P 1: System to be designed - Lawn Sprinkler System

System Description:

An average sized garden has 4 sprinklers that have to be turned on and off. A series of 8 soil moisture sensors are placed at different parts of the garden. The sprinkler system works twice in a day. Once at 9: 00 am and then at 5:00 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. There is a overhead tank from which the system draws required water. If the water level is below a certain level, the sprinkler are not turned ON and buzzer is sounded.

P2: System to be Designed : Smart AC System

Description: This system opens/closes four AC vents based upon the current temperature in the Room. The temperature is maintained at a range of 16–35 ^{0}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 4 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 4 sub-areas each with its own sensor and ac vent.

User Interface: LCD displaying Temperature in ^{0} C.

Single push button to vary temperature between 16^{0}C – 35^0 C.

The duration for which the system is ON can be set by the user in minutes ranging from 30 min. to 6 hours with a granularity of 30 min. Once the defined time has elapsed, the vents are closed.

P3

Design a microprocessor based **EPROM Programmer** to program 2716 and 2764.The EPROM can be programmed by applying 25V at VPP and 5V at OE pin. Initially all data of EPROM will be 1's and the user should make the bits zero selectively. Before the EPROM location is programmed it must be checked for whether it is empty (data in location must be FFH if the location is empty) The 8- bit parallel data is applied to the data pins of EPROM. The address for the EPROM is to be provided. To program the address of each location to be programmed should be stable for 45ms.When address and data are stable, a 40ms active high pulse is applied to CE input. After the EPROM is programmed, IC number is to be displayed on LCD as "27xy programmed".

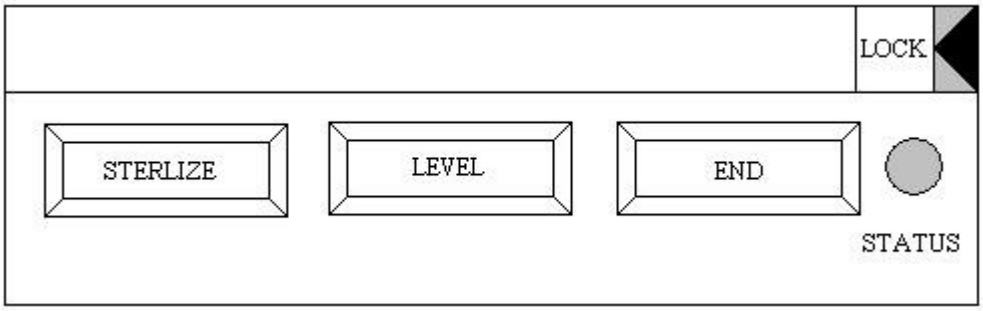
P 4 System to be designed : Sterilization Unit:

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 slider is used to decide this value

Level-1:2 minutes
Level-2:4 minutes
Level-3:6 minutes
Level-4:8 minutes

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.

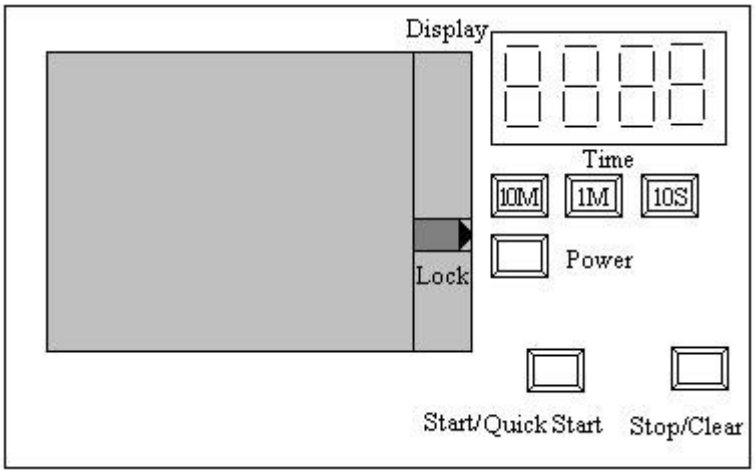
User Interface: Status LED glows as long as the sterilization process is being done. Once 30^0C has been reached then LED goes off and the door mechanism unlocks. Once the door is closed again the temperature has to be brought back to 30^0C.



