Institut National des Sciences Appliquées de Toulouse
Département de Génie Electrique et Informatique

January, 2021

Portfolio :

Presentation of the skills I developed during my 5th year at INSA

PTP Innovative Smart System (ISS)

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I. Generality

I.1 Portfolio overview

This portfolio is a report of my experiences and developed skills during the PTP ISS that I followed for my 5th year's first semester at the INSA of Toulouse. This document aims to describe the courses I have been following and to highlight the knowledge I have acquired.

After a presentation of the ISS PTP and my profile, the document will be structured around three main parts. The descriptive part will present my main experiences and the responsibilities I took to carry out these projects. Then, a technical part will detail the courses followed during this semester, the skills mobilized to solve the difficulties encountered as well as the knowledge developed. In this part I will use a skills matrix to self-evaluate on every 5ISS courses. Finally, in the analytical part, I will give my personal point of view over this formation and how much I feel prepared to enter the world of work.

The appendices to this report are available in the 5ISS repository on my GitHub account at this address:

https://github.com/LeoPotiers/5ISS

I.2 Presentation of PTP Innovative Smart System

The PTP Innovative Smart System (ISS) began in September 2020 and ends in January 2021. This master's degree is mainly accessible to students coming from the Computer Science and Network branch (IR) and those coming from the Electronics and Automatic Control for Embedded Systems branch (AE-SE). Some different profiles also follow the training as engineers in reconversion or who wish to broaden their spectrum of skills. Everyone's varied knowledge and experiences is shared in order to approach courses and projects as a whole.

The ISS program is composed of six training units that aim to present the entire process of setting up a stand-alone sensor. This starts with its creation in a clean room and ends with its deployment and publication of its data on a network.

Training Unit (TU)	Content of the TU	Courses part of the TU	Hours	ECTS
Smart Devices	Microcontrollers, Open-source hardware, Computer Aided Design (CAD)	● Introduction to Sensors ● Microcontrollers and Open Source Hardware	59,5	5
Communication	Protocols, Wireless Communication, Energy and Security for connected objects	● Communication Protocols for Smart Devices ● Energy for Embedded Devices ● Security for the Internet of Things	56,25	6
Middleware and Service	Service architecture, Middleware for IoT, Adaptability: Cloud and Autonomous management	● Service Oriented Architecture ● Middleware for the Internet of Things ● Adaptability: Cloud and Autonomic Computing	62	6
Analysis and data processing	Software engineering, Semantic Data processing, Processing and Analysis of Data: Big Data Principle	● Software Engineering ● Semantic Data Processing ● Data Processing and Analysis: Big Data	37,25	5
Innovative Project	Apply the knowledge of other TUs in a concrete interdisciplinary project	● English	X	6
Innovation and Humanity	Innovation, Social Acceptability, Business Development, Creativity Methods, Team Management, Sport		95,5	6

Figure 1 : Table of the 5ISS training units and their content

I.3 Curriculum

I.3.1 Student profile

I am a 23 years old student at INSA of Toulouse. I grew up in Lyon and Nice and I moved to Toulouse in 2016 to follow the INSA's formation. I am interested in a career in embedded systems in the autonomous vehicle field. This is why I am doing my graduation internship in the ADAS service of Continental, as a CELAD service provider.

I am a very open-minded person, easy to live with and always open to meeting people from new horizons. I have always participated in many activities in parallel with my studies. I played tennis for 15 years, I was a teacher in my childhood club in high school and then in the university sports association. Today I practice trail running and triathlon. I have travelled a lot since I was a child, first with my family (USA, Canada, Vietnam, Indonesia, Guatemala, Chile, Bolivia, Morocco ...) and then alone (England, Spain, Portugal). In my second year at the INSA I did a humanitarian social trip to an alternative school in Cusco, Peru. During my 4th year, I have done an university exchange for a semester in the University of La Plata in Argentina. Today I speak English fluently and I also speak very good Spanish.

I.3.2 Curriculum Vitae

Léo POTIERS

Étudiant ingénieur – Cinquième année
Systèmes Embarqués
Innovative Smart System

PROFIL

Étudiant ingénieur de **5e année à l'INSA Toulouse**, je projette une carrière dans **la conception de systèmes embarqués.**

Actuellement à la recherche d'un **stage de stage de fin d'étude, d'une durée de 6 mois, à partir de février 2021.** Je veux mettre mes compétences en application dans le secteur de **l'automobile, de l'aéronautique ou de la robotique.**

- Né le 12/01/1998, 22 ans
- Permis de conduire B, véhiculé

COMPÉTENCES

- Participatif et rigoureux
- Responsable et autonome, habitué au télétravail
- Très à l'aise en équipe, communicatif et sociable

- Langage C/C++ ●●●●●
- Linux ●●●●●
- Python ●●●○○
- Matlab ●●●○○
- JAVA ●●○○○

- Anglais (C1) ●●●●●
  - Voyages en Angleterre et États-Unis
- Espagnol (C1) ●●●●●
  - Semestre d'échange universitaire en Argentine
  - Voyages en Espagne, Argentine, Pérou, Chili

CONTACT

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- Skype : leopotiers

FORMATION

Institut National des Sciences Appliquées - Toulouse

2016 - Aujourd'hui

- 2021 : Spécialisation Innovative Smart System
- 2020 : Spécialisation en Systèmes Embarqués
- Juillet 2019 - Janvier 2020 : Semestre d'échange à l'Universidad Nacional de La Plata (La Plata, Argentine)
- 2019 : Spécialisation en Automatisation et Électronique
- 2017 : Spécialisation en Ingénierie des Matériaux , Composants et Systèmes

Baccalauréat général série scientifique

2016

- Mention très bien

EXPÉRIENCES PROFESSIONNELLES

Stage au LAAS - CNRS : Développement d'un outil de reconnaissance visuelle d'objets par apprentissage

Juin 2020 - Septembre 2020 (3 mois, télétravail)

- Au sein de l'équipe de robotique humanoïde Gepettto, j'ai pris part au laboratoire ROB4FAM (Robots For the Futur of Aircraft Manufacturing), mené conjointement par le LAAS et Airbus depuis 2019. Application industrielle de techniques de Machine Learning telles que la détection et classification d'objets, l'estimation de pose. Utilisation du langage Python, Jupyter, de Docker et des frameworks TensorFlow et Pytorch.

