



**PAF- KARACHI INSTITUTE OF ECONOMICS & TECHNOLOGY**

**College Of Engineering**

Software Engineering Department

**COMPLEX ENGINEERING ACTIVITY**

**EE-3417 - Embedded Systems Design**

# Student Name(s): Student ID(s):

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CEP**  **Statement** | | Gathers information from a respective domain and identify emerging problems in manual systems, then Design and implement automated version of manual management systems with embedded solutions of identified problems, to solve a real-life management issues. | | | | | | |
|  | | | | | | | | |
| **PLO’s** | | **PLO2 – Problem Analysis** | | | Bloom’s Taxonomy | **C4 – Analyze** | | |
| **PLO3 – Design and Development** | | | **C2 – Apply** | | |
| **PLO9 – Team Work or Individual** | | | **P2 – Set** | | |
| **COMPLEX ENGINEERING ACTIVITY** | | | | | | | | |
| **CPA** | **CLO’s** | | **Aspects of Assessments** | **Excellent**  **(75-100%)** | **Average**  **(50-75%)** | **Poor (<50%)** | **Marks** | |
| **CEA-2**  **CEA-5** | **CLO2**  **PLO2** | | **Problem Analysis** Problem identification, analysis /literature review, resulting in meaningful conclusions | Completely identifies the problem in question through efficient analysis/produces near to exact results | Partially identifies the problem in question and with academic support produces the required results. | Lack of identification of the problem, needing more than par support to analyze the problem and production of results. | **Project**  **Idea**  **(15%)** |  |
| **Proposal**  **(15%)** |  |
| **CEA-1**  **CEA-2**  **CEA-5** | **CLO3**  **PLO3** | | **Design & Development** Design/Develop solution of real-life management issues using knowledge gather while learning SPM course. | A complete solution / Explain necessary theories according to task description with great use of time and resource material. | Solution was complete but need minor modifications / student could have followed specification more closely. | Solution was complete but did not work, needed several modifications / did not make correct use of resource material or instructions. | **Project Progress**  **(40%)** |  |
| **CEA-2**  **CEA-5** | **CLO8**  **PLO9** | | **Teamwork** Completion of project tasks with proper team work and contribution. | Proactively work with other team members to complete assigned tasks. | Worked well with team but did not offer much positive feedback. | Very little, if any, contributions to group and less contribution in completion of overall lab tasks. | **Demo**  **(15%)** |  |
| **Report**  **(15%)** |  |
|  | **Total Marks: 30** | | | | | |  | |

**Graded by Lab Engineer:** \_ **Date:**

**Remarks:**

## Complex Engineering Activity

The semester project is designed in a way to able students to solve a complex engineering Activity. The following characteristics of Complex Engineering Activity are targeted in this semester’s project on Embedded Systems Design:

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| --- | --- | --- |
| **CEA-1** | Range of resources | **Diverse resources** (people, money, equipment, materials, information, and technologies |
| **CEA-2** | Level of interaction | Require resolution of significant problems arising from interactions between **wide-ranging** or **conflicting** technical, engineering, or other issues. |
| **CEA-5** | Familiarity | Can extend **beyond previous** experiences by applying **principles-based** approaches |

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| --- | --- | --- | --- | --- |
| **Course** | **CPA Attributes** | **CLO** | **PLO (WA)** | **Bloom’s Taxonomy** |
| **Embedded Systems Design**  **(Lab)** | CEA-2  CEA-5 | CLO2 | PLO2 | C4 **(Analyze)** |
| CEA-1  CEA-2  CEA-5 | CLO3 | PLO3 | C2 **(Apply)** |
| CEA-2  CEA-5 | CLO8 | PLO9 | P2 **(Set)** |

## CEP Statement:

Design an embedded system that does something interesting. This is very open-ended, but some guidelines are below.

## Guidelines:

* You may work either alone or in groups of two or three. If you work in a group your end project will have higher expectations.
* You may use any embedded board or microcontroller or embedded devices (PIC18F or Arduino or Raspberry Pi) for this project.
* You may use any programming language you like, but again if it’s not in C or Assembly or Python I might not be able to provide a full range of help.
* You may use code/libraries found online as long as licensing allows it and you properly document it.
* There must be some original code done by your group. You cannot just stitch together code found online.
* Your board will have to take input from a user, and display some manner of output. Both of these need to go through one of the low-level hardware interfaces discussed in class (Sensors, i2c, SPI, 1-wire, GPIO, USB, A/D, PWM, audio in/out, HDMI, etc.)
* Your project may complement one being done in another class. However your project must be a new implementation, you cannot just turn in previously done work.