P5 System to be Designed : Microwave Oven

Description: A Simple Microwave Oven without grill.

User Interface: Is shown in the following Figure



o User can cook at 3 different Power levels: 90%, 60%, 30%

p Press of a Power Button decrements the power level by 30 %

q 1 Press - 90%; 2 Presses – 60% ; 3 Presses – 30%; 4 Presses – 10 %;

r 4 Presses – Brings the power level back to 100 %

s The Default power level is 90%

t Power Level is varied by controlling the amount of time for which the microwave is turned on.

u Time of cooking is broken up into 10 sec slots, if power is 60% then for 6 seconds the microwave is on and rest of the 4 seconds the microwave is off.

v 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.**

w Once Time has been set Power cannot be modified.

x 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.

y Once the cooking begins the door gets locked and should open only when cooking process is terminated.

z User can terminate cooking anytime by pressing the STOP button.

aa When Stop button is pressed once cooking is aborted, timer is stopped, not cleared; cooking can be resumed by pressing Start.

bb When stop is pressed twice, cooking is aborted and timer is also cleared.

cc When cooking time elapses, a buzzer is sounded; pressing the Stop Button stops the buzzer.

dd 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.

P6

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

(i) 7408
(ii) 7486
(iii) 7432

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 results of the test along with the IC number are to be displayed on LCD as "74xy PASS" or "74xy FAIL". Design the necessary hardware and write the necessary ALP for implementing the above-mentioned task.

P7: System to be designed: Spirit Level Tester

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

This system tests the sobriety of the user by giving a sequence of hexadecimal characters of varying length(6 to 12 characters) by showing it on the LCD. It records the reaction time of the user in ms and displays the same on the LCD on a successful patch. The sequence should disappear after 2 seconds. The user is given a new pattern if he/she enters a wrong pattern. The user is given a total of three chances. After three mismatches of patterns an alarm is sounded. The pattern is generated randomly by the systems.

P8

A microprocessor system is to be designed as a batch weighing machine. The system is interfaced to three load cells by means of a 10 bit A/D converter.

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

Where K is dependent on the property of the sensor.

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 50 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.

P9

Voice signal is to be digitized and reproduced with certain modification by the microprocessor. Output from a microphone is sampled and digitized using a 8 bit ADC at the rate of 800 samples per second. The digitized signal is to be stored in RAM. The signal for a period of 3 seconds has to be digitized. The voice stored has to be reproduced with delay with of 5 seconds.

P10

Design a microprocessor Voting Machine which has provision for 4 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. To put it in use, it needs to be enabled by 4 polling agents and the Presiding officer. If any one is missing it should not be enabled. After 8 hours (9 a.m. to 5 p.m.) it should stop taking input. There has to be a provision that the Presiding officer by pressing a code [‘CA’] can lock it in between & then can restart it by pressing [FØ].For retrieving the count of each candidate provision should be there. The count of each candidate has to be send to a remote device using a serial interface. (Do not take into consideration the design of the remote device and its programming)

P11

Design a microprocessor based RAM tester. The tester should be able to test 6116 and 62256 RAM chips. The tester test 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 results of the test along with the RAM IC number are to be displayed on LCD as "PASS" or "FAIL".

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

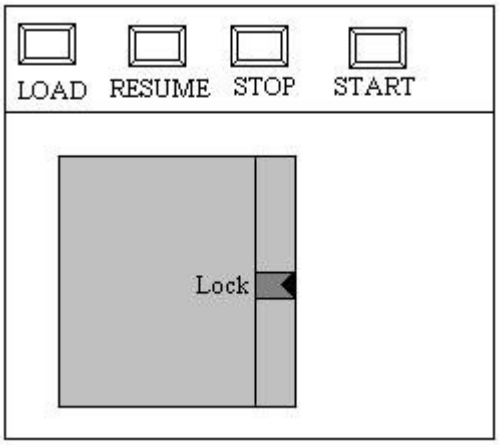
- The Washing Machine is a single tub machine.
- The Washing machine is made of a Revolving Tub and an Agitator. The Agitator is activated during the Rinse and Wash cycle; revolving tub is active only during the Dry cycle. The door of the washtub should remain closed as long as the agitator is active.
- 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.
- Display the load selected using a seven segment display.

