Case Study Essay

Introduction

This is a summative assignment that requires you to write an essay to explain your design of a consumer electronic product and to apply the knowledge that you have learned in this microprocessor module. This contributes to 7% of your overall grade.

You will be assigned a certain product to study. Your task is to think about how this kind of products can be designed and constructed with a single STM32F401RE microcontroller. You are expected to write your essay on your own, in no more than 2000 words (roughly 4 pages single spaced).

References:

- STM32F401RE: https://www.st.com/en/microcontrollers-microprocessors/stm32f401re.html

Product Research & Technical Specification

Based on the given product as an example (with the basic user instruction), you can carry out research about similar products in the market. Your essay should begin with a clear and concise technical specification on your decision of what the product can do and of what the performance it can achieve. Your design in both the hardware and the software will then be based on this technical specification (instead of the example product that is provided).

You can choose the best format to present your specification. It can be written in a product description, listed as a table of functionalities or illustrated with a diagram.

This part should take around 20% of the essay (~400 words).

Hardware & Software Design

This is the most important part of your essay – where you can demonstrate your knowledge about microprocessor design for a simple embedded system. You should discuss the system design in both hardware and software perspectives. The key objective is that the hardware and software need to work harmoniously with each other since they are also dependent of each other. You are recommended to work on an overview of both sides to give yourself a clear picture before writing the details.

Hardware – explain the hardware features that you are going to use and some interfacing circuitry that are necessary to produce the required functions. You should consider the basic hardware features (but not limited to) like interrupts, GPIOs, timers, USART. While

there is no absolute choice for hardware, you should aim to reduce the manufacturing cost by using built-in hardware/ports as much as you can. Of course, you need to identify necessary peripherals, sensors, etc. to fulfill the specification and explain how these components can be connected to the microprocessor. Your discussion should focus more on the microprocessor itself, rather than the peripherals.

You can provide a diagram or illustration to help describe the hardware.

Software – assuming the hardware is made, you can continue to work out the flow of the control software that will be loaded to the microprocessor. Your focus here is to explain the division of the CPU time usage among different tasks that you need to accomplish. For example, are you going to poll the GPIOs? Or would you use timer or external interrupts? Since you are not programming the actual hardware, you just need to justify that you can service all devices/peripherals/sensors/actuators in a timely manner with a single microprocessor, preferably with an estimation in the right order of time (e.g. every 10 ms).

Similarly, you can provide a diagram or illustration to show your software flow.

Each of this part should take around 30% of your essay (a total of 60%, ~1200 words).

Testing Strategy

The last section of your essay is a plan on how would you test the product, assuming both the hardware and software are developed. You should provide a list of tests that you aim to perform to make sure the product performs the functions stated in the specification. It is ideal to begin with basic and simple tests and then work towards integrated functions.

This part should take around 15% of your essay (~300 words).

References

You need to include a list of important references (8-10 items) from books, magazines, online tutorials, websites that you study in the end of your essay. However, there is no need to include any materials provided from our module (e.g. slides, sample codes, etc.).

Rubric

Section	Weights
Technical Specification	20%
Hardware Design	30%
Software Design	30%
Testing Strategy	15%
References	5%

Submission

Prepare a single PDF for your essay (no more than 2000 words, excluding references) and submit it to QMplus.

Your essay will be forwarded to Turnitin for plagiarism detection.

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