Membre du Toulouse Ingénierie Multidisciplinaire (TIM)

Septembre 2019

- Association qui construit des voitures qui consomment le moins de carburant possible. Conception d'un véhicule autonome pour participation au Schell Eco Marathon Autonomous Challenge. Membre de l'équipe chargée de la fusion de données multisensorielles (ROS)

Stage ouvrier rémunéré

Juillet 2017

- Préparateur de parfums chez Accords et Parfums (Tel : 04.93.60.52.52) Insertion dans une équipe de laboratoire et de production, fabrication de parfums et contact avec les fournisseurs et clients en français et anglais

CENTRES D'INTÉRÊTS

Sport

- Tennis (depuis l'âge de 5 ans), champion par équipe des Alpes Maritimes en 2010 et obtention du classement obligatoire pour être professeur en 2015. Moniteur assistant pendant 2 ans au Tennis Club de Peymeinade (Tel : 04.93.42.25.73) puis 3 ans à l'INSA.
- Course à pied (semi-marathon de Cannes 2020) et Trail de la passerelle 2020 (1er espoir masculin)

Associatif étudiant

- Responsable et professeur de l'association de tennis de l'INSA
- Représentant étudiant au conseil du centre des APS
- Membre du pôle sensibilisation de l'association Ingénieurs Pour Demain, promouvoir l'éthique et le métier d'ingénieur durable auprès des étudiants

Voyages

- Nombreux en Europe, Asie, Afrique, Amérique du Nord et du Sud, seul ou accompagné
- Voyage humanitaire social au Pérou en juillet 2018

Musique

- Guitariste depuis l'âge de 10 ans, j'ai joué dans un groupe en tant que guitariste-chanteur pendant 4 ans

I.3.3 Background

Before entering the PTP ISS, I have followed the master level degree in Electronics and Automatic Control for Embedded Systems (AE-SE). This training is a solid base of knowledge in control, embedded electronics, database, network and programming. The main courses and projects that I have been following during my 4th year are also accessible on my Github 5ISS repository. Throughout my years at the INSA, I also learned to work in groups, to work on a long-term project and to defend it in front of a jury. The ISS master's degree seemed obvious to me as my final orientation choice, first of all for the subjects covered that were matching with my career development plan, but also for the autonomy that was granted to us.

II. Descriptive Part

The experiments described below are described in chronological order, starting at the beginning of my 4th year and ending at the end of the 5ISS semester.

II.1 Object-oriented programming : C++ coding a connected sports watch

II.1.1 Environment and context

As part of our fourth year Object Oriented Programming course, we had to code the connected object of our choice. We had never used C++ programming language before this project but I was surprised how intuitive it is when we are familiar with C. I do not consider myself an excellent programmer but I liked this project a lot because I found it very informative. Frist, we had a theoretical formation of C++in order to understand the concepts of oriented-object programming. I remember that I also formed myself using the OpenClassrooms MOOC to start some projects. This course started just after the very first lockdown, at this time I left Toulouse to go to a vacation house and I had a lot of free time so I really invested myself in programming in C++. The disadvantage is that because of the confinement, we did not have access to the arduino board to connect the desired sensors. The professor provided us with a code simulating the arduino, and we did the same for the sensors and actuators we wanted to use.

II.1.2 My function

Since running is undoubtedly my favorite activity, I immediately suggested to my friend Maxime to code a connected sports watch software. The interest of this kind of connected watch is to help the athlete in his progression by giving him access to his statistics. Often the watch has several activity modes, we chose to propose a stopwatch mode, a walking mode, a running mode as well as a swimming mode. Since we didn't have access to sensors that would publish the step frequency or the evolution of the athlete's GPS position, I did the simulation of these sensors in C++. So I coded a user simulation, a pedometer sensor that detected each step, and also a

gyrometer sensor that detected the orientation of the watch for swimming in the pool. I also participated in coding the actuators that the watch would have, that is to say 4 buttons (START - STOP - RESET - MODE). Of course I also participated to design the loops of the main code. Together, we also detailed the general functionment of the code, linked lists, explaining legacy classes, by doing use case diagram, State Chart diagram and Sequence diagram in our report.

II.2 Electronic design of an autonomous energy production system starting from photovoltaic cells

II.2.1 Environment and context

The design and wiring of an autonomous energy production system was an important group work in my 4th year. On this project, we first worked collectively on the global understanding of the electrical circuit, using the LTSpice software and interacting with tutors. We dimensioned the circuit together by clearing the three main stages (Buck - Boost - Inverter).

II.2.2 My function

I specifically worked on the inverter stage of the assembly, that is to say the stage that had to transform the DC input voltage into a AC output voltage while respecting specifications in terms of power supply. After performing numerous dimensioning calculations, I simulated the complete stage on LTSpice by adjusting the values of the components to those of the commercial components at our disposal. I also drew up a table listing commercial components to evaluate the minimum price of the designed stage.

