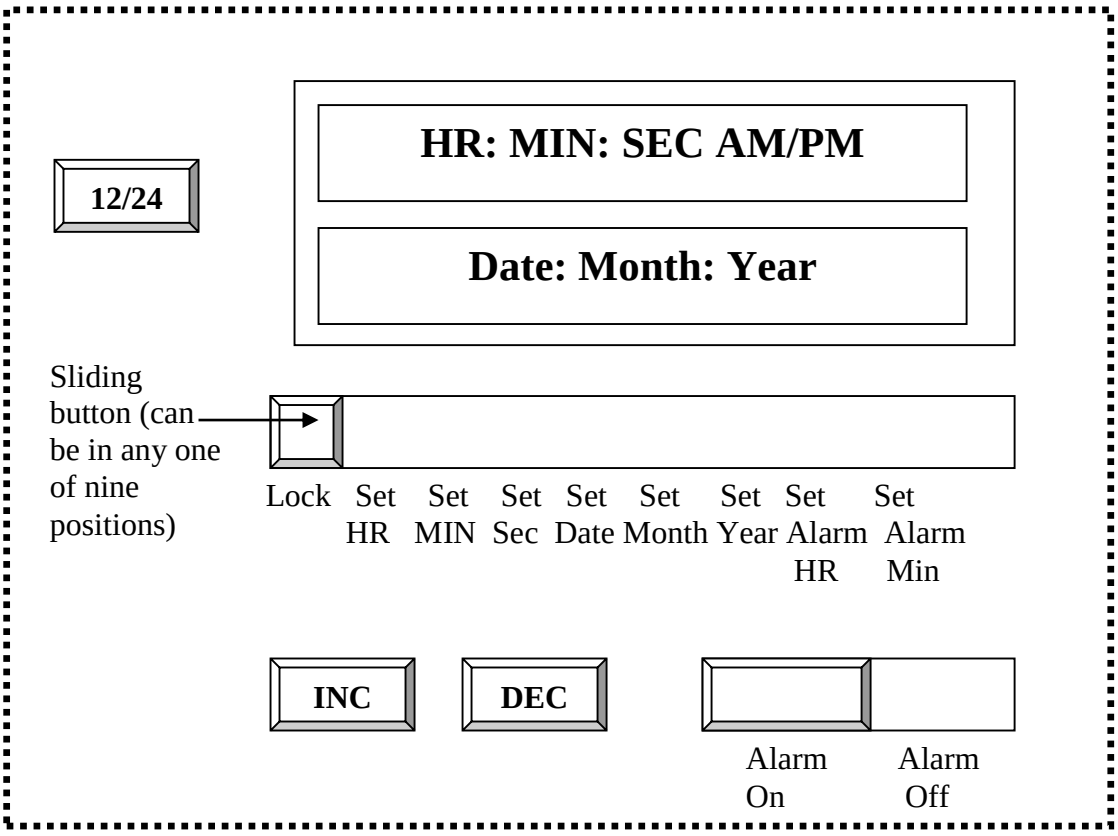
Design a Micro-Processor based flour packing machine. You have flour contained in the silo. The user keys in the required amount of flour per packet. The user interface has a keypad with keys 0-9 , Weight, Temp and Start Key. The user will press the Weight key and then provide the required weight via the keypad. The system is also required to monitor the temperature of the floor where packing is going on. This temperature range (in Celsius) is user settable. To set the temperature the user will press the Temp key followed by the temperature (2 digits). While the user is pressing a key it should be displayed on 7-segment displays available with the keyboard. The measured temperature value of the floor should be displayed on a seven segment display. On pressing of START key the system should pack the specified amount of flour based upon the user input. The system is also required to display the number of packets packed in every hour on a seven segment display. The number of packets per hour will not exceed 99. An alarm has to be provided if the temperature rises 5 degrees above the set temperature. If the user presses the START key without configuration, then the system should pack for the preset/default weight and temperature. The system will have display one temperature and as well as number of packets at the same time.

P-10 System to be designed: Digital Clock

Description: A Digital Alarm Clock that displays Time

User Interface: Time is displayed in Hours and minutes and seconds.

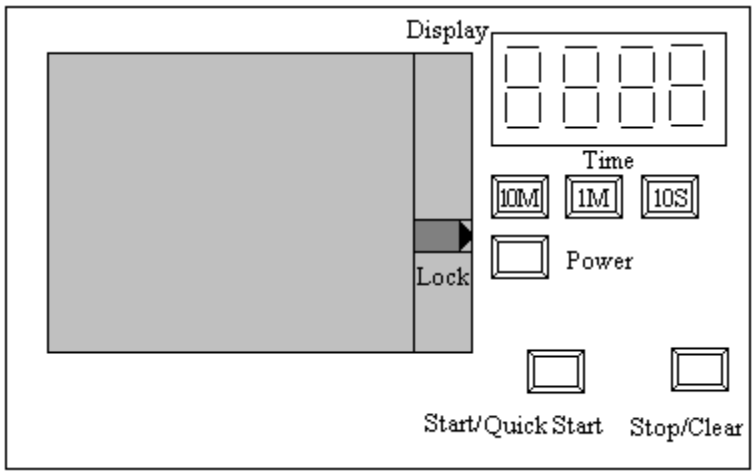
- An LCD is available for display
- The LCD displays the time as well as date and day
- Using the Set Switch user can set Minutes/ Hours/Seconds/Date/Month/Year /Alarm Hr/ Alarm Min by placing the sliding switch at the appropriate positions. When the set switch is in **LOCK** position the clock functions normally.
- Alarm Set switch is used for setting the Alarm.
- The Hour and the Minute of the Alarm can be set using the Hr/Min Switch with the Alarm Set switch in the on position.
- INC push button is used for incrementing values displayed and DEC switch is used for decrementing values displayed
- Alarm switch is used for turning on the Alarm.
- Time can be displayed in AM/PM or 24 hour format
- User can toggle between any of the display formats at any time by pressing the 12/24 key
- While Time/Alarm is being set the value being set should be seen on the display.



