The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical & Computer Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code	**: EEX4436**
Title	**: Microprocessors and Interfacing**
Academic Year	: 2021/22
Date	: 26th February 2023
Time	: 1330-1630hrs

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Four (4)** questions in **SECTION A** [70 Marks] and **two (2)** questions [30 Marks] in **SECTION B** on **Five (5)** pages.
3. Answer **ALL Questions.**
4. The answer to each question should commence from a new page.
5. Relevant charts/ codes are provided.
6. This is a Closed Book Test (CBT).
7. Answers should be in clear handwriting.
8. Do not use Red colour pens.

Special Instructions

- When you write any Assembly Language Program (ALP), you need to provide appropriate comments where necessary. **Full marks will only be given to correct programs with comments.**
- Refer **datasheet of the 8051 microcontrollers (given separately)** when you answer the questions in this paper. **Do not attach it to the answer script.**
- State your assumptions (if any) clearly.

Section A

Answer all questions [70 Marks]

Puzzle Parking System (PPS)

The following description is about a part of a *Puzzle Parking System (PPS),* a type of car parking system that involves arranging and moving cars in a compact and efficient manner. These systems are often used in areas with limited space, such as densely populated urban areas.

You are required to analyze and design the ***PPS*** (Figure 1 and Figure 2) according to the given requirements.

