# National Taiwan Normal University
# Department of Electrical Engineering

## Embedded Systems February 2025 Semester

## PROJECT

Instructor:                          Dr. Cheng-Kai Lu

Project Duration:                    from Now to Week 13

Project Demonstration Date:   Week 14 &15 (during the lecture session on Wednesday)

Report Submission Date:        End of Week 16

As mentioned earlier, you will be required to undertake a project in groups of two (2). Each group must develop an engaging project that applies the concepts learned in this course.

**Project Requirements**

Your project must incorporate **GSM connectivity (mandatory)**, sensing functionality, and display features. Below are some suggested project topics that you may find interesting:

- **Intelligent Robot Navigation System**
- **Smart Home Appliance**
- **Monitoring System via GSM Connectivity**

Additionally, you are encouraged to integrate **RTOS** into your project if applicable.

**Project Evaluation & Timeline**

By **Weeks 8 & 9**, each group must demonstrate their progress. The project will be assessed based on the following criteria:
- **Effort, teamwork, creativity, and originality**
- **Project complexity**
- **Hardware and software functionality**
- **Quality and accuracy of the final report**

**Key Deadlines**
- **Project Demonstration:** Weeks 14 & 15 (during the lecture session)
- **Final Report Submission:** End of Week 17 (**Saturday, June 8, 2025, 23:59 (Taiwan local time)**)

**Sample Project 1. AI-Powered Smart Agricultural Monitoring and Prediction System**

**Description:**
Enhance the **GSM-enabled smart agricultural system** by integrating **AI-based predictive analytics** to forecast optimal watering schedules and detect potential plant diseases. The system will use **machine learning (ML) models** to analyze environmental conditions and send **smart recommendations via SMS** to farmers.

**Key AI Features:**
- **Machine Learning-Based Watering Prediction**:
  - Train an ML model using historical **temperature, humidity, and soil moisture** data to predict **optimal watering schedules**.
  - The system **automatically adjusts irrigation** based on AI recommendations.
- **AI-Based Plant Disease Detection**:
  - A **camera module** captures plant images.
  - A **lightweight CNN model** detects diseases based on leaf color and texture.
  - If a disease is detected, the system sends **an SMS alert** with suggested countermeasures.
- **GSM Connectivity:** Sends AI-generated watering and disease alerts via SMS.
- **Display:** LCD/OLED screen to show real-time data and AI predictions.

**Use Case:**
- **Improves water efficiency and prevents crop loss** by using AI to make **smart irrigation decisions** and detect **early plant diseases**.

**Project 2. AI-Enhanced Smart Door Lock with Face Recognition & Intruder Detection**
**Description:**
Upgrade the **GSM-based smart door lock** by integrating **AI-powered face recognition and anomaly detection** to enhance security. The system will use **deep learning models (CNN)** for accurate face recognition and **AI-based behavior analysis** to detect suspicious activities near the door.

**Key AI Features:**
- **AI-Powered Face Recognition**:
  - Uses a **pre-trained deep learning model** (e.g., MobileNetV2 or FaceNet) to recognize **authorized users** with high accuracy.
  - If an unknown person is detected, the system **triggers an alert via SMS** and captures an image.
- **Anomaly Detection via AI**:
  - Uses **motion sensors and a camera** to detect unusual movements outside the door.
  - **Machine learning algorithms** analyze patterns (e.g., repeated loitering) and send alerts if suspicious behavior is detected.
- **GSM Connectivity:** Sends SMS alerts for unauthorized access attempts or detected intrusions.
- **Display:** TFT/OLED screen to show real-time security status.

**Use Case:**
- **Enhances home and office security** by using AI to **identify authorized users accurately** and **detect intruders or suspicious behavior** in real time.