P11 System to be Designed : Microwave Oven

Description: A Simple Microwave Oven without grill.

User Interface: Is shown in the following Figure



- User can cook at 5 different Power levels: 100%, 80%, 60%, 40 % 20%
- Ever press of the Power Button decrements the power level by 20 %
- 1 Press - 100%; 2 Presses – 80% ; 3 Presses – 60%; 4 Presses – 40 %; 5 Presses – 20%
- 6 Presses – Brings the power level back to 100 %
- The Default power level is 100%
- Power Level is varied by controlling the amount of time for which the microwave is turned on.
- Time of cooking is broken up into 10 sec slots, if power is 60% then for 6 secs the microwave is on and rest of the 4 secs the microwave is off.
- Time is set as multiples of 10 Mins, 1Min, 10 Secs. **For e.g. if the cooking time is 12 Minutes and 40 secs- the 10 Minutes button has to be pressed once, 1 Minute Button has to be pressed Twice and 10 seconds button has to be pressed four times.**
- Once Time has been set Power cannot be modified.
- When user is setting power level or Time, the value being pressed should be displayed, and when user presses the Start button, the cooking process begins and the time left for cooking to complete is displayed.
- Once the cooking begins the door gets locked and should open only when cooking process is terminated.
- User can terminate cooking anytime by pressing the STOP button.
- When Stop button is pressed once cooking is aborted, timer is stopped, not cleared; cooking can be resumed by pressing Start.
- When stop is pressed twice, cooking is aborted and timer is also cleared.
- When cooking time elapses, a buzzer is sounded; pressing the Stop Button stops the buzzer.
- A Quick Start mode is available where timer or power need not be set, just Start button needs to be pressed, the default power value is taken and time is set as 30 secs, for ever press of the start button time is incremented by 30 seconds.

P12: System to be designed: Automatic Washing Machine

Description: An Automatic washing machine with Dryer.

The Washing Machine can handle three different types of load: Light, Medium and Heavy

The Washing Machine has three different cycles: Rinse, Wash and Dry.

Depending on the load the number of times a cycle is done and the duration of the cycle varies.

Light Load: Rinse- 2 mins, Wash- 3 mins, Rinse – 2 mins, Dry Cycle –2 mins

Medium Load: Rinse- 3 mins, Wash- 5 mins and Rinse – 3 mins Dry Cycle –4 mins

Heavy load: Rinse- 3 mins, Wash- 5 mins and Rinse – 3 mins, Wash- 5 mins and Rinse – 3 mins, Dry Cycle – 4 mins

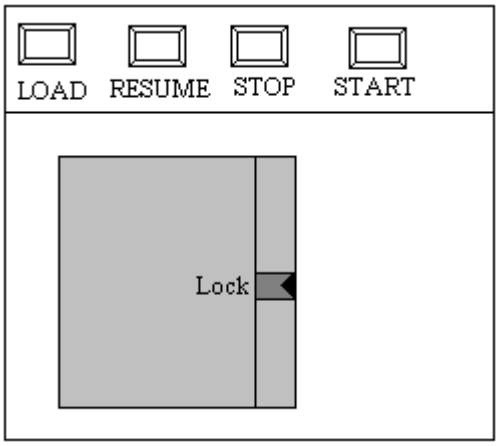
- The Washing Machine is a single tub machine.
- The Washing machine is made of a Revolving Tub and an Agitator. The Agitator is activated during the Rinse and Wash cycle; revolving tub is active only during the Dry cycle. The door of the washtub should remain closed as long as the agitator is active.
- Before each cycle the water level is sensed. At the beginning of the cycle the water level should be at the maximum possible level, the water should be completely drained during dry cycle. The cycle should begin only when the water level is correct.
- At the end of each cycle a buzzer is activated. The user should drain the water at the end of the rinse/wash cycle and refill the water for the next cycle; once this has been completed the user can press the resume button.
- At the beginning of the wash cycle the user should add the detergent.
- At the end of the complete wash process the Buzzer is sounded.
- User can turn off system by pressing STOP Button
- Different sounds are used for different events.

User Interface: The User Interface is shown in fig below

The number of times the load button is pressed determines load : 1press- light; 2 presses – medium and 3 presses –heavy.

To begin washing process START is pressed.

Pressing STOP can stop the process.



P13: System to be Designed: Smart AC System

Description: This system opens/closes six AC vents based upon the current temperature in the Room. The temperature is maintained at a pleasant 20 –25 degree C. The AC vents can be gradually opened / closed. This is done in accordance with the temperature in the room. The room is a fairly large sized room so 6 temperature sensors are placed at different points of the room. Each sensor and AC vent is associated with part of the room. You can assume that the room is broken up into 6 sub-areas each with its own sensor and ac vent.

User Interface:

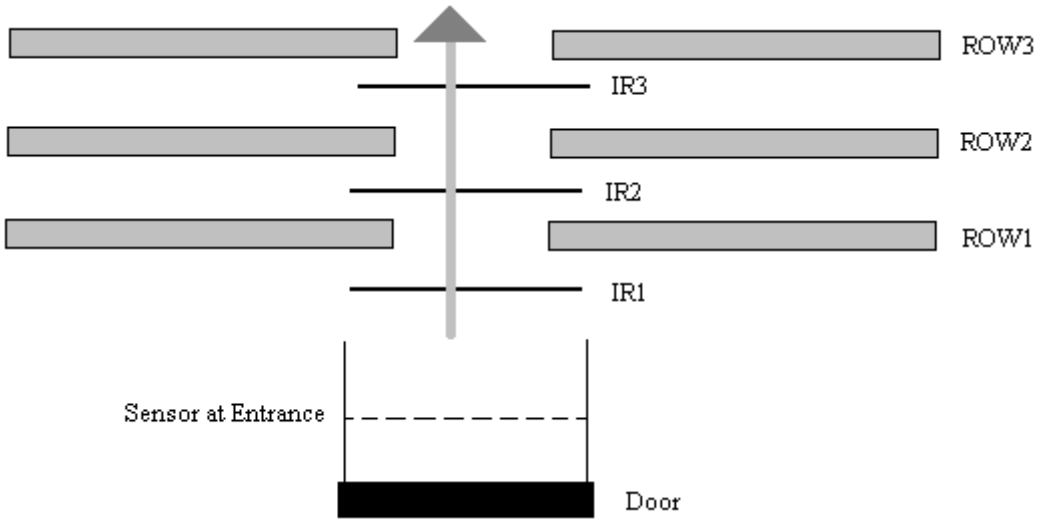
1. Air-conditioner starts when user presses 'Start' button.
2. User can also set the required temperature by using a keypad interface. This temperature value should be displayed on a 7-segment display.
3. After setting temperature initially, user should be able to change the temperature setting by an up and down switch. Each press on this arrow button increases/ decreases the temperature by one degree Celsius. Min temp value is 20 deg, whereas maximum temp value is 25 deg Celsius. Pressing 'UP' button after reaching to 25 deg C, should not change the display value or setting of AC. Same is true for lower bound.
4. Air-conditioner can be stopped by pressing 'Stop' button.
5. User can also set the mode of AC as 'Bio-Sleep' mode besides a 'Regular mode' setting.