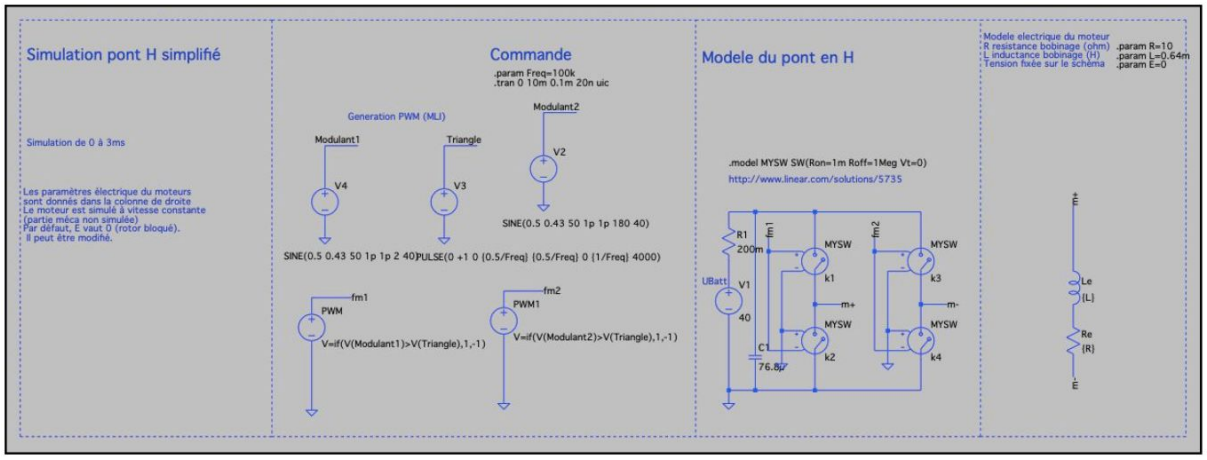

Figure 2 : Electronic circuit of the inverter stage of the autonomous energy production system

II.3 Research Project : Multi-Sensor Data Fusion for the TIM (Toulouse multidisciplinary engineering)

II.3.1 Environment and context

In the context of the research initiation project (PIR) in 4th year, I worked on the multisensory fusion of an autonomous vehicle for the TIM association of INSA. The TIM is an association that aims to build and improve vehicles capable of covering the longest distance on the track with the lowest possible fuel consumption. Every year, it takes part in the Shell Eco Marathon, a European competition held in London that confronts the vehicles of many similar associations. As part of the project of the TIM to develop an autonomous vehicle in order to take part in the autonomous car competition of Shell, we helped them with the multi-sensor data fusion. This year-long group work started when I was on an exchange semester in Argentina, I missed the beginning of the state of the art research but I quickly caught up with my classmates.

II.3.2 My function

For the state of the art part, I researched and wrote the data acquisition part. I evaluated the different existing technologies, the necessary sensors and their functioning, and also their performances. I focused on the study of stereoscopic cameras, electronic sensors, lidar and radar. Thanks to my research and conclusions, we opted for the purchase of a Lidar Livox DJI, 8 ultrasonic sensors and a CMOS camera. Unfortunately, due to the quarantine, we could not receive the sensors and had to continue working remotely on the project. So we had to reorganize ourselves, following the plan detailed below.

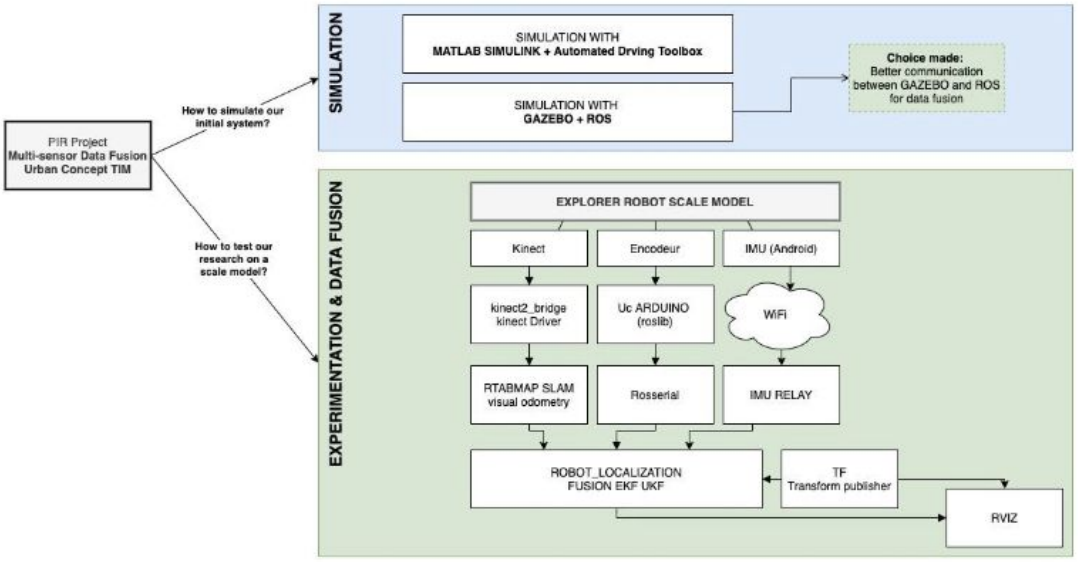

Figure 3 : Reorganisation of our PIR during the lockdown

I worked with a friend on the multisensor data fusion of the data generated from a Kinect, encoders on the wheels and the IMU of a smartphone. We analyzed the data returned from the kinect using ROS and RVIZ doing SLAM (Simultaneous Localization and Mapping) and the Robot Localization Package of ROS.

We used the IMU of a smartphone as a second source of odometry. Our work consisted in a lot of research, first, to familiarize ourselves with ROS, and then understand which ROS package would be compatible with the data returned by our sensors. We spent a lot of time researching open source works and trying to get inspiration from their settings to get a consistent result. Finally, we managed to merge the data from our two sensors.

