

THE OPEN UNIVERSITY OF SRI LANKA

Faculty of Engineering
Department of Electrical & Computer Engineering
Diploma in Technology – Level 04
FINAL EXAMINATION – (2007/2008)



ECX4236 – Microprocessors and Interfacing

162

Time Allowed: 3 hours

Date: 21st April 2008

Time: 13.30 – 16.30 hours

INSTRUCTIONS TO CANDIDATES

1. This question paper contains 1 question in **SECTION A** and 3 questions in **SECTION B** on 5 pages.
2. Answer **ALL** questions in the **SECTION A**.
3. Answer **TWO** questions from **SECTION B**.
4. This is a **CLOSE BOOK** examination.

NOTE:

1. When you have to write any assembly language program for your answer, you need to provide appropriate comments where necessary. **Full marks will be given to correct programs, with comments.**
2. Refer **attached data sheet of the 8051 microcontroller**, when you answer the questions in this paper.

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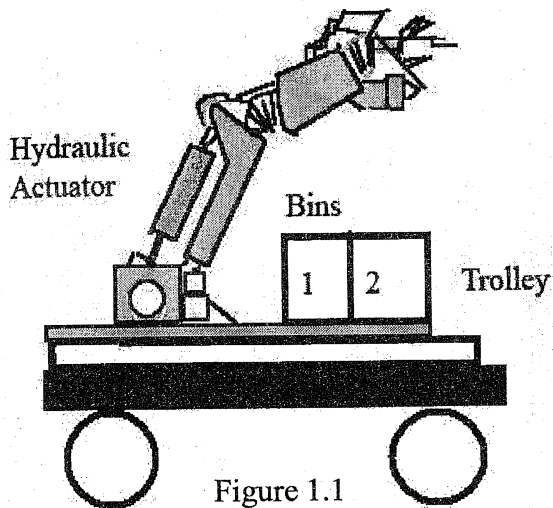
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SECTION A:
Answer ALL questions

Question 1

Tomato Picking Robot

The following description is about a Tomato Picking Robot and you are supposed to analyze the system according to the 8051 microcontroller specifications. A typical view of the robot is given in Figure 1.1.



The robot consists of four wheel trolley, hydraulic actuator and two bins. Trolley is operated by two 24V motors. One motor drives the trolley forwards and backwards and the other motor turns the trolley to left and right. Hydraulic actuator picks the tomatoes and places them into an appropriate bin according to the color of tomatoes (green/red). Typically, for this task hydraulic actuator will take 2.5 seconds to complete it. Assume that the hydraulic actuator is already manufactured for this task and you need to activate it to perform the task. Before activating the hydraulic actuator makes sure that the appropriate bin is open according to the digital signal given by the color sensor.

Bins are operated by two 24V solenoid valves. Maximum carrying weight is 30kg. Once the weight limit is reached, the robot needs to come back to the base location and unload the bins by opening the output solenoid until the bins becomes empty. At the base location the robot will be connected to a PC and each count of (green/red) tomatoes should be transmitted via serial communication. After that the robot needs to return back to the place where it was picking tomatoes and starts its work again.

There might be obstacles in the robot operated area and on top of the robot a sensor is mounted to detect such obstacles. Speed of the motors will be controlled by varying the duty cycle of the PWM signals.

When answering following questions, clearly state your assumptions

- Draw the external view (i.e. diagram to represent the inputs and the outputs) of the system. [10 Marks]
- Identify the sub units/sub modules of the system and draw the interconnected block diagram of the system by using central controller. [10 Marks]
- By selecting one sub unit/sub module, answer the questions (c).(i) and (c).(ii).
 - List the necessary interfacing devices and other electronic components to control the sub unit/sub module. [05 Marks]
 - Draw the schematic diagram for the sub unit/sub module. [05 Marks]
- Draw a flowchart to represent the control logic of the system. [15 Marks]
- Write an assembly language program to implement the system. [15 Marks]
- Is it possible to implement your design on an ASIC (Application Specific Integrated Circuit)? Give comments. [04 Marks]

SECTION B:

Answer any TWO questions

Question 2

In the ECX4236 laboratory, a student considered the experimental setup for displaying counter value (assume FFh \geq counter value $>$ 0h) in three seven segment displays as base ten digits. For this particular experiment the following Truth Table 2.1 was identified as one of the interfacing devices that involved in the experiment.