6. In Bio-sleep mode, user should be able to enter the value of time in terms of hours after which the AC has to be switched off automatically. (For example, if value entered is 2, then the AC should switch off after 2 hours from the time this setting is applied).

P14:System to be Designed: Smart Lighting System

Description: This is a lighting system for a conference room. As the seats get filled the light should be turned on. The rows are filled from row1 onwards. There are 4 lights per row. As each row begins to get filled the lights get turned on. As each rows empties completely the light gets turned off. You can assume there are atleast 5 rows. Entry to the auditorium is restricted to a certain point of time. Exit can be at any point of time.

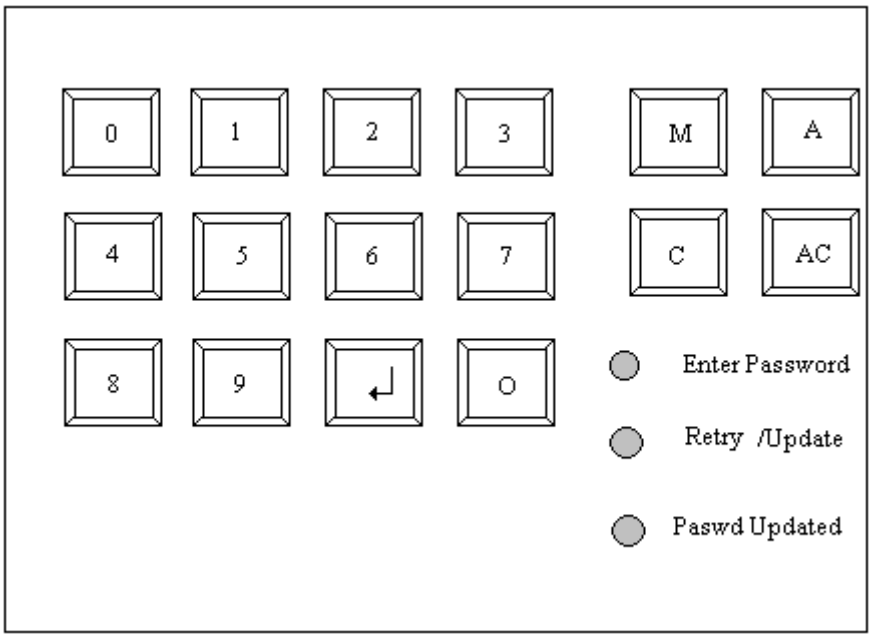
System Details:



P15: System to be Designed : Door Security Control

Description: This system controls the opening and closing of a door based on password entry. If the password is correct the person can enter. Each person is given two chances to enter the correct password. On failure an alarm is sounded. Inside the room a button is available when the button is pressed the door opens for I Min, so that the person can leave the room.

User Interface: There are three set of passwords: (1) User (2) Master (3) Alarm off



- The Master password is used by the security Personnel for updating Password of the day. Pressing the M button activates this mode. The system glows Enter Password LED asking the personnel to enter the password. The master password is a 16-digit value. The master is given only a single chance to enter the password. If authenticated, the retry/Update LED glows. If there is a failure in authentication the alarm is sounded. When the retry/ Update LED glows the user has to enter password of the day. This is 12-digit value. Once this value has been accepted by the system the Passwd Updated LED glows.
- User has to press the O key when he wants to enter the room. The Enter Password LED prompts the user to enter the password. The user is given C/AC option as well. If the first attempt fails, the RETRY LED glows. The user is allowed to re-enter password, on authentication door opens for a period of 1 Min. On Failure an ALARM is sounded.
- To Turn-off the Alarm the A button has to be pressed. Enter Password LED glows prompting user to enter the 14-digit password for turning of alarm, no retries are allowed. If authentication is successful then the alarm is turned off.
- To leave the room a button is available inside the room, when the button is pressed the door opens for 1 Minute so that the person can leave the room.

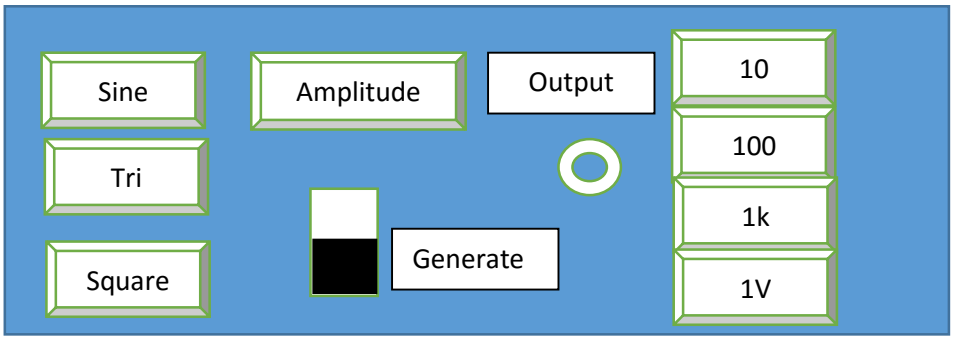
P16: System to be Designed: Fire Alarm System

Description: This system checks for abnormal smoke content in a room and under such conditions throws open all exit doors and windows and opens a valve that releases the gas to put-out the fire. An Alarm is also sounded; this alarm is sounded until the smoke level in the room drops to an acceptable level. The room has two doors and four windows. The smoke detection system is made up of three smoke sensors placed on the ceiling of the room. When atleast two of three detectors get turned on, the alarm system is activated. If only one of them is activated a different alarm sound is produced indicating probable mal-function of alarm. The system can be activated or de-actived using a single switch.