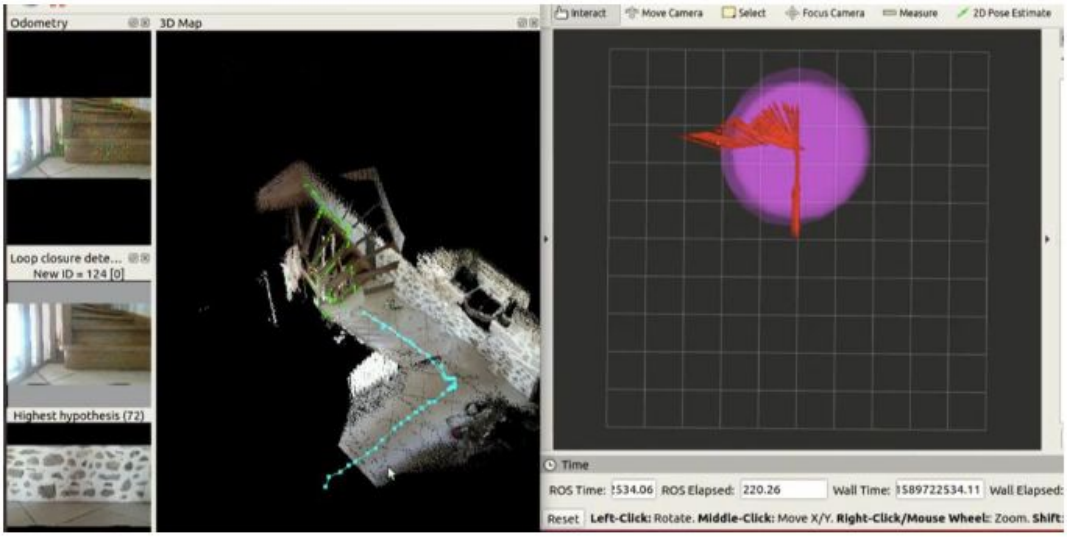

Figure 4 : Results of multisensor data fusion

II.4 Three months internship at LAAS-ROB4FAM : Object detection and Pose estimation with IA for aircraft manufacturing

II.4.1 Environment and context

Between June 15 and September 15, 2020, I did an internship at LAAS-CNRS. I took part in the ROB4FAM research team, composed of researchers from the LAAS Gepetto team, which is working on humanoid robotics, and Airbus engineers. Founded in 2019, this project aims to deploy humanoid and semi-autonomous robots on Airbus assembly lines. This very interesting internship, in the heart of a very diverse team and rich in various skills allowed me to set up neural networks for computer vision and intelligent recognition of industrial features. The objective of my internship was to develop a tool to recognize and locate screws, holes, rivets or bolts on an aircraft skin. This convolutional neural network will be deployed on a humanoid robot capable of performing, according to the recognized primitive, a basic command such as drilling, tightening or screwing.

II.4.2 My function

The first part of my internship was focused on understanding the different methods of machine learning in order to propose one that would solve the problem posed. After studying different frameworks, I chose to implement the object detection method proposed by Tensorflow. I built my own database from internet images and videos taken on the airplane skin in the LAAS premises.
I chose the SSD-Mobilenet model that would be suitable for real-time onboard recognition. I set up the learning process by doing learning transfer to accelerate this step.

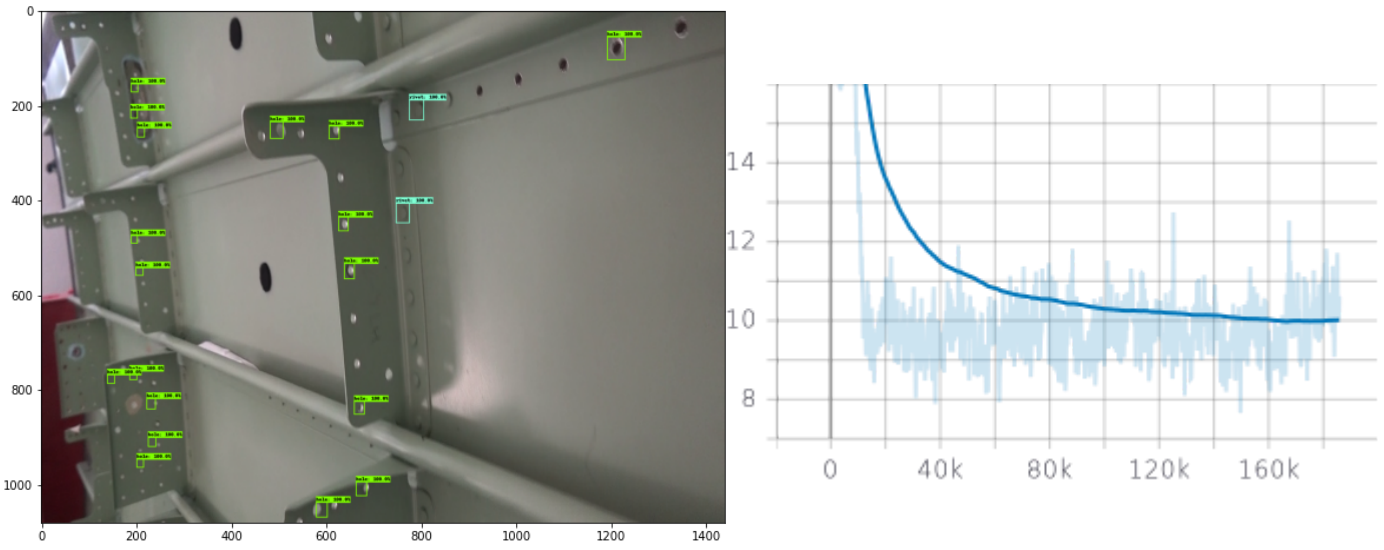

Figure 5 : Test of the SSD-Mobilenet trained for industrial features detection, and a TensorBoard plot of its training process

At the end of my internship, I also worked on a pose estimation method that would be useful to discern the orientation of the aircraft skin before performing on it. I used a network called PVnet that was able to recognize the orientation of an object even if it is truncated or partially masked.