Input	Selection		Output			
X	S ₁	S ₀	Y ₃	Y ₂	Y ₁	Y ₀
X ₀	L	L	H	H	H	X ₀
X ₁	L	H	H	H	X ₁	H
X ₂	H	L	H	X ₂	H	H
X ₃	H	H	X ₃	H	H	H

Where X₀ – X₃ are input signals

Truth Table 2.1

- Name the interfacing device that is represented by the Truth Table 2.1 and draw the block diagram of that device. [05 Marks]
- Draw the complete block diagram to interface three seven segment display units to 8051 microcontroller with help of the interfacing device that you identified in Q2. (a). (You may need additional interfacing devices in addition to that) [05 Marks]
- Write an assembly language program to display counter value in the seven segment displays. [08 Marks]

Question 3

- Briefly explain the “*Baud Rate*” in serial data communication. [02 Marks]
- In a certain experiment, a student has the timer value as 0FEh and he set the variable baud rate to 9200. Find out the suitable crystal frequency for this experiment. [04 Marks]
- Write an assembly language program to send the data stored in a lookup table from 400h to 410h to another PC through serial communication with 2400 baud rate. (Assume that the PC will acknowledge to the 8051 microcontroller for each and every successful reception of byte. If sending fails then microcontroller needs to send the same byte again) [12 Marks]

Question 4

A poly bag manufacturing company consults you as an engineer to measure the weight of the manufactured poly bags. The machine has a metal roller and newly made poly bags revolve along with the metal roller and weight of the metal roller is 5kg. The weight measuring transducer gives following output wave pattern (Figure 4.1) and you need to count the number of pulses received when the enable signal (EA) goes high. This counter value is equal to the weight of the poly bags with the metal roller in kilograms.

- (i) Identify the suitable sensor/transducer to measure the weight of the poly bags. [03 Marks]
- (ii) Using one of the hardware counters in the 8051 microcontroller draw the counter configuration with relevant counter mode. Show the input signals clearly. [05 Marks]
- (iii) Write an assembly language program to measure the weight of the poly bags and then compare with the actual value of the expected weight (25kg) that is stored in the external RAM location 100h. If the measured weight is equal to the given weight then clear the port 1 bit 4 (P1.4), if the measured weight is less than the given weight then clear the port 1 bit 5 (P1.5) else clear the port 1 bit 6 (P1.6). [10 Marks]

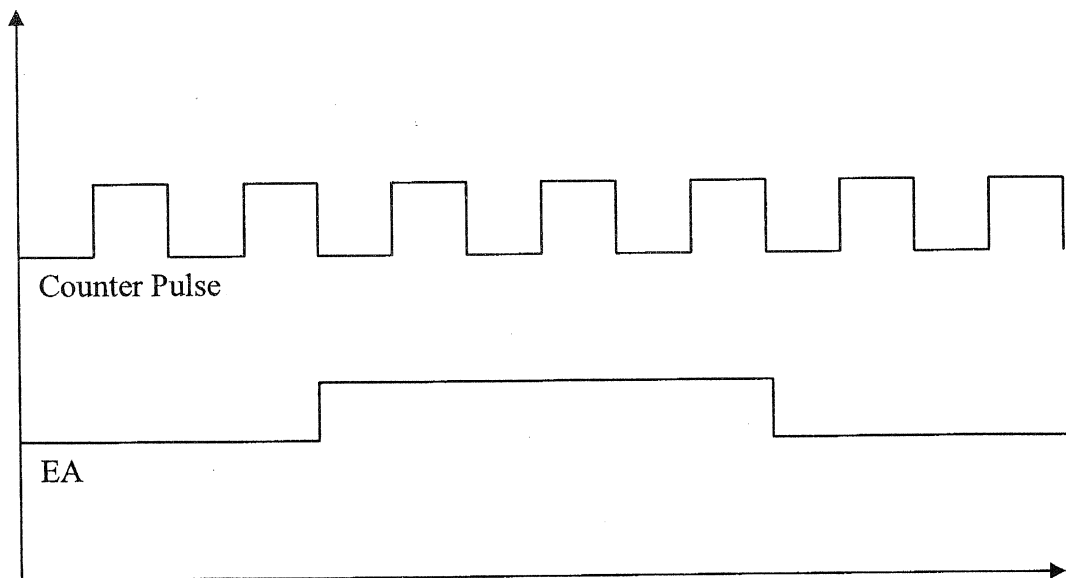


Figure 4.1