P17: System to be designed: Frequency Generation

Description: This system is used to generate a Sine/Triangular/Square waveform of Frequencies ranging from 10 Hz to 99KHz. Voltage is between 0-10V.

User Interface:



On system power up the user has to configure the desired type of waveform (square/triangle/square) , frequency and amplitude.

To generate a Square Waveform of Frequency 9.35 KHz the user has to press square key, followed by 1K Key- 9 Times, 1K Key – 4 Times, 100 Key –3 Times 10 Key- 5 Times.

To select the Amplitude the user will have to press Amplitude key and then press the 1V key “n” number of times where “n” is the peak to peak amplitude of the waveform to be generated. (only integer values of output voltages needs to be generated)

When generate switch should be turned on and then the frequency generation is enabled ie, the square waveform of that frequency will be generated.

When frequency generation is enabled, if the user wants to change the waveform into another type for e.g. sine he just has to press sine.

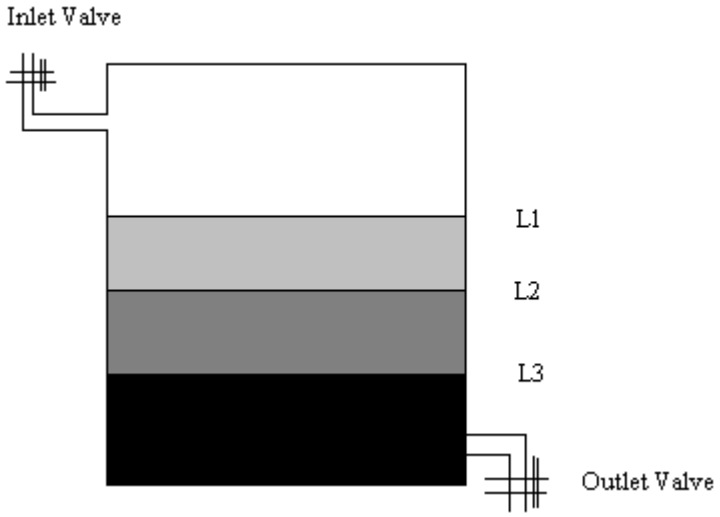
When a signal of different type/amplitude /frequency has to be generated, the user will have to turn-off the generate switch and then configure the function generator as mentioned above.

P18: System to be Designed: Smart Overhead Tank

Description: This is a tank system in which the water level is maintained according to the time of the day. The water level should be maintained at three different values according to the time of the day.

Peak Hours: Maximum Level of Tank Peak Hours is between 6:00 AM to 10:00 AM in the Morning and 5:00-7:00 PM in the evening

Low Hours: Minimum level. The rest of the time it is maintained at a nominal level. Low hours is between 12:00 Midnight and 5:00 AM in the morning



The inlet valve draws water from the main-tank system and the outlet valve sends the surplus water back to the main tank. The water in the main tank must be maintained at a constant value, if the level drops the motor must be turned on.

The water tank is used for supplying water to bathrooms and kitchen – sensors used must be non-contact.

P19: System to be Designed : Chocolate Vending System

Description: This automatic machine vends three different types of chocolates.

Perk: Rs. 5.00

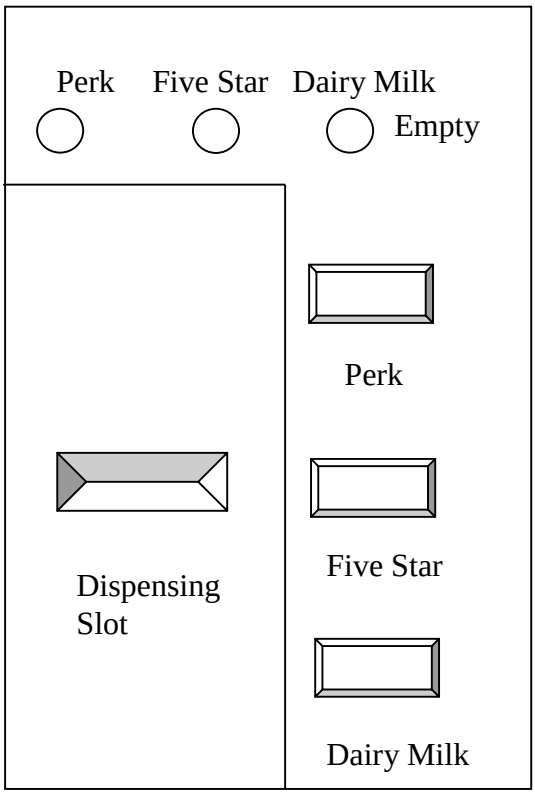
Five-Star: Rs10

Dairy Milk: Rs20.

The currency has to be given in terms of 5 Rupee coin. A weight sensor is used to detect whether the coin is an Rs5 coin or not. There are three buttons available for the selection of the chocolate. After the chocolate has been selected user has to put the correct currency into the coin slot. When the user has dropped the entire amount into the slot, the machine dispenses the correct chocolate.

LED's are used as indicators to show if any of the chocolates being vended are not available.

User Interface:



P20: System to be Designed: Smart Garage System.