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.



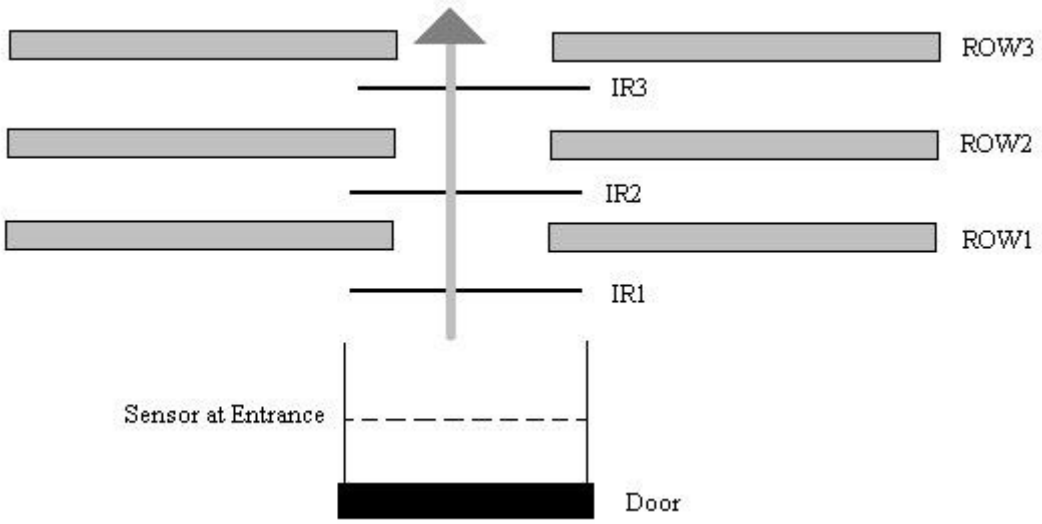
P13

Design a Microprocessor based flour packing system. The flour to be packed is contained in a tower. The user keys-in the required amount of flour per packet which could be 5, 10 or 20kgs. The system should take the input and pack the specified amount of flour upon press of a START key. It is also required to monitor the temperature of the floor where packing is going on. This temperature range can be user settable which should also be displayed on a seven segment display. An alarm for any malfunctioning of the system like out of range temperature should be provided.

P14:System to be Designed: Smart Lighting System

Description: This is a lighting system for a conference room. On detection of a person the door is automatically opened/closed. As the seats get filled the light should be turned on. The rows are filled from row1 onwards. There are 3 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 6 rows. The system should also display the number of people in the room on a LCD display.

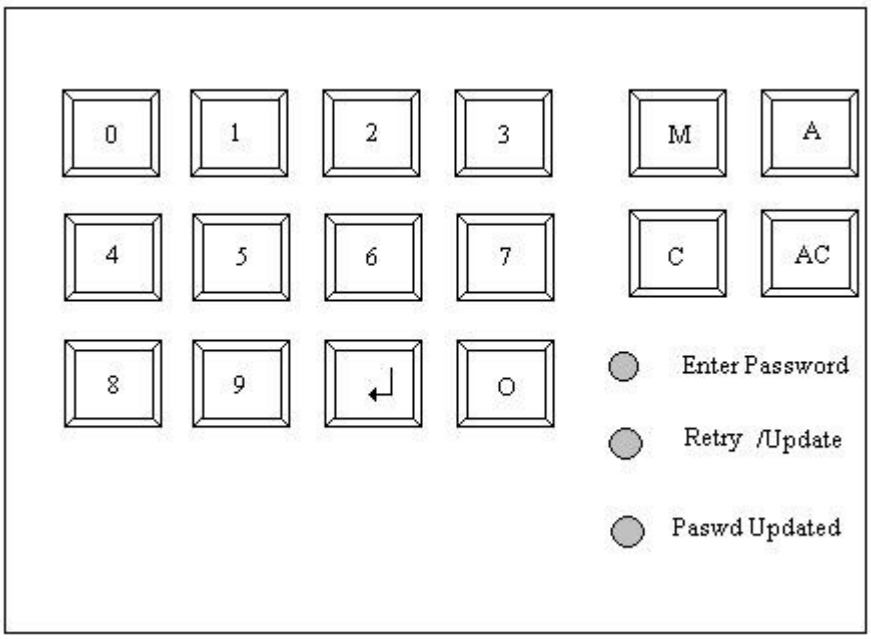
System Details:



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 2 Min, so that the person can leave the room.

