

**MKEL 1123 2021-2022-1**  
**Advanced Microprocessor System**  
**Group Assignment (30%)**

**Group Project (Group)**

**1.0 Group Distribution and Members**

Students are allowed to form their own groups within their section only. Cross-section groups are not allowed. A group must consist of **3** persons only.

**2.0 Group Ethics**

All members of a group must contribute to the development of the project. Group members can report to the instructor of members who does not contribute to the project. A peer review assessment will be given at the end of the group project assignment.

You are encouraged to collaborate with other groups, but strictly no copying is allowed on the group work. Sharing of core low-level code for common operations is allowed, e.g. driver codes.

The final project report must not contain similarities above 30% with other sources. You are encouraged to paraphrase the contents and cite the sources. A plagiarism checking software link will be provided by your instructor (Turnitin account).

**3.0 Project Description**

**3.1 Minimum Hardware Requirements**

In this semester, the **NUCLEO-F446RE** development board or similar board is required with a mini-USB cable (not micro-USB). The board must be purchased by each group. The board price is approximately RM 60.20 and is available from various sites such as Mouser.com, Element14 and digikey.my. You may also get it from your seniors.

<https://my.element14.com/stmicroelectronics/nucleo-f446re/dev-board-arduino-mbed-nucleo/dp/2491978?ost=nucleo-f446re>

A desktop/laptop is required for the development. Additional electronic components may be required depending on the application being developed.

**3.2 Minimum Software Requirements**

A compiler toolchain is required to get started with the board and for future software development. The suggested software are:

1. STM32CubeIDE
2. STM32CubeMX
3. or Keil MDK

all the above software are freely available.

**3.3 General Project Description**

You are required to build an STM32F4-based system that takes advantage of CMSIS and FPU with DSP instructions.

Find a conference or journal paper (such as from IEEE Xplore or Elsevier ScienceDirect or Scopus) that has an algorithm or application that can be solved using CMSIS-DSP (Digital Signal Processing) or CMS-

NN (Neural Network). You will take this paper as your main reference on which your work will be based on.

For example;

1. You may have found a paper that has an application based on 8-bit microcontroller, which is limited, however can further be made better had it been given a higher performance processor such as the STM32F4.
2. You have an existing application that runs on a PC, but you want to make it embedded.
3. Or perhaps you have found a DSP/NN application that is already running on a different microcontroller, but you want to port it to STM32F4.

Based on your findings, you will need to write a proposal to explain, justify and propose your implementation.

### 3.4 Milestones and Deliverables

This group project consists of six milestones. The descriptions are as follows;

Milestone	Description	Deliverables	Assessment
1	<p><b>Familiarizing with the STM32F4 Development Board</b></p> <p>In the first milestone, you are required to write a simple Blinky application for the STM32F4 board. This is to familiarize yourself with the development board, IDE and verify that the development setup is functioning correctly.</p> <p>The Blinky application is a simple application that simply blinks an LED on the dev board.</p> <p>All your firmware code must be uploaded to a GitHub account.</p>	<p>1. A GitHub account for your code.</p> <p>2. A video/link to a video showing the Blinky app running on the dev board.</p> <p>3. A short instruction on the process of setting up the Blinky app (1 page).</p>	<p>1%</p> <p>2%</p> <p>2%</p>
2	<p><b>Proposal</b></p> <p>Based on your reading and the selection of your main reference paper, you are required to write a Proposal following the IEEE conference paper format. The proposal must be only 1 page in length. The contents are</p> <ol style="list-style-type: none"> <li>1. Abstract</li> <li>2. Introduction / Current Work</li> <li>3. Proposed Methodology/Implementation <ol style="list-style-type: none"> <li>a. CPU Selection</li> <li>b. Algorithm</li> <li>c. How the algorithm intends to apply CMSIS</li> <li>d. Novelty – how it is different from your main reference?</li> </ol> </li> <li>4. References</li> </ol>	<p>1. Proposal report</p>	<p>5%</p>
3	<p><b>Development Progress (Video Blog)</b></p> <p>Milestone 3 is in the middle of your project development. In this milestone, you are required to record a short video of no more than 5 minutes to describe the current state of development, the achievements, and the problems encountered (if any).</p>	<p>1. Video</p>	<p>5%</p>

