UNIVERSITÀ
degli STUDI
di CATANIA

Department of Math and Computer Science
Bachelor's degree in Computer Science

PARK SMART

Development of a multi-threaded embedded software for remote management using C++ and MQTT

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Park Smart

Park Smart is a Sicilian solution company which operates in the field of Smart Cities.

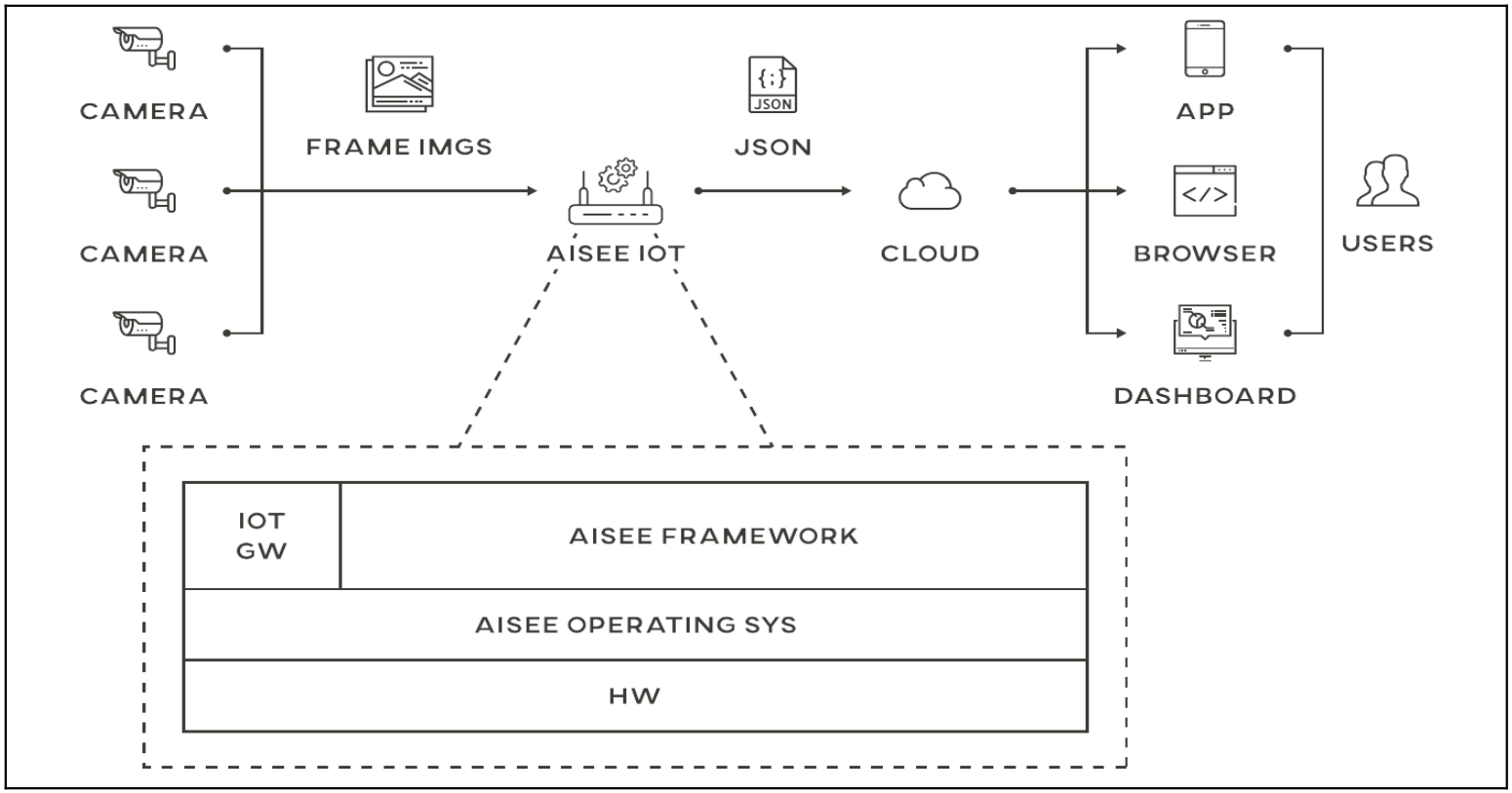
The company's goal is **monitoring** the parking areas of the city and **communicate** the parking **availability** to city's inhabitants.