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



- o 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.
- p 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.
- q 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.
- r 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.
- s LCD show the entry as asterisk when the password characters are entered.

P16: System to be Designed : Fire Alarm System

Description: This system checks for abnormal smoke content in a room every two seconds. Under abnormal conditions it throws open two doors and two 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 smoke detection system is made up of two smoke sensors placed on the ceiling of the room. When the smoke level comes back below the danger level, the doors, windows and valves are closed.

P17

Design a microprocessor transistor hFE tester. The system has to display the hFE 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.

$$I = V * 10^{-4} \ A$$

The emitter of the transistor is grounded, and the collector is connected to a 2.2K resistor, whose other end is connected to the +5V supply. The Voltage drop across a 2.2K resistor is measured and this is related to the hFE by the following relation:

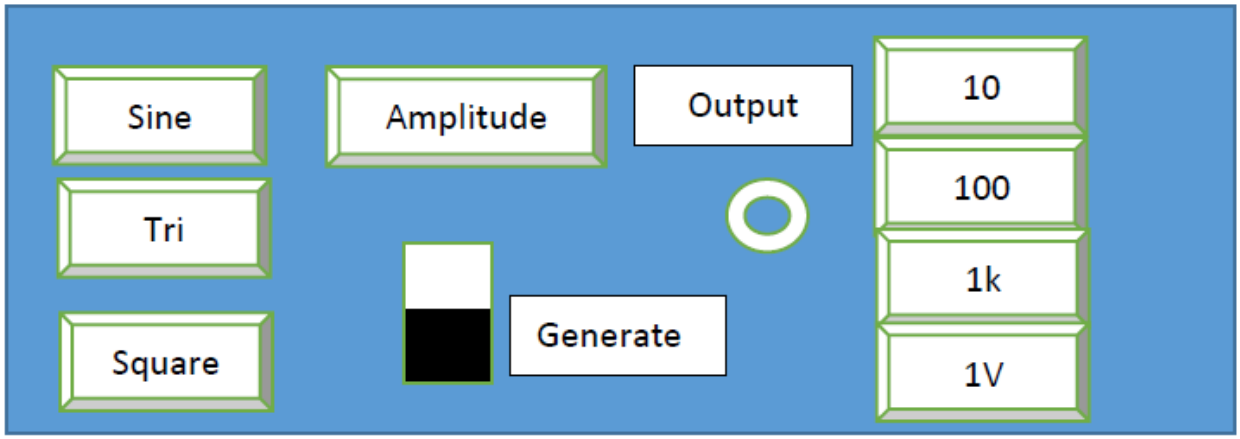
$$hFE * I * 2200 = \text{Voltage drop}$$

The hFE value should be displayed on a LCD display. If the hFE value is less than 50, an alarm should be sounded 2 seconds.

P18: 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.

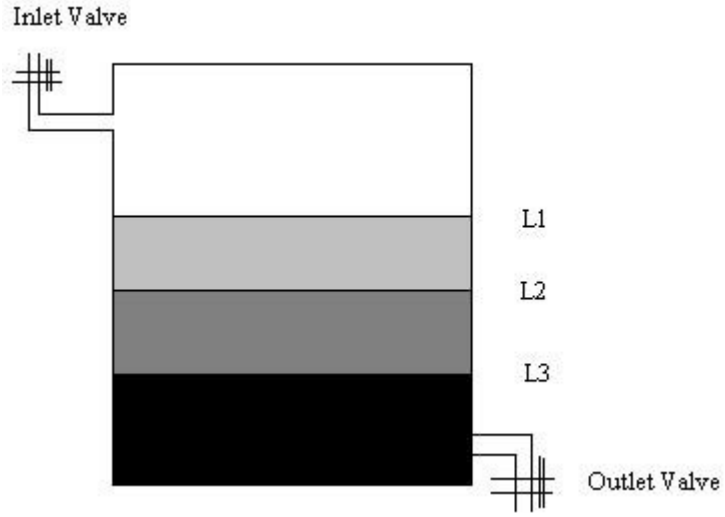
When a signal of different type/amplitude /frequency has to be generated, the user will have to turn-off the generate switch and then configure the function generator as mentioned above.