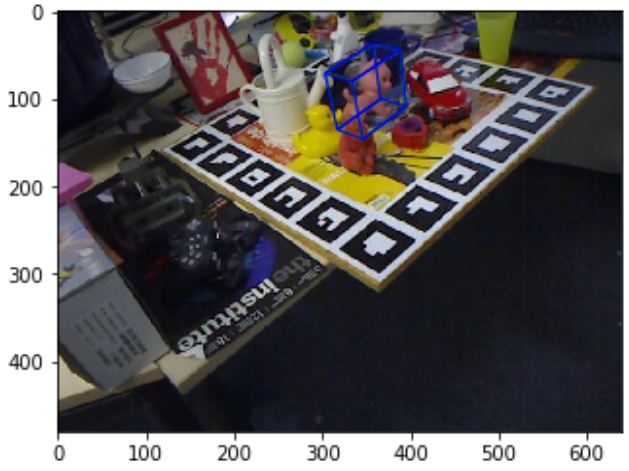

Figure 6 : Test of PVnet for pose estimation

Due to the lack of data at my disposal and the difficulty of this method still at the research stage, I did not have the time to apply this method to our specific use case. On the other hand, it was very interesting to understand how it worked, and to use PyTorch to implement it.

In addition to everything I learned during my internship about computer vision methods, I developed various anex skills. I learned how to use Jupyter to run scripts, Docker to create individual working containers and to generate appropriate workspace writing in the Dockerfile, and finally I improved a lot on Unix because I was connecting remotely to a sufficiently powerful machine at the LAAS.

II.5 5ISS semester project : Create an affordable smart car kit to update old vehicles

II.5.1 Environment and context

In the context of the 5th year, I took part in the Smart Car Kit project with four other students from various backgrounds. Our diversified team is composed of a student coming from Physical Engineering, an industrial engineer in reconversion, a student from MS IoT, and a second student, coming like me, from the AE-SE branch. Our project is part of the agreement between INSA and the ACTIA chair to work jointly on the development of technologies related to the autonomous and smart vehicle. Our mission was to think and develop a kit that could be deployed on any vehicle not well equipped in order to update it with very latest functionalities. That way, our affordable kit would easily help increase the vehicle's confort, security, and extend its lifetime.

II.5.2 My function

In this project, following the internship realized in the ROB4FAM team, I proposed to realize a tool for detection and recognition of traffic signs. I evaluated various trained models to select the one with best performances that was RFCN-Resnet 101.

Figure 7 : Traffic sign detection and classification in bad visibility conditions (night, snow, truncation)

After this I worked on a function to evaluate the proximity between the vehicle and every detected sign on the video flow. This function will be very useful because once connected to the mobile application of the kit, the user will be informed of the upcoming traffic signs but also of their order of appearance. The detection of traffic signs will be deployed in order to make the drive smoother and safer. The neural network is able to recognize upcoming traffic signs faster and with more reliability than a human that could be tired or distracted. The detected information will be fastly shared to the driver so that he can anticipate road dangers or regulations and so adopt the appropriate driving style. Moreover, we can imagine that once deployed on enough cars, this tool will help to fluidify the traffic and to significantly reduce the crash risk. I also worked on the deployment of the network by configuring the Jetson Nano board with every needed frameworks, softwares and libraries. Unfortunately, I didn't have time to deploy the code on it and test the network in real conditions.

III. Technical Part

In this part, I will detail each of the teachings I received during this semester in the ISS master's program. After a presentation of each training unit, the teaching context and the topics covered, I will detail the problems and questions raised as well as the skills mobilized and developed. Each course will be detailed using a competency matrix in which I will self-assess myself. Here is the self-evaluation scale, rated out of 4 :

1 - Level of application: **follow-up of instructions or procedures**
2 - Level analysis: **improvement or optimization of solutions or proposals**
3 - Level of control: **design of programs or definitions of specifications**
4 - Level of expertise: **definition of guidelines or strategies**

Figure 8 : Self evaluation scale for the 5ISS skills matrixes

As a reminder, I give here once again the link to my GitHub repository where I uploaded all my reports and presentations of this 5ISS semester:

https://github.com/LeoPotiers/5ISS

III.1 Smart devices

III.1.1 Presentation

The Smart Device training unit helped me understand the entire process of setting up a sensor on a network. To start, we built a nanoparticle gas sensor in the AIME laboratory ("Atelier Inter-Universitaire de Micro-Electronique") of INSA Toulouse during one week. We evaluated its performance in order to write its datasheet. On LTSpice, we also designed the electronic circuit that powers the sensor to make measurements. On KiCad, we designed the footprint of our sensor, and connected it to an Arduino Uno board footprint. Finally, we had a few face-to-face sessions to understand how to use an arduino board and to connect it with sensors. In parallel to this work, we had a course on the use of Github and shared our work on a shared repository.

III.1.2 Raised problems

I did not particularly face any problems in this TU, the tutors were supportive and available to answer any of our questions.Having never used an arduino before, practical works were done to explain clearly how to code a card by connecting it with sensors, actuators, and even to connect it using Bluetooth with an Android application. My big disappointment about this course was that I didn't have time to finish connecting my Arduino board to the LoRa gateway on campus to publish the measurements. Out of covid context I would have liked to spend more time in the GP classroom and I could have continued outside of the practical class hours, because the number of hours planned was insufficient to do the practical work and the project of deploying our network.

III.1.3 Knowledge and skills mobilized

In this course, I mobilized my know-how of sensor manufacturing in white room since we had already designed a photovoltaic cell at AIME. I also used my knowledge in electronics to dimension the power supply circuit of the gas sensor.

This course allowed me to discover the KiCad software, to learn how to use an arduino card and I appreciated the course on GitHub because Ifelt a lack of knowledge on that point during my 4th year internship, it is an essential notion for a computer engineer.