How?

 # Artificial Intelligence ***# Computer Vision***

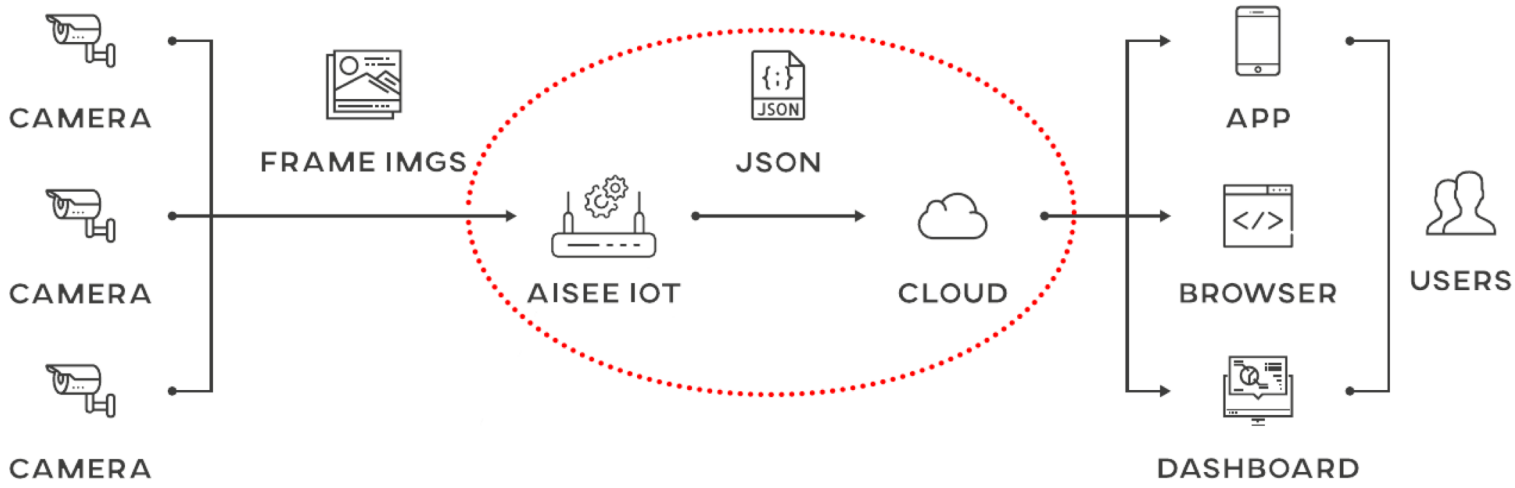
 # Cloud System ***# Mobile Application***