P19: 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 5:00 AM to 9:00 AM in the Morning and 4:00- 6:00 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.

P20: System to be Designed : Chocolate Vending System

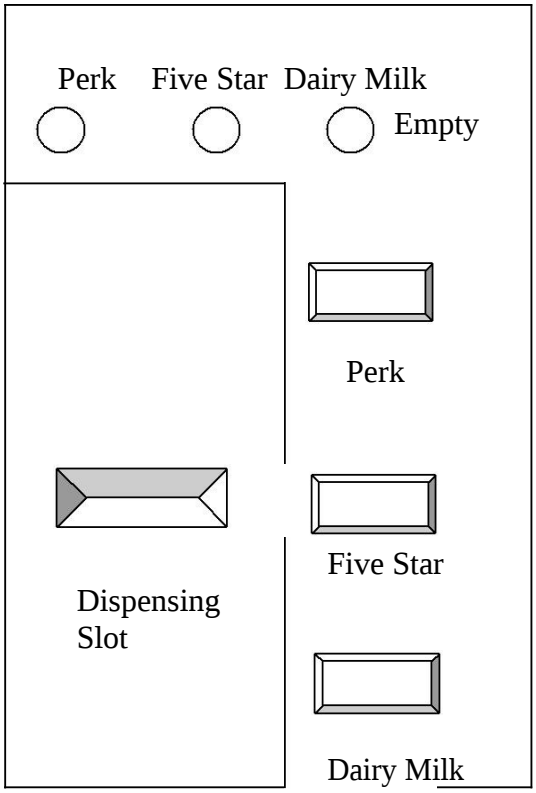
Description: This automatic machine vends three different types of chocolates.
Perk: Rs. 5.00

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. Whenever the chocolate is dispensed successfully, a buzzer is sounded.

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



P21: 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.
- Full and empty status is shown through an LED.

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.

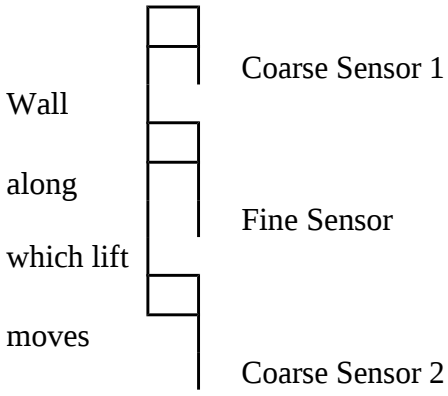
P22: System to be designed: Elevator control

System Requirements

- The elevator operates along **3 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**. o 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 60%.
- The frequency of the PWM signal is 20 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 Sensor1 and Fine Sensor will be available. On the 3rd floor only Coarse Sensor 2 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 fine 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 60 %. And for deceleration, the duty cycle
  reduced from 60 % to 20 %. The increase is in steps of 20 %

o A 7447 chip (BCD to seven segment converter) is used for driving the 7-segment displays. o 7447 takes a 4-bit BCD value and converts into the corresponding 7-segement equivalent.

P23: 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.

P24: System to be designed: Weather Monitoring Station

System Description

This system monitors weather parameters such as: Air Temperature, Air-Humidity, barometric Pressure, wind speed and Displays the average over regular intervals of an hour on a LCD display. The Display is continuous. Update of the display is done once in an hour. Weather parameters are sensed at regular intervals of 2 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 25: 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

P26 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.

P27: 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.

- o An LCD is available for display
- p The LCD displays the time as well as date and day
- q 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.
- r Alarm Set switch is used for setting the Alarm.
- s 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.
- t INC push button is used for incrementing values displayed and DEC switch is used for decrementing values displayed
- u Alarm switch is used for turning on the Alarm.
- v Time can be displayed in AM/PM or 24 hour format
- w User can toggle between any of the display formats at any time by pressing the 12/24 key
- x While Time/Alarm is being set the value being set should be seen on the display.
- y The clock should also play musical octave (Sa Re Ga Ma Pa...) on an alarm.