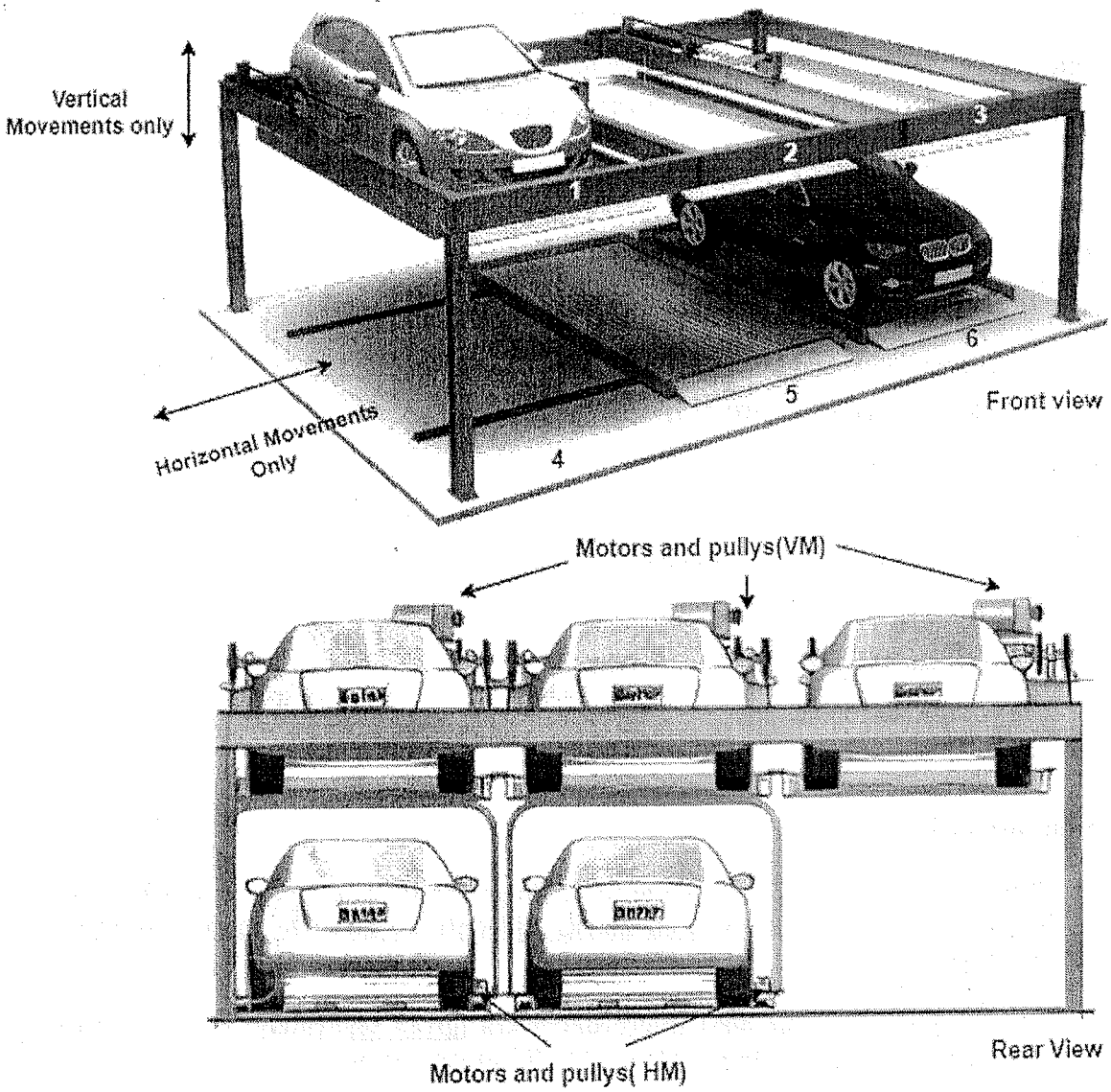


Figure 1: Typical Views of the PPS
Source: https://kleemannlifts.com

Figure 1 shows the typical view of two-level PPS. Each level has three parking slots with one empty parking slot resulting in a maximum of five cars parked in the given PPS system. Ground-level (Level 0) cars can move only horizontally, and upper-level (Level 1) cars can move only vertically, as shown in figure 1. Level 1, each stot has a motor (VM) and pully system to control the UP/Down movements. There are three motors, VM1, VM2, and VM3.

To move level 0 slots left and right, motors (HM) are used in each slot. Motor HM1 and HM2 are used to move car trays 5, and 6 left or right side as required.

The control interface of PSS is shown in Figure 2. It consists of a keypad, an On/Off switch, an Emergency button, and a display. Additionally, there is a bell and red indicator light to warn in case of an emergency or system malfunction.

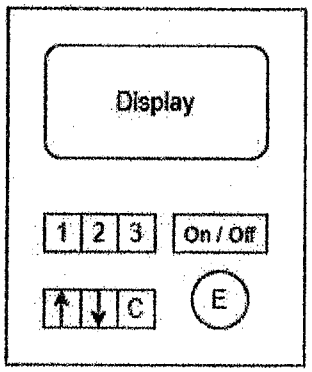


Figure 2: Control Interface

One to three digits show the parking slot number, and arrows show the Up and Down movements. When we want to take the level 1 car to ground level, the operator has to select the slot from the digit and press the down key. If there is no parked cars below, it should move to level 0. Suppose a car is already parked below the selected slot. In that case, level 0 car slots should move appropriately to their right or left automatically and get the level 1 car slot to level 0. The button "C" (denoted "Clear" the choice) is used to clear the selected slot if needed. Bell and the red indicator light should be on in an emergency for 5 seconds. The maximum carrying capacity of one parking slot is two tons(You can assume all vehicles weigh less than two tons). All motors must operate at constant velocity with 50% PWM for each move.

State all the assumptions clearly (if any) when answering questions.

[Q1] For the proposed mechanism, identify suitable sensors and actuators to detect the following and draw simple block/interfacing diagrams for each to explain your methodology. Clearly show where you will install these sensors and actuators in PSS.

(i) To identify the occupancy of each parking slot. [03 Marks]

(ii) To determine the status of the level 1 parking slots.(whether it is at level 0 or 1) [03 Marks]

(iii)To identify the status of the level 0 parking slots to decide where to shift, right or left. [03 Marks]

[Q2]

(i) Analyze the given specifications/parameters related to the operations/processes of the PSS and then prepare a Table of resources/features and conditions/constraints required to design the PSS. (Table should contain, Processes, Sub-Operations, Parameters, Conditions, Resources, Feature Required of 8051 microcontrollers, and Comments). [07 Marks]

(ii) Draw the external view of the system, i.e., a diagram that shows the inputs/sensors and the outputs/actuators of the system. [10 Marks]

(iii) Identify the subunits/sub-modules of the system and draw the interconnected block diagram of the system using the central controller and other required interfacing devices. [10 Marks]

(iv) Draw an Interfacing diagram to show the 8051 port connections. [10 Marks]

[Q3] Draw flowchart(s) to represent the algorithm of the operation of the PSS. [12 Marks]

[Q4] Write assembly language programs (ALP) to perform the above task (i.e., Q3). Clearly show the assembly language routines with comments related to the flowcharts drawn in the above Q3. [12 Marks]

Section B

Answer all questions [30 Marks]

[Q5]

1) Write ALP programs for the following three tasks.
   (i) Place the number 8Ah in the internal RAM location 30h and 32h.
   (ii) Copy the data at the internal RAM location 70h to R0 and R3.
   (iii) Place value 42h to R3 and value 3 to R1.Then place the value pointed by R1 to the accumulator.

[08Marks]

2) Draw an interface diagram to connect an 8-bit ADC to the 8051. Show the necessary waveform and write an ALP to convert analogue data into digital data.

[07Marks]

[Q6]

1) A design is needed for a control system based on an 8051 microcontroller to move a robot arm in a 90° clockwise and anticlockwise direction. A key input controls direction. The stepper motor has a step angle of 1.8°.
   (i) Determine the number of steps required to rotate the arm by 90°.
   (ii) Draw the interfacing diagram between the stepper motor and the Microcontroller.
   (iii) Draw a flow chart to show the algorithem drive the motor with a delay of 0.5 seconds.

[08 Marks]

2) Write an ALP to receive a character from the serial port and save it in R7. Use 9600bps, 8-bit data bits, 1 start bit, and 1 stop bit, and ignore the parity bit. [07 Marks]