Park Smart Infrastructure



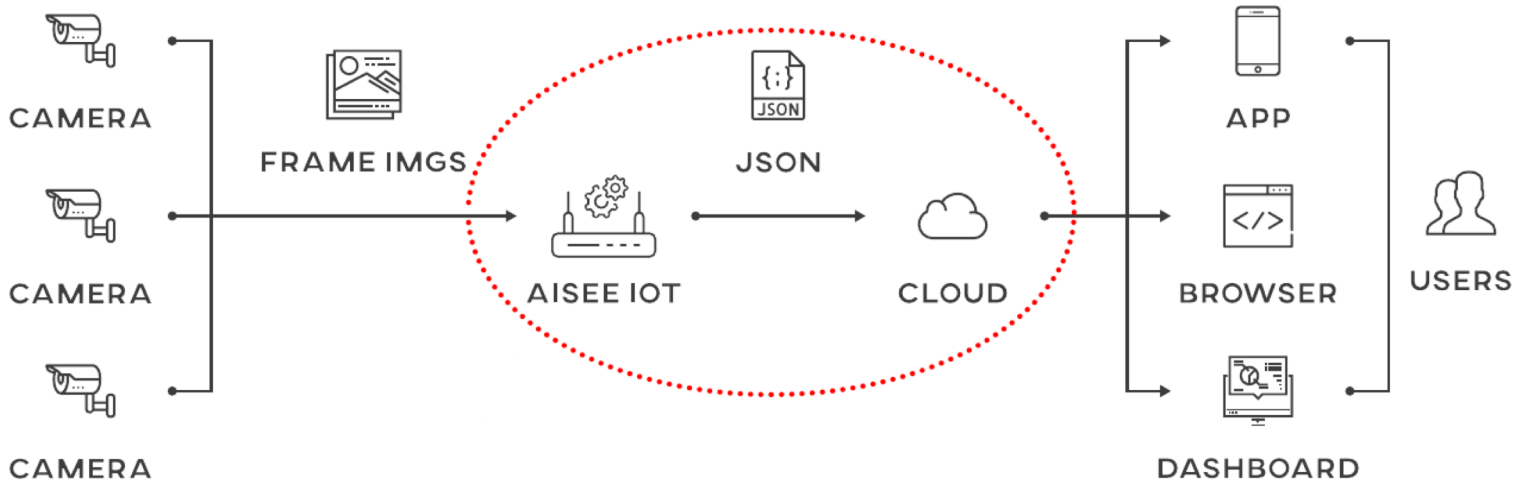
Final Project Main Goal

Develop a **software** for allowing the *AISee Box* device (Computer Vision system) to communicate **efficiently** and **asynchronously** with the company's Cloud System.



