MEE391 Instrumentation and Measurements
Course Project · Project Description
Semester · Spring 2025

PROJECT OBJECTIVE

The main objective of this Project is for you to come up with **innovative solutions** to problems that we are currently facing. Thus, you are encouraged to use the knowledge acquired in this course and any additional knowledge you acquired (i.e., personal research) during and while working on your project to develop an innovative product.

To help you with choosing an idea or a challenge to address we have compiled a list of potential ideas for you to choose from and build on across three main courses the **MEE332 Manufacturing Processes**, the **MEE341 Kinematics of Machines**, and the **MEE391 Instrumentation and Measurements**.

However, you are highly encouraged to come up with **creative ideas** and turn them into **tangible products** by the end of this semester.

INSTRUCTOR'S EXPECTATIONS

To see that you have understood the theoretical concepts that we have covered throughout the semester along with the practical concepts during the Laboratory sessions and that you can **creatively** use such concepts along with the additional valuable concepts acquired from the other two courses to **engineer** a solution for a specific problem or to solve a potential challenge.

PROJECT DESCRIPTION

To engineer a useful product we need always to lay a set of objectives, constraints, standards, and milestones since in practice we never have an infinite amount of resources (money, equipment, time, etc.). As an engineer, you need to **build optimal and reliable working products based on non-perfect sub-systems** in a short amount of time, subject to several financial and technical constraints, and with minimum resources.

PROJECT IDEA COMMUNICATION AND SUBMISSION

The Project idea must be discussed with the instructors and approved to ensure it is feasible and the project can be finished during the semester.

PROJECT SUBMISSIONS

A link will be provided on **Blackboard** to submit all your files as a single **.zip folder** in addition to a **report** that must be submitted separately.

In the main folder (MEE391_ProjectName_StudentsNames) you must have several sub-folders as follows:

- Computer-aided design (CAD) models, if applicable
- Datasheets (For all the components that you have used such as sensors, actuators, etc.)
- Diagrams and schematics (Circuits Diagrams, State-Machine Diagrams, etc.)
- LabVIEW codes including VIs and sub. VIs.
- Demo Videos, Animation, etc.

Note 1: The report must be submitted separately as it will be passed through Turnitin. Thus, a separate link will be provided on **Blackboard** to submit the report.

Note 2: The Project Files Submission should be submitted to **Blackboard** before the submission deadline. Make sure you start the submission process before the deadline. Late submissions will be penalized. **No hard copy of the report is required**.

REPORT OUTLINE EXAMPLE

1. **Title Page** with Title, Group Members' Names, Date, Course, and Term
2. **Table of Content**
3. **List of Figures**
4. **List of Tables**
5. **Design Summary** · A concise overview of what the device is, what it does, and how it works. Include, number, and refer to a well-labeled figure or photograph illustrating the overall device.
6. **System Details** · A concise description and illustrations of the system's basic design and function. Include illustrative figures and/or photographs with key features and components clearly labeled, circuit schematics (if appropriate), functional diagrams, and concise software flowcharts. Be sure to number and refer to all figures and describe them briefly.
7. **Design Evaluation** · Briefly describe the success of the device in meeting the functional element categories.
8. **Partial Parts List** · For each unique and/or interesting component in your design, list the following information: Part Name and its Number with a short description.
9. **Lessons Learned** · A list of significant problems or difficulties you faced, with brief and concise explanations for how you solved them along with recommendations for future students who might face similar problems or difficulties. Also, include a paragraph on what you have learned in terms of knowledge that extends beyond what is covered in class.
10. **Conclusion**
11. **References**
12. **Appendices**

Note: After looking at the figures and illustrations, and after reading the brief and concise descriptions in "**Design Summary**" and "**System Details,**" the reader should be able to quickly and fully understand what your device is, what it looks like, what it does, and how it functions (without seeing a demonstration of the actual device).

The report must be short and concise.

REQUIRED FUNCTIONAL ELEMENT CATEGORIES AND SOFTWARE

Your device should contain some of the functioning elements listed below (Category G is optional). The examples under each element category are generally listed in order of increasing rating scores, depending on how you use and what you do with the element. Other components not listed as examples below are acceptable and encouraged.

