FACULTY OF ENGINEERING
ELECTRONIC (COMPUTER) ENGINEERING PROGRAM
KS30503 EMBEDDED SYSTEM
INDIVIDUAL MINI PROJECT

1.0 Introduction

An embedded system is a system that has software embedded into computer-based hardware. There are many embedded systems in our surroundings. For instance, there are printers, photocopy machines, scanners, air-conditioners in the office; microwave ovens, dishwashers, washing machines, refrigerators at home; etc. In this individual mini-project, the student is tasked to select, analyze, develop, and improve one established embedded system.

2.0 Course Outcomes (CO), Program Outcomes (PO) and Complex Engineering Problems (WP) & Knowledge Profile (WK)

There are two (2) course outcomes (CO), and two (2) program outcomes (PO) integrated with complex engineering problems (WP) and knowledge profiles (WK), as shown by the mapping in Table 1.

Table 1: Mapping of CO, PO, WP and WK

Course Outcomes (CO)	Program Outcomes (PO)	Complex Engineering Problems (WP)	Knowledge Profile (WK)
CO2: The ability to analyze and interpret the design of an embedded system (C5)	PO2: Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences (WK1-WK4).	**WP1: Depth of Knowledge Required** Cannot be resolved without in-depth engineering knowledge at the level of one or more of WK3, WK4, WK5, WK6 or WK8 which allows a fundamental-based, first principles analytical	**WK3**: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline. **WK4**: Engineering specialist knowledge

CO3: The ability to design an embedded system to solve a specific problem (C6)	PO3: Design solutions for complex engineering problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations (WK1-WK4)	approach. **WP3: Depth of analysis required** Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models. **WP7: Interdependence** Are high level problems including many component parts or sub-problems.	that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline. **WK5**: Knowledge that supports engineering design in a practice area.

3.0 Learning Outcomes

At the end of this project, the students should be able to:

i. Pick an ideal microcontroller for an embedded system design.
ii. Analyze the operation of an embedded system.
iii. Design an embedded system.
iv. Apply modern tools in designing an embedded system.

4.0 Problem Definition

Task 1:

1.1 Pick one embedded system that is available in your house. Get its control panel's picture and obtain/derive the block diagram.

1.2 Suggest an optimal microcontroller for the control system. Explain why you picked that microcontroller based on the technical aspect.

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Task 2:

2.1 Suggest a suitable device/component for every part in the block diagram. Justify your suggestion.

2.2 Obtain the datasheet of the suggested devices/components. Estimate the total application power required by the circuit and how much heat is produced. Determine whether the system can be powered using a battery. If yes, what are the battery capacity and run-time? If no, state the reason why. Provide calculation whenever necessary.

Task 3:

3.1 Construct the circuit for the selected embedded system in Proteus by using the PIC16F887 microcontroller as the processor. Use substitutes for components/devices that are not available in the Proteus Library.

3.2 Derive the flowchart/algorithm to present the operation of that embedded system. Write a C program based on the derived flowchart/algorithm.

3.3 Simulate the embedded system to verify its operation.

3.4 Improve the embedded system by adding at least a new practical feature.

   i. Discuss why the system needs that improvement.
   ii. Modify the circuit and program to accommodate the improvement.
   iii. Reestimate the power requirement considering the improvement.

Task 4:

4.1 Construct the real hardware for the system. Embed the program and demonstrate. Discuss the outcomes.

4.2 Submit a report detailing Task 1 to Task 4.1. The report should have:

   i. Cover page.
   ii. Content.
   iii. Task 1
   iv. Task 2
   v. Task 3

vi. Task 4.1
vii. Conclusion

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Student Name: **Student Number:**	**Assessed by:**

Task	Unsatisfactory (2)	Satisfactory (3)	Good (4)	Excellent (5)	Mark
CO1: The ability to explain the embedded system and the features/organization of a microcontroller					
Task 1 (10 marks)	• The block diagram is missing out on crucial parts. • A microcontroller is proposed but without relevant technical justifications.	• The block diagram generally represents the system. • A microcontroller is proposed and supported with relevant technical justifications.	• An almost complete and detailed block diagram is given. • A microcontroller is proposed with relevant and acceptable technical justifications.	• A complete and detailed block diagram is given. • A microcontroller is proposed with sound technical justifications.	
CO2: The ability to analyze and interpret the design of an embedded system					
Task 2 (15 marks)	• Wrong/irrelevant devices or datasheets are provided. • Power requirement estimation is performed. • No discussion on the power requirement is provided.	• Correct devices and datasheets are provided for crucial components/parts in the system. • Power requirement estimation is performed roughly. • A discussion on the power requirement is provided.	• Correct devices and datasheets are provided for most components/parts in the system. • Power requirement estimation is supported with calculation. • A good discussion on the power requirement is provided.	• Correct devices and datasheets are provided for every component/part in the system. • Power requirement estimation is supported with detailed calculation. • A comprehensive discussion on the power requirement is provided.	

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Task	Unsatisfactory (2)	Satisfactory (3)	Good (4)	Excellent (5)	Mark
CO3: The ability to design the embedded system to solve a specific problem					
Task 3 (25 marks)	• The constructed circuit is not presenting the general/basic system. • The program flow does not make sense. • The basic connection of PIC16F887's is used. • Simulation produces wrong output. • The real system is not working.	• The constructed circuit presents the general/basic system. • The program flow can be understood. • At least one PIC16F887's feature is used. • Correct simulation output. • The real system is working.	• The constructed circuit presents the entire system. • The program flow is easily understood. • At least two PIC16F887 features are used. • Correct simulation output. • The real system is working and producing the desired output.	• The constructed circuit presents the entire system completely. • The program flow is neat and easily understood. • More than two PIC16F887 features are used. • Correct simulation output. • The real system is working perfectly and producing the desired output.	
CO4: The ability to properly use modelling and simulation tools					
Observation during project demo (10 marks)	• A circuit is drawn but can't be simulated. • Unable to compile the written program.	• A neat circuit is drawn and can be simulated. • The written program can be compiled without syntax error.	• A neat circuit is drawn and can be simulated. • The written program can be compiled without syntax error.	• A compact and neat circuit is drawn with complete label. The drawn circuit can be simulated. • The written program can be compiled without syntax and logic errors.	
				Total	