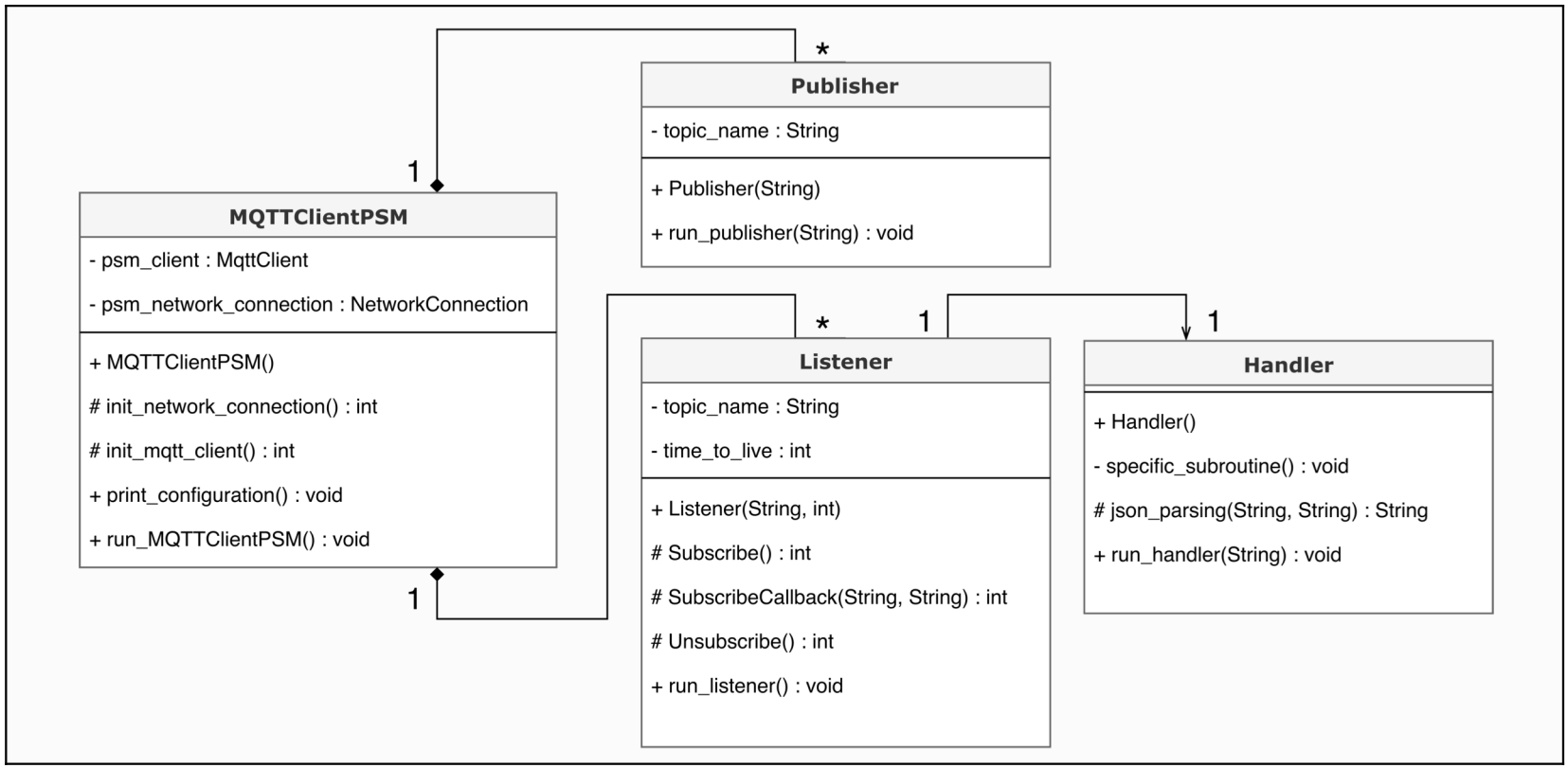
Other Goals

1. **Stable**
2. **Modular**
3. **Multithread**
4. **Cross Platform**



Used Technologies

Software Desing (a part of)



Software Development (a part of)

```
int Listener::Subscribe(){
  cout << "[Listener][INFO] I'm doing the Subscribe on the topic: " << topic_name << endl;

  // Linking the ApplicationCallbackHandlerPtr to SubscribeCallback
  awsiotsdk::mqtt::Subscription::ApplicationCallbackHandlerPtr p_subscribe =
    bind(&Listener::SubscribeCallback, this, placeholders::_1, placeholders::_2);

  // Using the SDK API for making the subscribe operation:
  shared_ptr<awsiotsdk::mqtt::Subscription> p_subscription =
    awsiotsdk::mqtt::Subscription::Create(move(topic_name), QOS0, p_subscribe, nullptr);

  awsiotsdk::util::Vector<shared_ptr<awsiotsdk::mqtt::Subscription>> topic_vector;
  topic_vector.push_back(p_subscription);

  int rc = temp_mqtt_client->Subscribe(topic_vector, awsiotsdk::ConfigCommon::mqtt_command_timeout);

  // Checking if subscription is OK:
  if(rc != 0) cout << "[Listener][FAILURE] Impossible make the Subscribe." << endl;
  else cout << "[Listener][OK] Subscribe correctly made up." << endl;

  return rc;
}
```

Software Development (a part of)

```
int Listener::SubscribeCallback(String topic_name, String payload){
  cout << "------------------------------------------------------------------" << endl;
  cout << "[Listener][INFO] Message on topic: [" << topic_name << "]" << endl;
  cout << "[Listener][INFO] Message length: " << payload.length() << endl;
  cout << "[Listener][INFO] Message content:" << payload << endl;
  cout << "------------------------------------------------------------------" << endl;

  // Starting a new thread:
  thread th_handler(&Handler::run_handler, payload);
  // This thread will continue the execution and th_handler executes independently:
  th_handler.detach();

  return 0;
}
```