4	<b>Work Procedure Documentation</b> Each group is required to produce a documentation on the development process, which includes: <ol style="list-style-type: none"> <li>1. Software/Tools setup</li> <li>2. Configuration Steps</li> <li>3. Steps for firmware development</li> <li>4. Steps for hardware development</li> </ol> Submit to Github	1. Github	5%
5	<b>Conference Paper</b> An IEEE conference paper (max 6 pages) that details the project. The paper consists of the following: <ol style="list-style-type: none"> <li>1. Abstract</li> <li>2. Introduction</li> <li>3. Problem/Motivation</li> <li>4. Current Works</li> <li>5. Methodology (Hardware, Software, Algorithm)</li> <li>6. Results</li> <li>7. Discussion</li> <li>8. Conclusion</li> <li>9. References</li> </ol>	1. Conference Paper	5%
6	<b>Final Product Video Demo</b> A video presentation of your final project must be submitted, showcasing the problem being addressed, the development process and the final product.  <b>Group Presentation/Interview</b> In the last class, a QnA session will be conducted.	1. Video 2. Live QnA	5%

#### 4.0 Assessment Rubrics (0 marks for no submission)

##### 4.1 Milestone 1

Element	5 marks	3 marks	1 mark
Github Link	-	A valid Github account/link with source code to Blinky	Invalid account, or missing source files.
Video	Less than 1 min. Showing all team members, and LED blinking on the board.	Video too long or team members are not shown or LED is not blinking.	Video submission incomplete.
Setting Up Report	1 page report clearly detailing the steps to successfully develop, compile and flash the Blinky app.	A report that is too long, or with missing steps.	Report submission is incomplete.

##### 4.2 Milestone 2

Element	5 marks	3 marks	1 mark
Introduction	Clearly and concisely state the paper's purpose. The introduction is engaging, states the main topic and	States the paper's purpose. The introduction states the main topic but does not adequately preview the structure of the paper.	Incomplete and/or unfocused. There is no clear introduction or main topic and the structure of the paper is missing.

	previews the structure of the paper.		
Proposed Methodology	Provides in depth explanation on design criteria, thoroughly discusses all required steps and uses simulations where necessary.	Demonstrates reasonable level of design criteria but incorrect sample calculation and/or appropriate simulations.	Fails to provide appropriate design methodology, relevant sample calculations and/or simulations.
Conclusion	Report has considered all key issues for the project and fully understand the scope of the challenges they are likely to face.	Report has considered most of the key issues for the project and student understand the scope of the challenges they are likely to face.	It is not clear that student understand the challenges that they are likely to face.

#### 4.3 Milestone 3

Element	5 marks	3 marks	1 mark
Summary of Activities	Clearly describes all the content of activities as well as reflections.	Most of the activities are described with some level of reflection on the progress.	Some of the reflections describe unrelated points, unprofessional and violated ethics in the content of activities.
Technical Understanding	Demonstrates complete understanding of the project by delivering proper technical contents.	Demonstrates adequate understanding of the project by delivering appropriate technical contents.	Demonstrates poor understanding of the project by delivering inappropriate technical contents.
Use or modern technologies	Clear information on modern tools or technologies used in the project.	Adequate information on modern tools or technologies used in the project.	Limited information on modern tools or technologies used in the project.