Note that you cannot receive credit for any category until you have a device that is mostly complete. **Also, you must have a functioning device, not just a collection of independently functioning elements**. Having several different components in a single category can help your rating, but quality and function are more important than quantity.

You can have few elements but a very innovative solution that uses such elements creatively and addresses a challenge. The grade is not directly correlated with the number of elements.

A. Output Display and HMI (Display Visual Messages to the User)

- LEDs as Indicators
- 7-Segment Digit Display(s)
- LCD Screen
- Computer Screen
- Tablet/Smartphone

B. Audio Output Device (Display Audio Messages to the User)

- Constant Tone Buzzer
- Variable Tone Buzzer
- Alarm Siren
- Speaker for Audio Instructions or Sound Effects

C. Manual User Input (User input)

- Switches and Push Buttons (ON/OFF, Emergency Switches, Rotary Switches, etc.)
- Potentiometer
- Joystick
- Keyboard/Keypad
- Barcode Reader/Scanner
- Touch Screen (Resistive or Capacitive)

D. Sensors

- Limit Switch, Proximity Switch, Hall Effect Sensor
- Photo-Optic Emitter/Receiver
- Ultrasonic Sensor
- Potentiometer
- Photocell (LDR)
- Temperature Sensor (Thermistor, Thermocouple, etc.)
- Accelerometer, Gyroscope
- Encoder
- LVDT
- Load Cell
- Pressure Sensor
- Piezo Electric Material
- Smart Material

E. Actuators and Mechanisms

- **Actuators**
  - RC Servo Motor
  - Solenoid Valve
  - ON/OFF DC Motor
  - Direction-Controlled DC Motor
  - PWM Speed-Controlled DC Motor
  - Stepper Motor
  - Water Pump (ON/OFF)
  - Water Pump with Flow Control
  - Pneumatic Actuators
- **Mechanisms and Hardware**

› Solid and Reliable Mechanical Design, Manufacturing, and Assembly
› Interesting and Effective use of Linkages, Cams, Screws, Levers, Gears, etc.
› Appropriate and Effective use of 3D-Printed and Machined Parts

F. Logic, Processing, and Control

- State Machine Architecture
- Open-Loop Control

- Menu-Driven Software
- Data Storage/Retrieval from a Database
- Advanced and/or Multiple Interfaced Microcontrollers (Arduino and myRIO, or others)
- Closed-Loop Feedback Control

G. Bonus · Optional · Applying Topics not Covered in Class

- Interfacing with Sensors using Special Protocols (I2C, SPI, UART, etc.)
- Implementing Closed-Loop Control Techniques (PID, Fuzzy Logic, etc.)
- Using a Camera for Computer Vision with Digital Image Processing
- Using Artificial Intelligence for Decisions or Classification (Machine Learning, etc.)
- Other Advanced Applications

Software

You are **required to use LabVIEW** for building the software for your project. Any other addition to the main LabVIEW codes must be discussed with your Instructor.

GRADING

The group's grade for the project is based on the device's performance in each functional element category listed above (A, B, C, D, E, and F, G is a Bonus). The rating for each category will be a number between 0 and 15 based on the following benchmark values:

Rating	Performance Description
0	Nothing is Implemented
2.5	Something is Implemented but Nonfunctional
6.5	Something is Implemented (i.e., Has some Level of Functionality and is Interfaced with a DAQ) but not Functioning as Designed in a Repeatable and Reliable Manner
11	Something is Functioning as Designed (i.e., Performs some Intended Useful Function) and repeatable (i.e., It Works Every Time) but did not Require Much Research or Effort (e.g., Purchased Something Requiring Very Little Interfacing and Work or used Something Presented in Detail in Class or Laboratory Sessions)
16.5	Something is Functioning as Designed and Repeatable and Required Significant Research and Effort (e.g., Built Something not Presented in Detail in Class or Laboratory Sessions which Required Significant Research and Effort).

Note: The ratings are based not only on what components you use but also on the relevant and interesting things you do with the components through software and integration. **Creativity is highly valued**.

Report and Presentation

The quality of the submitted report and the presentation during the **Engineering Project Day** will be part of the overall grade of the project

Team Size and Composition

5 Students Per Team · **Each student must report their contribution to the project**. This means that not all team members will get the same grade. An interview will be held with the students to check their contribution in case needed.

Keep Learning and Best Wishes