Software Development (a part of)

```
int run_publisher(String temp_message){
  cout << "=============== START PUBLISHING ON A TOPIC ===============" << endl;
  cout << "[Publisher][INFO] Publishing on topic: [" << topic_name << "]" << endl;
  cout << "[Publisher][INFO] Message length: " << temp_message.length() << endl;
  cout << "[Publisher][INFO] Message content:" << temp_message << endl;

  // Using the SDK API for making the publish operation:
  int rc = temp_mqtt_client->PublishAsync(topic_name, false, false, QOS1,
                                          temp_message, nullptr, 0);

  // Checking if publish operation went OK:
  if(rc == 0) cout << "[Publisher][OK] Messagge correctly published on topic." << endl;
  else cout << "[Publisher][FAILURE] Messagge not published on topic." << endl;

  return rc;
}
```

Software Execution and Testing

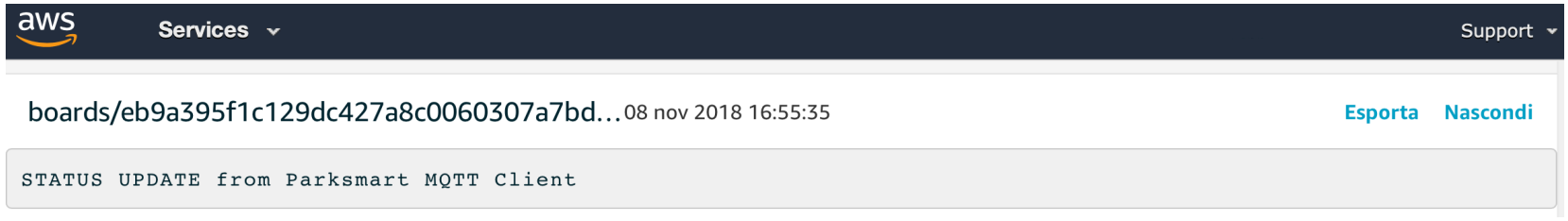
Start and Inizialization

```
================================================ STARTING PARKSMART MQTT CLIENT ================================================

================================ CREATING PSM_MQTT_CLIENT ================================
[MQTTClientPSM] [OK] MbedTLS connection correctly established.
[MQTTClientPSM] [OK] Correctly created psm_mqtt_client
[MQTTClientPSM] [OK] Connection to endpoint accepted.
[Handler] [INFO] Handler correctly built.
[Publisher] [INFO] Publisher correctly built.
[Listener] [INFO] Listener correctly built.
[MQTTClientPSM] [INFO] MQTTClientPSM correctly built.
==========================================================================================

__________________________________________________________________________________________
Endpoint: a3rzums6u8jbaw-ats.iot.eu-west-1.amazonaws.com
MQTT port: 8883
Root CA Certificate: /certs/root-CA-1.crt
Device Certificate: /certs/eb9a395f1c129dc427a8c0060307a7bd70f571fa1c5d799b4523bee7e8aa0f66.certificate.pem.crt
Device Private Key: /certs/eb9a395f1c129dc427a8c0060307a7bd70f571fa1c5d799b4523bee7e8aa0f66.private.pem.key
Client ID: eb9a395f1c129dc427a8c0060307a7bd70f571fa1c5d799b4523bee7e8aa0f66
Classification Config Path: /data/classification_tool/config
Img Path: /data/classification_tool/img_dataset
Model Path: /data/classification_tool/models
Firm Path: /data/fw
Class Path: /data/classification_tool/res_class
Http Config Path: /data/classification_tool/res_class
__________________________________________________________________________________________
```

Software Execution and Testing

Publishing on a MQTT topic

```
============================== START PUBLISHING ON A TOPIC ==============================
[Publisher] [INFO] Publishing on topic: [boards/eb9a395f1c129dc427a8c0060307a7bd70f571fa1c5d799b4523bee7e8aa0f66/status]
[Publisher] [INFO] Message length: 40
[Publisher] [INFO] Message content:  STATUS UPDATE from Parksmart MQTT Client
[Publisher] [OK] Messagge correctly published on topic.
=========================================================================================
```



Software Execution and Testing

Listening on a MQTT topic and handling of the received command