Course Work: Project
Requested by Prof. Mahmoud El-Hadidi
For Course: ELC4015- Selected Topics in Communications - Internet of Things
Academic year: Fall Semester 2025/2026

Please read the following details carefully and do your best to fulfill all requirements.

A) Your group is required to design - and "optionally" implement - one of the typical IoT applications. "Sample" topics are listed below:

1. Weather Reporting System (Example: URL: https://microcontrollerslab.com/weather-station-using-arduino-labview/)
With this, you can find the weather of any specific place and don't have to rely on weather forecasting agencies anymore. It uses temperature, humidity, and rain sensors to monitor and report weather conditions statistics online via WiFi connection. You can set limits and alerts for particular conditions. The system will notify you whenever the weather conditions cross the set limits values. The system helps collect data in extreme environments like a volcano, minefield, polarzone, etc.

2. Air Pollution Monitoring System
Today, the air's quality is inferior. Air pollution is increasing rapidly, affecting human health and causing lots of diseases. IoT based Air Pollution Monitoring System is used to monitor air quality over a web-server using the Internet. It shows the air quality in PPM on the LCD and the web page so that the system can easily monitor air pollution. It also saves data logs for future use. When the air quality degrades beyond a certain level, the system triggers an alarm. Sensors such as MQ135 and MQ6 can be used for monitoring Air Quality as they detect the most harmful gases and can measure their amount accurately.

3. Flood Detection System
Floods are common natural calamities that occur in many countries every year—causing a lot of damage. The early flood detection system is a great real-life application of IoT, which can prevent the enormous loss of life, property, and valuable assets. This system is built to monitor and detect different natural factors like temperature, humidity, water level, etc., to predict a flood. It allows us to take necessary measures to minimize the damage, which a flood can cause.

4. Home Automation Systems (Example: URL: https://www.iot-now.com/2020/06/10/98753-iot-home-automation-future-holds/)
The system automates the function of household appliances, which are connected over the IoT network. It gives users the power to control and manage household appliances just via a smartphone from any location in the world. The system contains a WiFi connection, an AVR family microcontroller, inbuilt touch-sensing input pins.

5. Smart Gas Leakage Detector Bot
The gas pipelines are an essential part of households and industry sectors. Any leakage can cause fire accidents, toxicity in the air, and disaster in industry sectors that work with chemicals. This IoT controlled smart bot includes a gas sensor to detect any gas leaks in a building. All you have to do is insert the bot into a pipe, and it will monitor the condition of

the line as it moves forward. If the bot detects any leak, it will transmit the leakage's location via an interface GPS sensor over the IoT network.

6. Liquid Level Monitoring System

Many industrial sectors use large volumes of fluids in their day-to-day operations. Liquid Level Monitoring System can be used to monitor a particular liquid's level and prevent it from overflowing. It can also track the usage of specific chemicals and detect leaks in pipelines. Ultrasonic, conductive, and float sensors are some of the few sensors for a monitoring system.

7. Smart Agriculture System (Example: URL: https://www.javatpoint.com/iot-smart-agriculture-domain)

It is predicted that by 2050, the population will grow to 9.6 billion, for which agriculture must rise to meet the demands. This project focuses on developing a smart agricultural system that can perform and even monitor a host of farming tasks. The system monitors crops with the help of sensors and automates irrigation systems.

It helps you to schedule the system to irrigate a chunk of land automatically or spray fertilizers on the crops, or farmers can monitor crops from anywhere on the Earth via their smartphone. Using this, farmers can focus more on manual-intensive agricultural tasks.

8. Smart Parking System (Example: URL: https://in.nec.com/en_IN/solutions_services/intelligent_transport_solutions/smart_parking.html?)

There is so much traffic on the roads, finding a parking space is not short of a challenge. We have a solution to all parking problems. The IoT-based smart parking system is designed to avoid unnecessary roaming searching for an appropriate parking area. When you are in the parking space, the system using an IR sensor monitors the whole area at the run time, giving the driver an image of the entire parking area, and the user can see any free spaces and drive straight to it. The system can even open a car gate if there is enough slot in the parking area.

9. Smart Traffic Management System

The population is increasing, causing an increase in the number of vehicles on the roads and seeing the traffic every day; Smart Traffic Management System is the perfect solution for traffic management. The system can effectively manage traffic on roads and offer free pathways to emergency vehicles like ambulances and fire trucks. It can also identify and monitor traffic violators even at night. In an emergency, the emergency vehicle can connect to the system, find signals and pathways where the traffic flow can be controlled dynamically.