System Requirements

- The capacity of the garage is 2000 cars.
- System is used in underground parking lot of a hotel.
- Each user of the garage has a remote unit which he can use for opening and closing the garage door.
- Remote unit has only a single button.
- User is allowed to retrieve the car at any point of time
- A LCD Display is available indicating the number of cars in the garage.
- System runs from a standard power inlet available in the garage.
- When the number of cars reaches 2000, the LCD displays ”FULL”
- When there are no cars, the LCD displays “EMPTY”

System Specifications

- Remote unit button toggles the condition of the garage door- i.e. if the door is opened it is closed and vice versa.
- The remote unit is used for short distances only.
- A DC motor is used for opening and closing the door – The motor is a 50V -3 A motor.
- Maximum frequency input to the motor system cannot exceed 100 KHz.
- The system should be able to distinguish between a person and a car.
- A switch is available that can be closed only by the weight of a car.
- System is used in the hotel- so you can assume that a valet parking system is followed – this indicates that only one person leaves the garage after the car is parked and only a single person enters the garage to retrieve the car
- The system also has to distinguish between entry and exit. You have to develop a scheme to distinguish between entry and exit of person/car. [Hint: Use any number of IR sensor pairs as required]
- Whether a car enters or a valet enters the door remains open for a period of five minutes
- The door can close after 5 Minutes or when the valet uses the remote.
- The remote can be used inside as well as outside the garage.

P21: System to be designed: Elevator control

System Requirements

- The elevator operates along **4 floors**.
- When not in use the elevator is always on the ground floor.
- The elevator can be called by pressing any one of **two buttons available on each floor**.
- One button is **up** and the other is **down**.
- Whether the elevator stops at the floor or not depends on the direction in which the lift moves. For eg. if the lift is moving in upward direction and the person on say the 2nd floor presses the down button; the lift will not stop in the current journey. When the lift reaches the 3rd floor and starts moving down then the lift will stop at the 2nd floor.
- At **every floor there is a 7-segement display** that indicates the floor in which the lift is right now. The display can be any value from 0 - 3. '0' indicates the ground floor.
- Inside the lift **- buttons are available for floor selection**.
- **The floor towards which the lift is moving is also displayed** within the lift.
- **Doors to the lift open and close automatically**.
- When the lift reaches any floor where it has to stop it opens automatically, and it closes when a button called "Door Close" is pressed. **Lift does not move until the door is closed.**
- System runs from a standard power inlet.

System Specifications

- An Electro-magnetic system is used for open and close of the door. You just need to provide the on/off control.
- A heavy duty servo motor is used for lift movement. You just need to provide the input to the driver circuit.
- The inputs are direction (up/down) and a PWM input which control the speed at which the lift moves. The duty cycle can vary from 20% to 50%.
- The frequency of the PWM signal is 10 Hz.
- For detecting whether the lift has reached a floor, the system has a set of three sensors – two 'coarse' sensors and a 'fine' sensor. All the sensors are contact switches (i.e) when the lift reaches the point where the sensors are placed, the contact switch gets pushed in. Output of contact switches are low when closed and high otherwise. The sensor arrangement is represented in the fig below

- On the ground floor – only Coarse Sensor2 and Fine Sensor will be available. On the 3rd floor only Coarse Sensor 1 and the Fine Sensor will be available.
- When the lift starts at the ground floor it starts at a low speed gradually accelerating to the maximum speed. It should operate at maximum speed when it reaches 'Coarse Sensor 1". As the lift moves up if it has to stop at floor '1', when Coarse Sensor 2 is detected at that floor the lift starts moving at a low speed until it can stop when it reaches Fine sensor. When it starts again it moves at low speeds and reaches the maximum possible speed when it reaches the Coarse sensor. The same is done in the reverse direction with the appropriate sensors.
- Speed at which the lift moves is proportional to the duty cycle. For acceleration, duty cycle has to be gradually increased from 20 % to 50 %. And for deceleration, the duty cycle reduced from 50 % to 20 %. The increase is in steps of 10 %
- A 7447 chip (BCD to seven segment converter) is used for driving the 7-segment displays.
- 7447 takes a 4-bit BCD value and converts into the corresponding 7-segement equivalent.

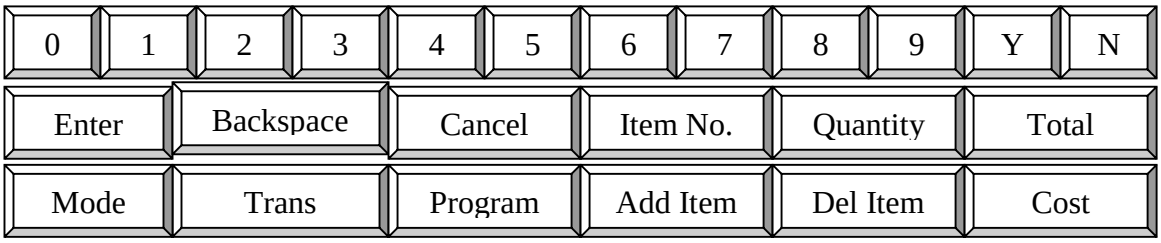
P22: System to be designed: Cash Register

The system to be designed is a **Cash Register** a modified form of the one available in the institute cafeteria. The system is a stand-alone with inputs provides via a keyboard. Outputs are available via a LCD display. System gets power via the standard power outlet. System has chargeable battery available with it, that is used a battery back-up of the RAM. The battery charges itself when the system is on. A fully-charged battery has a life-time of 36 hours.

