

IoT Project 2024

Two different options are available for the implementation of the IoT project:

- Solo project,
- Group project: each group must be composed of 2 students.

No other options are available.

The project **must** be discussed in the same exam session in which the oral part of the exam will be given.

In the case of group project, the project can be discussed only if at least one of the two members will give the oral part of the exam in the current session.

Project Objective

Development of an IoT application. The use-case of the project must be chosen by the student(s) among these:

- Industry
- Healthcare
- Waste management
- Smart Grid

Please refer to this paper “S. Nižetić, P. Šolić, D. López-de-Ipiña González-de-Artaza, Luigi Patrono, “*Internet of Things (IoT): Opportunities, issues and challenges towards a smart and sustainable future*” to take ideas on the use case.

The paper can be found as Teaching Material on the TEAMS channel of the course.

We encourage you to be original in defining the use case.

System scheme and structure

The system must comprise the following components:

- A *network* of IoT devices, including sensors collecting data from the physical system/ environment and actuators.

As the application protocol, the IoT devices **may** use MQTT (**optional**, under the condition that a **MACHINE LEARNING MODEL** is implemented and exploited) and **must** use CoAP. The IoT devices that use CoAP are both CoAP Server that expose their resources (e.g., actuators or sensors) and CoAP clients. The network must be deployed using real sensors (nrf52840 dongle). In the network a border router must be deployed in order to provide external access¹.

- **A MACHINE LEARNING MODEL** that runs on a subset of the IoT devices. The machine learning model aims at taking **autonomous decisions** on some of the functions of the use case **directly on the IoT device without requiring assistance from external applications**, e.g., by forecasting some metrics and making a decision, by highlighting anomalies and react to them, etc.

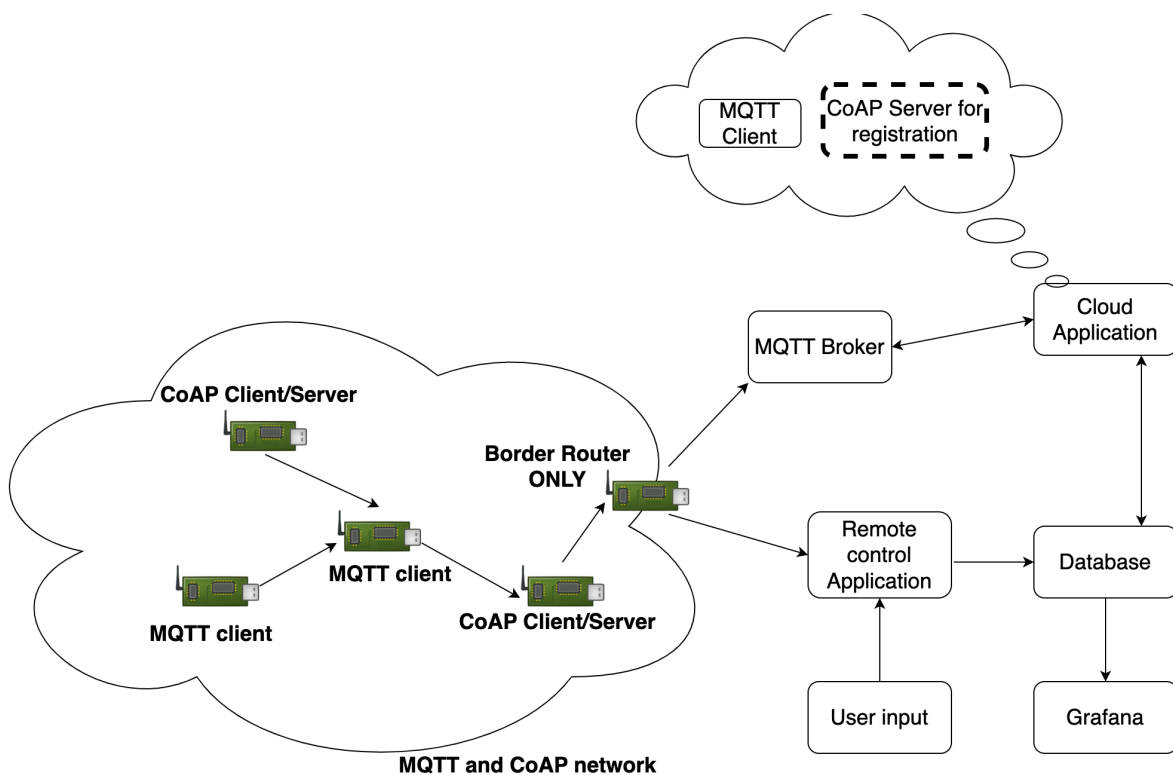
The machine learning model must be trained accordingly to the procedure presented in class using some open datasets available on the internet, e.g., <https://www.kaggle.com/>.