Skills - Smart Device	Auto-Evaluation
Introduction to Sensors	
Understand basic notions of sensors, data acquisition: physics, electronics and metrology point of view	4
Be able to manufacture a nano-particles sensor using micro-electronics tools: chemical synthesis, assembly, testing	4
Be able to design the datasheet of the sensor manufactured	4
Microcontrollers and Open Source Hardware	
Understand microcontroller archictecture and how to use them	3
Be able to design data acquisition system (sensor, conditioner, microcontroller) with respect to the application	4
Be able to design the electronic circuit of a sensor's signal conditioner (design + simulation)	4
Be able to design a shield to accommodate the gas sensor	4
Be abe to design the sofware to use the gas sensor and its HMI	3
Be able to combine all of the above mentioned components into a smart device	3

Figure 9 : Skills matrix for the training unit Smart Device

III.1.4 Summary

I really liked this module, it was very well teached and it is good to have an overview of all the steps prior to the installation of a sensor. Beyond the points discussed above, this course is one of the few to have taken place in person and it was very pleasant psychologically to share these moments with our partners for these hours of practical work.

III.2 Communication and Wireless Sensor Networks

III.2.1 Presentation

The field of smart devices is growing extremely fast, IoT is also on the verge of exponential growth with the deployment of 5G, these innovative markets are attracting a lot of attention. This communication course for the wireless sensor networks allowed me to better differentiate the existing networks according to the communication protocols implemented, their security and energy optimization. Because there are more and more users and risk of network saturation, I also worked on the protocols and legislation put in place to keep a network operational. I have also done a lot of research on the much criticized 5G technology to understand whether it actually represented a health and ecological risk.

III.2.2 Raised problems

Since smart devices are often limited in energy once deployed, it is important to optimize their consumption to extend their lifespan. On the other hand, it may happen that

these devices exchange personal information or that may affect the security of an individual, a building, a company, etc.
It may then be advisable to implement security measures even if it consumes energy. Depending on the type of application, it is essential to choose a suitable network.

Following this first point, we also studied how the energy was stored into an embedded system, and how it was possible to recover some ambient energy.

Another problem we tackled is that wireless smart devices often aim to have a high mobility and if so, the network must have a great cover. This is one more specification not to forget while selecting a network.

III.2.3 Knowledge and skills mobilized

I developed my networking knowledge by focusing on wireless sensor networks, their protocols and specifications. I have studied LoRa, Sigfox, BLE (Bluetooth Low Energy), Zigbee, NB IoT (5G) and M2M (5G) wireless networks. I did specific research on the BLE network by studying its physical layer (frequency, channel bandwidth, ripple ...), its MAC layer, its power consumption as well as its security protocols and vulnerabilities.

I also worked on Channel Access Methods (FDMA - TDMA - CDMA - CSMA), explaining how they operate and what their specifications are. But also on MAC protocols dedicated to wireless sensor networks and IoT (S-MAC, T-MAC, Z-MAC, B-MAC), by asking me the questions of clock synchronisation, localization capability, security mechanisms and node mobility.
I also refreshed my knowledge in embedded systems energy.

All those things were learned thanks to lectures, research, reading and discussions.

Skills - Protocols and communication	**Auto Evaluation**
Understand the major development phases for mobile communications and development of the associated technology	4
Understand the impact of new mobile technology	4
Be able to analyse and evaluate optimal wireless network technologies	4
Be able to suggest optimal technological solutions for IoT networks	4
Understand and master optimisation of communication protocols for IoT with respect to energy limitations	4
Understand and master optimisation of communication protocols with respect to security concerns	4
Know the main processing techniques used for digital communication and know how to explain the basic structure of digital RF transmitter-receiver	4
Mastering the architecture of an energy management system, simple storage, energy recovery, know how to size the storage element according to the specifications	3
Skills - Security for IoT networks	**Auto Evaluation**
Understand the fundamentals of security	4
Be able to identify security weaknesses in an IoT architecture	2
Be able to assess the impact of exploiting a security vulnerability in an IoT architecture	3
Be able to propose adequate security counter-measures	2

Figure 10 : Skills matrix for the training unit Communication

III.2.4 Summary

In conclusion, this course will have given me a lot of knowledge about the different networks for connected objects. But more generally, it will have taught me the key elements that characterize a network and that allow me to select one over another.

III.3 Middleware and service

III.3.1 Presentation

The two previous training units showed us how to design a sensor and how to connect it to a network, then how to choose a network adapted to our use. In the training unit "Middleware and Service", we will study how it is possible to visualize the data published by a sensor and to interact with connected objects using web services.

III.3.2 Raised problems

The main problems encountered in these courses were related to the installation of the setup environment. Being remote and working each on their own machine, with their own installation, we lost a significant amount of time due to errors related to missing libraries, or software incompatibilities.

III.3.3 Knowledge and skills mobilized

The first practical we have done was about controlling various smart sensors in a house (energy consumption controller, luminosity sensor and temperature sensor) in order to learn how to use the oneM2M platform, to send requests using the PostMan client and to monitor the application to watch every exchanged request.

The final project in this training unit was to develop a web application capable of reading information published by sensors on web pages, and to act on actuators according to the detected measurements. My partner and I chose to implement an autonomous post-use classroom aeration service in order to limit the risk of COVID-19 contamination. The first part of this project was to clearly define what functionalities our application was supposed to provide. To do that, we used the Scrum method with the help of JIRA, which is a platform dedicated to project management. After having defined all our sensors, actuators, the functions that would be linked to them and the necessary web services, we coded the whole project in JAVA on Eclipse, using Springboot to generate Maven projects.