System Requirements

Keyboard

Format of the keyboard is shown below



Display

Display is a Liquid Crystal Display .Size of the Display is 16 x 1. (16 characters on one line).The LCD is connected to the micro-controller through a display driver in this case HD44780 which is available with the LCD

System Operation

- The system is Interactive in nature
- The system is provided security by a hardware lock. Only when the lock is open the system is functional.
- The lock system comes with a key. When the key is turned, the lock circuit gives a TTL high output else it gives a TTL low output.
- If the user presses a key on the keyboard when the lock is closed the system turns on a buzzer.
- At any point of time when the system is operational if the lock is closed the system must be disabled.
- A pulse of frequency 4 KHz turns on the buzzer. Buzzer is turned on for 1 Minute and then turned off.
- After the lock is open, the LCD is turned on and it displays “System Ready”.
- The user has to then press the **Mode** button on the keyboard. The LCD then displays “Select Mode”.
- The user can operate in any of the two modes **Transaction/ Program.** Transaction is the normal function and in the Program Mode, user is allowed to add new items and their cost.
- Every item has an item code and a cost associated with it.
- If the user presses the **Trans** key the system enters into transaction mode. The LCD displays “Enter Transaction Mode Y/N ?”.
- User then has to press **Y** to confirm. If user presses **N** it goes back to Mode Select display.
- In the Transaction mode user is expected to enter the item code and the quantity. Item code has to be entered using the **Item No**. key followed by the item code. The item code can be entered with the help of the numeric keys **0-9**. At the end of the item code the user has to press the **Enter** key. The item code will be then displayed on the LCD.
- User can press **Backspace** key to change the value of last key press or he can press **Cancel** to delete the whole entry.
- After the item code is displayed, user has to enter the quantity by pressing **Quantity** key followed by quantity of the item (using the numeric keys) a person wishes to buy and the **Enter** key.
- Automatically the total cost of the item will be displayed on the LCD.
- The user can continue entering all the items and finally press **Total** to display the total cost.
- In the Program mode user can add new items or delete an item. If the cost of an item is to be updated it has to first deleted and re-added to the item list in memory.
- When you add a new item you have enter the item number by using the **Item no.** key and the cost using the **Cost** key. After the cost has been keyed in the user must press **Enter**.
- The inter-active display will confirm your entry before storing it in the memory.

- If an item is to be deleted it is done using the **Del Item** key. Then user is required to press the **Item No** key followed by the item code and then press **Enter**.
- The inter-active display will confirm your entry before deleting it from the memory

P23: System to be designed: Spirit Level Reaction-time Tester

System Description: Used for testing the sobriety of a person.

The basic project operates like this: When a 'start' button is pressed the unit waits a random time interval (between four and eight seconds) then begins incrementing LEDs on a bar graph display so that they appear to 'rise' upwards. When the user sees the LEDs moving, he/she presses a 'stop' button as soon as possible - the earlier the button is pressed, the fewer LEDs that are lit. The entire bar graph (9 LEDs) will sweep to the top in 0.4 seconds (with 50ms between LED steps).

User Interface

Spirit Level meter features two pushbuttons (Start and Stop) and nine LEDs on a bar graph. When the START button is pressed, a random time delay is generated after which the bottom LED lights. After a 50ms time interval the bottom and the next-highest LED both light. After another delay, the three bottom LEDs light. The process continues until either the STOP button is pressed (in which case the LEDs stop rising or when all LEDs are lit). The program must also check the STOP button just before lighting the bottom LED to ensure the user isn't simply cheating and holding the STOP pushbutton continually. If the user tries to cheat, blink all LEDs several times and simply go back to the start (waiting once again for the START button).

Generating a random number: In order to generate a random number, run one timer continually from an internal clock (do not stop it). When the START button is pressed, simply latch the value of the timer - this is essentially random. From that number, one can generate a random delay. The sobriety of a person on a scale of 1- 5 (1 –maximum intoxication) has to be displayed on a seven segment display.

P24: System to be designed: An Intelligent Humidistat

System Description: A humidistat is supposed to be reset according to the outside temperature - as the outside temperature falls, the humidity level inside the house should be set lower. The purpose of this project is to develop a humidistat which senses the outside temperature and adjusts the humidity accordingly. Two sensors are required: outside temperature and inside humidity. Output is provided via a simple relay with the humidifier (presumably on the furnace) being on or off. Also readings from the humidity and temperature sensors must be displayed on an LCD display. The entire system can be turned on or off using a single switch.

P25: System to be designed: Weather Monitoring Station

System Description

This system monitors weather parameters such as: Air Temperature, Air-Humidity, barometric Pressure, and Displays the average over regular intervals of an hour on a seven-segment display. The Display is continuous. Update of the display is done once in an hour. Weather parameters are sensed at regular intervals of 5 minutes.

The display is of the format: "Temperature – Value ^{0}C" and so on.

- Other than the regular display, the user can request the display of the weather parameters to be updated at any point of time by pressing a push button key. The accuracy of the parameters monitored has to be up to two decimal points.

P 26: System to be designed - Lawn Sprinkler System

System Description:

An average sized garden has 8 sprinklers that have to be turned on and off. A series of 16 soil moisture sensors are placed at different parts of the garden. The sprinkler system works twice in a day. Once at 11: 00 am and then at 6:00 pm. The sprinkler is turned on and off based on the time of the day and the soil moisture. The time for which the sprinkler remains on depends upon the difference between required soil moisture and actual soil moisture level.

P 27: System to be designed- Fan Speed Sensing and Control

Description: This system senses the speed at which the fan is rotating and adjusts the speed, based on the user input. The user can select three different speeds of the fan. The current speed should be sensed and the control mechanism should gradually increase the speed to the desired speed.

User Interface:

1. Fan starts when user presses 'Start' button.
2. User can then set the required speed by using a keypad interface. This speed value should be displayed on the display.
3. After setting speed initially, user should be able to change the fan speed setting by an up and down switch. Each press on this arrow button increases/ decreases the speed by 1 unit. Min speed value is 1, whereas maximum speed value is 5 Units. Pressing 'UP' button after reaching to value 5, should not change the display value or setting of fan speed. Same is true for lower bound.
4. Fan can be stopped by pressing 'Stop' button.
5. User can also set the mode of fan as 'Auto' mode besides a 'Regular mode' setting.