## Topic Selection: (due \_06-Dec-2023\_\_\_\_\_\_\_) (5pts)

* Each group should send a brief e-mail describing your project topic and listing group members.

## Progress Report (due \_27-Dec-2023\_\_\_\_\_\_\_) (10pts)

* A brief status update detailing progress your group has made. This is primarily to make sure your project is on track to be finished in time; if things are not going well the topic can be adjusted.
* Following points may please be included in the Report
  + State in one sentence a summary of your project.
  + Describe the hardware that you will be using: the embedded board, the input device, and the output device.
  + Have you acquired and tested the hardware mentioned? Are you on track for being finished on time?
* You can submit the status update by e-mail.

## In-Class Presentation (due \_03-Jan-2024\_\_\_\_) (40pts)

* You will have 10 minutes to present. Plan for 8 minutes of showing off the device and presenting plus 2 minutes for questions. Points will be taken off for going over.
* You may present slides using the projector if you want, but that’s not strictly necessary.
* Your presentation should have at least the following information. Feel free to include more.
  + Brief overview of what your device does and how it works.
  + A summary of the hardware being used, including the embedded board
  + Describe the input hardware and how you connect to it
  + Describe the output hardware and how you connect to it
  + A summary of the operating system (if applicable) and the programming language you used, and why.
  + Hardware limits: describe any power concerns
  + Software limits: describe any real time constraints, security concerns, and code density concerns
  + Challenges: list any challenges you had getting things working.
  + Future work: things you might add if you had more time.
  + Leave time to do a brief demo of the hardware.

## Project Write-up due (\_03-Jan-2024\_\_\_\_\_) (45pts)

* This will be a short paper (at least 6 pages, but you can include pictures, diagrams, etc.) that must contain all of the following:
* **Introduction:** What the device is and high level overview of what it does. Also be sure to make clear what is actually working in your implementation (as opposed to things you wanted to get work but for various reasons did not).
* **Hardware** 
  + Embedded Board Description: Describe the hardware, CPU (architecture, type and speed), RAM, and I/O. Also describe the operating system or other software (kernel version, etc.)
  + Input device description: Describe the device you are interfacing with, how you access it in software, and document the protocol you use to communicate with it.
  + Output Device description: same as for the input device.
  + Links to any data sheets for hardware you used, as well as schematics for any circuits you designed yourself.
  + Power Consumption: Explain any energy or power concerns with your application, and how you could optimize it to use less power.
* **Software**
  + Programming Language: Which one did you use? Why? Briefly explain the tradeoffs between the language you chose and doing the same in assembly language. (If your project is in assembly language, then explain the tradeoffs versus C).
  + Real Time: Does your device have real time constraints? What would happen if your code encountered an unexpectedly large delay?
  + Security: Describe any computer security issues there might be with your device (can it be exploited?) If you say there are no security issues, make sure you explain why.
  + If you use code not written by your group (code found online, libraries, etc) explain what the extra code does, and how your code interfaces with it. Explain how much of the code is original to your group.
* **Related Work**
  + Has anyone done a project like this before?
  + How does your project compare to existing similar projects?
* **Conclusion**
  + If you worked in a group: List who worked on what part.
  + Challenges: List any challenges you had, and if things didn’t work, explain why.
  + Future Work: List any improvements you might make if you had more time and resources to work on the project.
* **Appendix**
  + The source code (this can be submitted as a separate file, does not have to be included in the report).
  + OPTIONAL Make a short web-site or YouTube video describing your project. Get it posted on YouTube. No extra points for this, just bragging rights.

## Project Ideas:

* Alarm Clock: set time with buttons, play wakeup sound/music over audio out
* Some manner of robot.
* Wii Nunchuck (i2c accelerometer).
* Show orientation on LED display? Make a simple game? Log acceleration to disk?
* Wii controller to Pi3 via Bluetooth?
* Weather/Temperature Display that remembers high/low temperatures
* Audio in on the sound input driving some sort of audio visualization on LED display some sort of video game utilizing LED display
* Using wireless or Bluetooth in an interesting way?
* Color sensing candy sorter
* Car or bike computer
* Hooking old PS/2 style keyboard to Pi using GPIO interface
* Measure the power consumption of Pi doing various things, optimize for this.

## Summary:

The following are salient outcomes of the semester project in terms of Complex Engineering Activity:

* Brainstorming exercises forced them to explore the surrounding environment to sort out the problems to be solved using programming constraints.
* Problem formulation enhances their ability to gather real-time requirements and address conflicts/constraints.
* Design/Implementation gave them a chance to go through the in-depth engineering knowledge to solve the problem and analyze it in an effective way