Skills - Service Oriented Architecture	**Auto Evaluation**
Know how to define a Service Oriented Architecture	4
Deploy an SOA with web services	4
Deploy and configure an SOA using SOAP	3
Deploy and configure an SOA using REST	3
Integrate a process manager in an SOA	3
Skills - Middleware for the Internet of Things	**Auto Evaluation**
Know how to situate the main standards for the Internet of Things	4
Deploy an architecture compliant to an IoT standard and implement a sensor network	3
Deploy and configure and IoT architecture using OM2M	3
Interact with the different resources of the architecture using REST services	4
Integrate a new technology into the deployed architecture	3
Skills - Adaptability: Cloud and Autonomic Computing	**Auto Evaluation**
Understand the concept of cloud computing	4
Use a IaaS-type cloud service	4
Deploy and adapt a cloud-based platform for IoT	4

Figure 11 : Skills matrix for the training unit Middleware and Service

III.3.4 Summary

Despite the installation difficulties encountered at the very beginning of the course, I really liked this training unit because I completely discovered the existence of web services and how useful they are in the IoT. Moreover, the autonomy and freedom granted in the projects allowed me to appropriate the subject and to express myself with pleasure and satisfaction. Moreover, I developed theoretical and practical skills that I found very useful.

III.4 Analysis and data processing, business applications

III.4.1 Presentation

Today, data is becoming the most valuable resource in the world, companies all over the world try to collect as much data as it is legally possible in order to improve their revenue. We can note that the most important companies that are Google, Facebook or Amazon are also the ones that probably hold the most important data centers. We also can cite the Cambridge Analytica scandal after the 2016 USA's national election or the development of artificial intelligence to point out even more the value and influence of big data.

The objective of this training unit was to teach us practically how to treat and analyze a dataset, and also, through discussions and exchanges to make us aware of the value of big data.

III.4.2 Raised problems

The first problem addressed in this training unit is that to have access to data formatted in a way that can be processed. Indeed, we can notice that for the moment, the Web is not very data oriented. That is to say that the Web represents an impressive source of information but it does not make any link between them. This is a matter of implementing a certain logical reasoning to the web in order to enrich the data it possesses by weaving a link between them.

But this problem raises another one, especially when it comes to individual data, is it possible to allow a machine to reason about the data available on the Web while remaining within the bounds of what is relevant and ethical ?

III.4.3 Knowledge and skills mobilized

In this training we had a course called Semantic Data Processing, where we used the software "Protégé" and the reasoner hermiT in order to understand the concepts of lightweight and heavy ontologies. In this practical, we used data from weather sensor observations from the city of Aarhus in Denmark.

My favorite course of this training unit has been the course called "Data processing and Analysis : Big Data". In this course, we had to select a dataset and analyse it with R-Studio. Earlier, we had several practical courses to learn the R language and how to use the R Studio interface. My partner and I chose to study a free access dataset about every international soccer game in the world, since the very first game on the 30th of November of 1872 to 2020. We found it interesting to look more in detail into this dataset to see the evolution of this World gathering sport over the years, and maybe to see the impact of the COVID-19 crisis on this sport. In addition to the technical skills to analyze the dataset, it was necessary to be judicious in the choice of the information to be exploited from the dataset.

Analysis and data processing, business applications	
Software Engineering	**Auto Evaluation**
Define the different phases in software development	3
Know the different project management methods	3
Apply one of these methods a project	3
Processing Semantic Data	**Auto Evaluation**
Design and understand a model for an application	3
Know how to infer new knowlegde from a knowledge base	3
Be able to enrich data with semantic meta-data	3
Data Processing and Analysis: Big Data	**Auto Evaluation**
Know how to explore and represent data sets	4
Master R	3
Master complexity associated to statistical data processing and know the techniques to be used to minimise them	3

Figure 12 : Skills matrix for the training unit Analysis and data processing, business application

III.4.4 Summary

Being myself very sensitive to the issue of private data and our exposure on the web, I really enjoyed this course. Moreover, after completing my internship in the field of artificial intelligence, I realized how useful and valuable the data was. I really liked the way we worked, the skills we developed, again, the autonomy we were given in the management of our project.

III.5 Innovative project

III.5.1 Presentation

Because the project has already been introduced in the **Descriptive Part**, I will directly present the raised problems.

III.5.2 Raised problems

First of all, this subject was relatively undefined when it was proposed to us and we had to take the time to think about it, to imagine ourselves what it was possible to do with our skills, our time and our means.

In this group project, we also had to manage the team. One member of the group was not in France when the project started, we had to inform him of each progress or discussion with the tutors. Having never met him before, it was difficult for us to understand his skills, and the fact that he had difficulties with the French language made it difficult for us to communicate clearly with him. Unfortunately, a second team member had to stop his semester and leave the project for medical reasons. Finally, one last member who attended the MSIoT training often had a different schedule from ours and it was difficult to count on his presence during meetings with the tutors, or between us. Luckily he did his best to keep up to date and move the project forward with us.

We have also had to deal with problems related to COVID-19, such as the fact that we almost all the time worked remotely, which sometimes accentuates the impression of working alone and makes it more difficult to understand the difficulties encountered by each person and to help each other. It was often difficult for us to work together in our department at INSA, thus we lost time exchanging components or receiving the orders we made.

III.5.3 Knowledge and skills mobilized

In this project, the skills mobilized were very numerous and diverse. First, on the technical level, even if we were each specialized in one field, we tried to follow each one's progress as well as possible and thus to understand the stages of their work by following the thread of difficulties and solutions. I also applied the knowledge I gained during my internship at LAAS to focus on the traffic sign detection part. I developed these skills by working on the configuration of the Jetson NANO board. It was great to put in application some of the skills we developed in other training units like when we had to choose a network protocol for the communication between the board and the smartphone application (Bluetooth Low Energy), or also when we used sensors to get some information about the air quality in the passenger compartment. Finally, this project took place almost entirely at a distance, which develops our ability to work autonomously and to set up your machine by yourself.