¹ For the sake of simplicity, during the deployment we suggest to simulate the network on Cooja with (MQTT) and CoAP sensors.

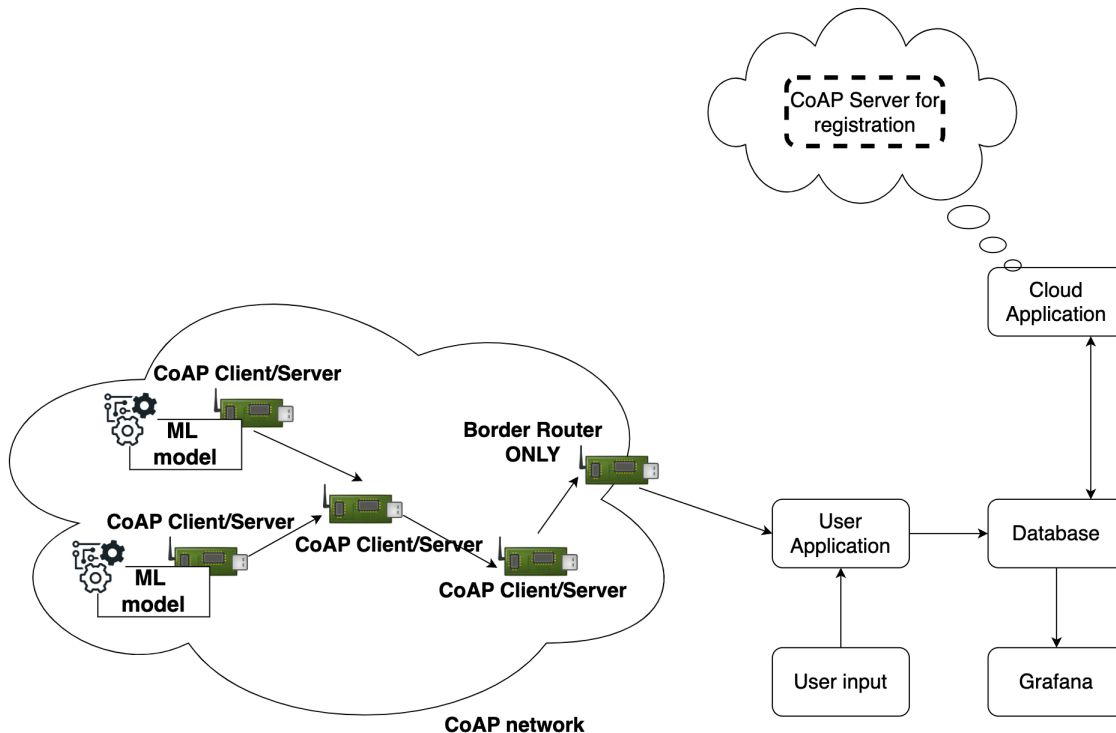
The colab workbook that is used to train the model must be downloaded and included in the project submission. The workbook must include also a reference to the dataset used.

- [GROUP PROJECT] The CoAP actuators and sensors must register to the Cloud Application, acting as a CoAP Client. This to create a directory of actuators in the Database.
- [SOLO PROJECT] The list of actuators and sensors is statically created and exploited by the User Application via a configuration file.
- [GROUP PROJECT] A web-based interface deployed using Grafana must be developed in order to show the data collected and stored on the database.
- The *Cloud Application* collects data from MQTT (**optional** to the adoption of a Machine learning model) or CoAP sensors, store them in a MySQL database.
- The *Remote control Application* reads information about actuators and sensors from the database and implements a simple *control logic* in order to apply some modifications to one or more actuators based on the data collected from the sensors, e.g. some closed-loop control logic.
- It is required to provide some User Input to implement the User logic for the IoT application. The User input can be implemented as a command line interface.

System scheme WITHOUT THE MACHINE LEARNING MODEL



System scheme WITH THE MACHINE LEARNING MODEL



Guidelines/Requirements

- The application can be implemented using JAVA or Python
- Button and LED interactions with sensors **must** be used.
- Data should be encoded in a proper format that might depend on the specific use-case. The selection of the encoding language should be motivated, and it is going to be part of the evaluation.

Project submission

Projects must be submitted at least **4 days prior to the day of the exam**, e.g., if the exam session is the 06/06/2024 the last day for the submission (included) will be 02/06/2024.

The project must be submitted using this link: <https://forms.gle/3CKJJfizFvP67b5s8>. Students must submit the **code** of the project and a **document describing the implementation and the use-case**. For the latter both a report or a detailed presentation are accepted.

Project discussion

The project discussion will take place the day of the exam, in person. The discussion, 10 minutes max for SOLO PROJECT, 15 minutes max GROUP PROJECT, will consist on the demo of the execution of the application, showing all the implemented and required features (5/10 minutes), and on 5 minutes questions on the code.