#### 4.4 Milestone 4

Element	4 Marks	3 Marks	2 Marks	1 Mark	0 Mark
Overall project and hardware description.	Clear, correct, sufficient, and easy to follow instructions.	Correct information. Instructions can be followed with some difficulty.	Mostly correct information. Insufficient instructions.	A random collection of stuff.	N/A
Source code and replicability	Complete. If not in report, direct link to Internet source are given. Can be copy-pasted for new project.	Some code available for copy-paste. Possible to replicate the project with some extra effort to find the missing source code.	Some code available for copy-paste but impossible to replicate the complete project.	Impossible to replicate. No source code or source code in print screen format only. Reader must type everything to replicate the project.	N/A

#### 4.5 Milestone 5

Element	4 Marks	3 Marks	2 Marks	1 Mark	0 Mark
Introduction	Clearly and concisely state the paper's purpose. The introduction is engaging, states the main topic and previews the structure of the paper.	Clearly states the paper's purpose. The introduction states the main topic and previews the structure of the paper.	States the paper's purpose. The introduction states the main topic but does not adequately preview the structure of the paper.	Incomplete and/or unfocused. There is no clear introduction or main topic and the structure of the paper is missing.	N/A
Content	Each paragraph has thoughtful supporting detail sentences that develop the main idea. Writer demonstrates logical sequencing of ideas through well-developed paragraphs; transitions are used to enhance organization.	Each paragraph has sufficient supporting detail sentences that develop the main idea. Paragraph development present but not perfected.	Each paragraph lacks supporting detail sentences. Organization of ideas is logical but not full developed.	Each paragraph fails to develop the main idea. No evidence of structure or organization.	N/A
Conclusion	The conclusion is engaging and restates the thesis. Conclusions are strongly supported by the paper.	The conclusion restates the thesis. Conclusions are supported by the paper.	The conclusion does not adequately restate the thesis. Some conclusions are not supported by the paper.	Incomplete and/or unfocused. Little indication of synthesis or drawing of conclusions.	N/A
Language	No errors in punctuation, capitalization or spelling. No errors in sentence structure and word usage.	Almost no errors in punctuation, capitalization or spelling. Almost no errors in sentence structure and word usage.	Many errors in punctuation, capitalization or spelling. Many errors in sentence structure and word usage.	Numerous errors in punctuation, capitalization or spelling. Numerous errors in sentence structure and word usage.	N/A
Citation	All cited works are noted in the correct	Some cited works are noted in the	Few cited works are noted in the	Absent. Includes few	N/A

	format with no errors. The paper includes more than the specified number of proper references.	correct format. Some inconsistencies evident. The paper includes more than the specified number of proper references.	correct format. Some inconsistencies evident. The paper includes less than the specified number of proper references.	proper references.	
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#### 4.6 Milestone 6

Element	4 Marks	3 Marks	2 Marks	1 Mark	0 Mark
Duration	8-10 min	<1 minute over/under	1-2 minutes over/under	>2 minutes over/under	N/A
Participation	All members visible and participating	All members visible but not all participating	Not all members visible	Nobody was visible	N/A
Organization and storyline	Elements of video flow cohesively into each other	Sequence of video is correct but the flow of ideas need some work	Some structure evident	A random collection of video clips.	N/A
Use of media	Suitable visuals, label and subtitles. Easy to understand. Good use of voiceover.	Missing 1 feature.	Missing 2 features.	Vertical video. Missing too many media features.	N/A
Content: The big picture	Has a clear plan/methodology to tackle the assignment	Has a plan	Probably has a plan	Clueless	N/A
Content: Algorithm	Understands the algorithm well and knows exactly how to embed into STM32	Understands the algorithm and have a rough idea how to embed into STM32	Looks lost but tried very hard anyway	Clueless	N/A
Content: Exploit STM32 Strengths	Successfully made full use of DSP instructions and CMSIS	Applies some DSP instructions or CMSIS	Attempts were made but not successful	No attempts at all	N/A
Content: Hardware Interfacing	Hardware works flawlessly. Data can move in/out of CPU.	Hardware works with minor hiccups. Most data can move in/out of CPU.	Hardware sometimes works.	Hardware is connected but not functioning.	N/A