In Auto mode, user should be able to enter the value of time in terms of hours after which the Fan has to be switched off automatically. (For example, if value entered is 2, then the Fan should switch off after 2 hours from the time this setting is applied

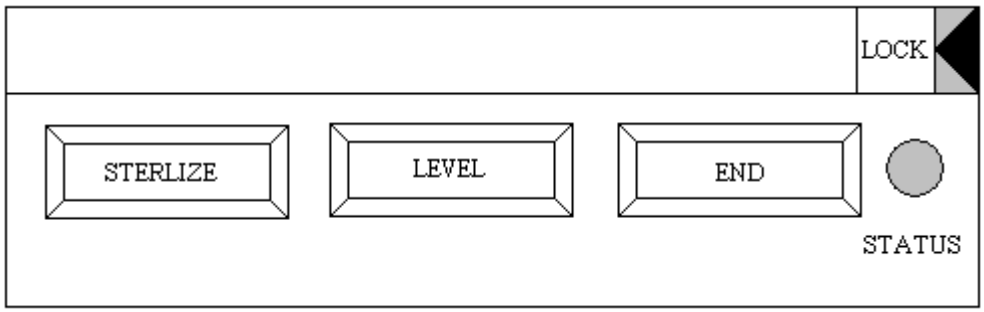
P 28 System to be designed : Sterilization Unit:

Description: This unit performs sterilization by increasing temperature to maximum value (x^0C). The temperature has to be maintained at the maximum value for 2 minutes before it is brought gradually to a nominal temperature value (y^0C). The time taken for bringing down the temperature can be varied between four different values as decided by the user. A Push Button switch (Level) is available for this purpose. The number of times the key is pressed decides the speed at which then temperature should be brought down.

1 press – 3 Mins
2 presses – 5 Mins
3 presses – 7 Mins
4 presses – 10 Mins

While the sterilization process is taking place the door to the unit must remain locked. The Door can be opened only when user presses End.

User Interface: Status LED glows as long as the sterilization process is being done. Once 30^0C has been reached then LED goes off and the door mechanism unlocks. Once the door is closed again the temperature has to be brought back to 30^0C.



P29 System to be designed : Soda Dispensing machine.

System Description:

Three different types of cool drinks can be dispensed by the machine. The cool drink is available in three different quantities: Small, Medium and Large.

There are three buttons available to select the cool drink type and another three buttons to select quantity. The user selects the drink, the quantity and then presses a button labelled dispense. LEDs are available with each button. When a choice is made the corresponding LED glows and turns off when the dispensing is completed.

There are three more LEDs available that are used to indicate when a particular type of cool drink is not available.

The cost is Rs: 5.00, Rs.10.0 and Rs15.0 respectively. There is a coin slot that accepts five rupee coins only. User can select type of cool drink, desired quantity and then drop the required number of coins. Each type of cool drink has its own dispenser. Based on the user's choice of drink the corresponding outlet will be open. The quantity of drink dispensed has to be accurately monitored. The quantity of drink is based on user's choice and the number of coins dropped in by the user.

P30: System to be designed : Underwater Drifter

An underwater drifter is as mall drogues that are buoyancy controlled, acoustically tracked, equipped with sensors for data collection and are part of an ad hoc network for relaying data to surface stations for analysis. The buoyancy control allows the drogues to collect data from various depths in the ocean. Propulsion is not needed as the drogues will be moving with the flow. Shown above is the picture of a drogue and its internal structure. Here, one can see a 25 cm diameter sphere consisting of two halves that can be disassembled for access into its interior. Drogues are free-floating underwater devices that operate autonomously.

Sensors in the drogue

Flourometers - for studies needing chlorophyll concentration data.

Output Voltage	0-5.0 VDC
Response Time	0.1 sec.
Accuracy	0.02 µg/l

Dissolved oxygen

Measurement range	120% of surface saturation in all natural waters, fresh and salt	
Initial accuracy	2% of saturation	
Typical stability	0.5% per 1000 hours	
Output signal	option 1:	0 - 5 VDC
	Option 2:	Frequency 4 -20KHz

Salinity

Output is analog varies between 4 – 20 mA output

pH

Output varies between 4 -20 mA

Turbidity sensors

Maximum Depth Stainless-Steel Body:	500 m (1640.5 ft)
Titanium Body:	1500 m (4921.5 ft)
Drift:	less than 2% per year
Maximum Data Rate:	10 Hz
Optical power:	2000 µW
Turbidity Accuracy:	2% of reading or 0.5 NTU

2.5 Output Option

Output Voltage = 0 to 2.5 V over selected NTU range
Supply Voltage = 5 to 15 Vdc
Current Drain = 15 mA

5 Output Option

Output Voltage = 0 to 5 V over selected NTU range
Supply Voltage = 5 to 15 Vdc
Current Drain = 15 mA

20 Output Option

Output Voltage = 4 to 20 mA over selected NTU range
Supply Voltage = 9 to 15 Vdc
Current Drain = 45 mA

Buoyancy Control

Buoyancy control is via CO2-pressurized neoprene bladder.

Stabilization of depth is obtained via feedback: a servo-motor for small changes in buoyancy volume and compression/bleed valve for large changes in buoyancy.

Valve can be open/closed to varying degrees using stepper motor.

Allegro 2998 B drivers are available for Servo Motors that have an enable and phase inputs. One Allegro 2998B driver chip can drive two motors.

Allegro 5804 B – Translator + Driver is available for Stepper Motors to which a clock input maximum of 5 KHz must be provided for rotating the motor- this will be translated into steps by the circuit available in the translator in the chip. The direction of the steps either in clockwise or anti-clockwise also has to be provided. One Allegro 5804 chip can drive two stepper motors.