10. Streetlight Monitoring System

According to the data, streetlights consume 19% of world energy consumption. Most street lights are on during daylight and remain on when there is no one on the streets. The streetlight monitoring system can efficiently monitor and optimize the energy consumption of streetlights. These lights are fitted with LDR sensors to monitor the movement of humans or vehicles in the street. It uses an efficient way to save energy; when the sensor catches any activity on the road, it signals the microcontroller, turning on the street light. Similarly, when there's no movement, the microcontroller switches the lights off.

11. Smart Energy Grid

We are in the 21st century and still energy grids are not optimized. Whenever the electricity grid of a given region fails, the entire area suffers a blackout. This project works to rectify this issue by creating a smart electricity grid. The grid uses an ATmega family

controller to monitor and control the system activities and communicate over the Internet via the IoT Gecko web page. The primary task is to facilitate the transmission line's re-connection to an active grid if a particular grid fails. When an energy grid faces a fault, the system switches to another energy grid's transmission lines, maintaining an uninterrupted electricity supply to the specific region whose energy grid failed. The system uses two bulbs to indicate valid and invalid users. It can also monitor energy consumption and detect incidents of electricity theft.

12. Smart Baggage Tracker (Example: URL: https://aa-highway.com.sg/travel-smart/) Bags are an integral part of our life, be it a luggage bag, school bag, or laptop bag. And 1% of the bags can be lost during traveling, and there is a significant rise in these cases. Using this system, you can track the bag's location with the help of coordinates sent to the users' phones. Also, it can tell the weight of the bag that can be very helpful while traveling by flight. Smart baggage trackers can innovatively help in the tourism sector. Tourists need to use a tracker on their travel bags.

B) The design details should include:

a) A description of the ***functions to be performed*** by the selected IoT application.
b) Identification of the type of ***data to be collected***, its format (e.g. integer, floating point, … , etc), its units (e.g. degrees celsius, …, etc), its size in Bytes, the frequency of its collection (e.g. very 15 minutes, every day, … , etc).
c) Specification of the way processed information is to be presented to the end-user (e.g. graph, table, . , etc), nature of notifications/alarms to be sent to the end user (e.g. text messages and their content, sound alarms, … , etc).
d) A schematic diagram for the overall system showing all components, including:
   i) Layout of the physical system under consideration
   ii) Type and location of sensors to be deployed, marked on physical system layout
   iii) Type and location of actuator(s) to be deployed, marked on physical system layout
   iv) Type and location of gateway(s) to be deployed, marked on physical system layout
   v) Communication technique to be deployed for sending data collected by IoT node(s), and justification for using such technique
   vi) Technique to be deployed for sending data gathered by gateway(s), and justification for using such technique
   vii) Communication technique to be deployed for Internet connectivity, and justification for using such technique
   viii) Software protocol to be deployed for data transfer (e.g. CoAP, MQTT, … , etc), the location of its components marked on physical system layout, and justification for using such protocol
   ix) Backend Servers needed for information storage & processing
   x) Type of Man-Machine-Interface to be deployed
   , … ,etc.
e) The brand/model/data sheet for the deployed components (sensors, controller(s), gateway(s))

Optionally:
f) The software implementation that executes the IoT application functionalities.
g) Security services that would be needed for safe operation of the designed IoT system

Remark

Groups are encouraged to get needed information from all available resources in order to complete its design in a ready-for-deployment manner.

C) A proper documentation of the design should be handed in the form of a technical report, which is the final outcome for the project. The report should include the following:

Title page
Executive summary
Table of Contents

1. Functions to be performed by the selected IoT application
2. Type of data to be collected (including details stated in b) above)
3. Information to be presented to the end-user (including details stated in c) above)
4. Schematic diagram for the overall system (including details stated in d) above)
5. Brand/model/data sheet for sensors, controller(s), gateway(s)
6. Software module developed for supervising data collection, data query and data delivery (Optional)
7. Security services needed for safe operation of the designed IoT system (Optional)

List of references

D) Projet Evaluation

Total grade is 20 points, distributed as follows:

5 points Initial Report
- due Saturday, 29 November 2025
Submitted report should include ALL items (except 5, 6, and 7) with 4 preliminary

10 points Final Report
- due Monday, 22 December 2025
Submitted report should include ALL items (with 6 and 7 optional)

5. points Presentation (20 minutes/group)
- on Thursday, 25 December 2025