Communications & Networks

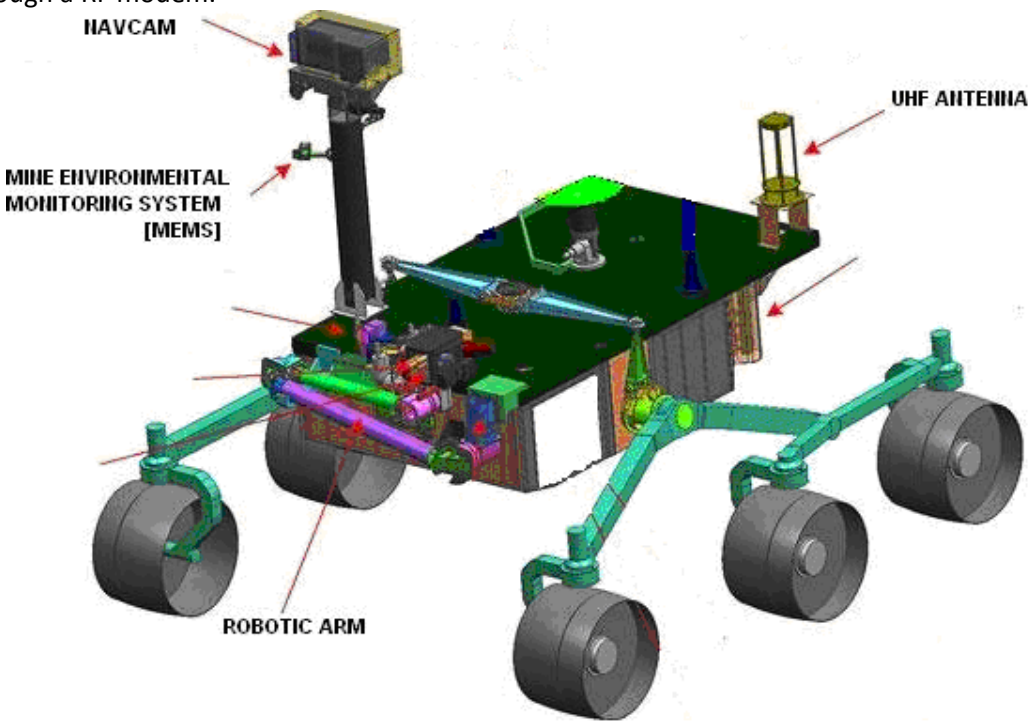
Data collected from the sensors are transmitted acoustically using acoustic link to the Surface Station at regular intervals of 10 minutes.

The communication is done using acoustic modems at a maximum data rate of 12kbps.

The acoustic modem is interfaced via UART interface.

P31: Mine Exploration Vehicle

A Mine Exploration Vehicle (MEV) is to be designed. The vehicle is six-wheeled with an on-board robotic arm to pick up samples and on-board scientific instruments and cameras (vehicle fig is shown below). The primary aim of the vehicle is to explore the terrain, measure atmospheric conditions in the mine and assess samples of rocks and soil. This can be controlled remotely from above the ground. All subsystems on the vehicle are controlled by the remote unit and are in contact with the remote unit through a RF modem.



Vehicular motion and Sample collection Subsystem

Each of the six wheels is to be powered by an individual motor so that the vehicle is capable of climbing over obstacles not exceeding a certain height. The vehicle can execute a 360° turn in-place. The front and rear wheels are used for steering. An upright position is to be maintained at all times and hence the suspension of the vehicle cannot have a tilt > 45°. The tilt is usually not allowed to exceed 30° during normal operation.

The vehicle should be capable of digging up to small depths. Digging is to be accomplished by spinning one of the front wheels in place to grind into the soil. The same mechanism that is used for tilting the vehicle upwards is also used for tilting the vehicle downwards. The vehicle is designed to remain motionless while the digging wheel is spinning.

DC motors are used for rotating the wheels and stepper motors are used for steering. The two front wheels are locked together by the same steering mechanism; the same is done in case of the rear wheels.

A Robotic arm is used for sample collection. The robotic arm is capable of movement both in the horizontal plane and in the vertical plane.

Communication of vehicle with surface takes place through RF modem (CC2420).

P32: Fire Alarm System

The system to be designed is a Fire Alarm System. The Fire Alarm System is to be implemented in a large building with 3 floors. The Fire Alarm System is made up of two types of subsystems. A **Floor Subsystem** and a **Centrally Coordinating Subsystem** ***(Note: These are only the names assigned by the user to the subsystems)***.

Floor Subsystem

Each Floor has 8 smoke sensors and 8 temperature sensors strategically placed along the floor.

Sensor outputs are conditioned to generate output voltages between 0- 5 V.

Sensors have a resolution of about 20 mV.

The smoke and temperature sensors are monitored regularly at intervals of 10 seconds.

If any abnormal levels are detected from any of the sensor inputs, data from other sensors are collected to validate the data of the sensor indicating abnormal level.

The data collected by the sensors is collected at the Floor Subsystem, processed and analyzed.

In case of normal conditions (i.e. when there is no indication of fire) data collected is sent to the *Centrally Coordinating Subsystem* at regular intervals of 2 minutes.

In case of any abnormal conditions the *Centrally Coordinating Subsystem* is alerted immediately.

In case of a fire, the Floor Subsystem activates the sprinklers (4 nos.) connected to it on, if asked to, by the *Centrally Coordinating Subsystem.*

The sprinklers are controlled by solenoid valves.

The sprinklers are turned off when normal temperature and smoke levels are restored.

Centrally Coordinating Subsystem

Collects data from the floor subsystems at regular intervals of time.

In the case of a fire indication asks the floor subsystems to activate the sprinklers.

It also sounds an Audio Alarm which is of the form in case of a fire.

You can assume that the Alarm is loud enough for all the Floors to hear the alarm.

In case of a fire the subsystem also alerts the nearest fire station using a Telephone connected via a Modem.

In case data is not received from any of the floors over a certain period of time, the *floor subsystem* is requested to send data.

If there is no response then a visual alarm is used to indicate floor from which data has not arrived.

Each of the floors has a bulb at the centrally coordinating subsystem to indicate failure

P33: Flying Robot

The Flying Robot is a hovering robot that possesses the capability to remain flying directly over an area of interest until a designated mission is complete.

The airframe is made up of 4 rods that span out from the center and form an X shaped pattern.

Attached to each rod is a DC motor and gear assembly for a propeller. The pitch of adjacent propellers is reversed to compensate for counter rotation, making two propeller rotate clockwise and the other two counter clockwise.

For sensors piezo gyros are placed on the three axis of rotation provide the yaw, pitch and roll angles of the hovering robot for control.

Gyro sensors outputs are used to adjust the speed of 4 motors to control the flying robot. In addition to the gyro sensors, four IR sensors are placed on the robot to detect obstructions if the robot approaches walls or obstacles.