About soft skills, it was interesting to work with students from different specialties that were able to complement each other. I also developed our business skills when we carried out a survey to conduct market research. I have also developed my project management skills by planning long-term project steps and scheduling sprints between presentations to tutors.

Finally, the final report, intermediate and final presentations were held in English, which allowed me to deepen my fluency and confidence in my professional use of this language.

Innovative project	Auto Evaluation
Analyse a real-life problem	4
Suggest a technological solution to a problem	4
Implement a prototype to solve the problem	3
Present and debate (in English) the technical choice made	4
Produce a report (in English) for the developed project	4

Figure 13 : Skills matrix for the training unit Innovative Project

III.5.4 Summary

This project was very interesting, it allowed me to deepen a wide range of hard and soft skills. I developed my knowledge of object detection techniques by configuring a nano Jetson board.

I'm happy to have led this project related to the transition to the autonomous and smart vehicle because this is one of the career opportunities that interests me the most. That's why I'm going to carry out my end-of-studies internship by doing a mission at the ADAS service of Continental, in the detection of road surface conditions.

III.6 Innovation and Humanity

III.6.1 Presentation

It is essential to remember that at INSA we are also trained as humanist engineers. Taking into account the ethical issues of the world around us in order to better understand it and to become a responsible engineer is part of our training and our values.

III.6.2 Raised problems

This year in particular, because of the health measures related to the COVID-19 pandemic, it was a pleasure to share debates and questions with others students. Although they were held at a distance, these classes helped build social cohesion among the students in the promotion.

Unfortunately the Sport week in the Pyrenees has been canceled due to the sanitary restrictions. One more time, students felt like we were stolen some key moments of our INSA student's life. This activity stay, known as APPN is a tradition for 5th year students, it also helps students who arrived at INSA just for the ISS master's degree to integrate into the heart of the promotion.

But if we claim to be responsible engineers, we must first be responsible students, and thus make the necessary sacrifices to contribute to the international effort to limit the spread of this virus.

III.6.3 Knowledge and skills mobilized

This year, we had some courses and exchanges around Innovation, Social Acceptability, Business Development, Creativity Methods, Team Management.

In these classes, we developed one of the main qualities of a human being and of an engineer which are ability to listen, and communication.

We open our minds to social and ethical issues, debating all together and by sharing our experiences, culture and points of view.

I personally made a presentation on stereotypes, prejudices and clichés, why and how to be aware of them. I also used the TRIZ method in creativity class to understand how to make an existing object evolve by proposing innovative improvements. I was quite impressed to realize that a method could help that much to innovate, before this class I thought innovations were developed after some genius ideas, not once I imagined that a method could be such a source of proposition. I also had a simulated interview with an experienced recruiter, which allowed me to receive interesting advice and apply them to find an interesting internship for finishing my studies.

Training Unit - Innovation and humanity	
Manage an innovative project:	**Auto Evaluation**
Solve a problem in a creative way	4
Develop the first stage of innovation	4
Understand production, validation, distribution, acceptability, and aftermath of innovation	4
Structure and lead an innovative project	4
Learn teamwork	**Auto Evaluation**
Multi-disciplinary students work as a team	4
Be convincing: present and defend an idea	**Auto Evaluation**
express and exchange hypotheses	4
Suggest a strategy to solve the problem identified	4
Suggest a model	4
Choose, design and / or justify a protocol or an experimental prototype	4
Self evaluation with portfolio	**Auto Evaluation**
Reflect upon my training process and methods	4
Be able to put forward my training experiences, whether they be explicit or implicit	4
Be self-sufficient and responsible towards my education	4

Figure 14 : Skills matrix for the training unit Innovation and Humanity

III.6.4 Summary

Since my first year at INSA, I have always greatly appreciated these non-technical courses. They enable us to open up to the world and develop our critical and creative minds, our open-mindedness and our ability to question our role and responsibilities as engineers in today's and tomorrow's society. In these very special times that we have been living in for more than a year now, when it is very difficult to project ourselves into our professional and personal lives, these courses have been a support and a very beneficial source of reflection and inspiration.

IV. Analytical Part

This last part will conclude my portfolio and thus my 5ISS master semester. It's also an opportunity for me to look back on my 5 years spent at the INSA in Toulouse. Those years went by so quickly that I still remember very clearly my first day on campus. The number of skills I have acquired during these 5 years is just impressive. The first few years were very dense, they allowed me to acquire a method of work and rigor, while getting me to touch very diversified subjects so that I could make the best possible choice of specialty. Over the years, I specialized more and more in embedded systems up to the ISS master's degree. There I received a very broad and complete training, allowing me to acquire a large number of technical skills and to develop a global vision of the various fields related to smart systems.

What I will also retain from the training I have received, is the importance given to courses on how to be responsible engineers, through the transversal courses we have taken each year. These courses have helped me to develop my critical mind and to become, beyond a good engineer, a better person.

Of course, no one imagined finishing the INSA under the conditions of the current sanitary crisis. It is impossible to know what the difference would have been in the quality of teaching and the transmission of knowledge if we had been able to attend the courses in person. Nevertheless, I would like to thank all the teachers of my 4th and 5th year, who managed to adapt very quickly and to offer quality teaching under these difficult circumstances.

During my courses, my meetings and my reflections over these 5 years, I have evolved a lot and so has my professional project. My 4th year internship and the ISS master's degree reinforced me in the idea that I would enjoy myself as an engineer in the transition to the autonomous vehicle. This revolution, combined with the ecological and energy transition in the field of transports, is clearly shaping the world of tomorrow. That's why my end-of-study internship mission focuses on intelligent detection of road surface conditions and obstacle detection.

The numerous skills developed in the field of smart devices, communication methods for wireless sensor networks, big data treatment and analysis and those of training neural networks to machine learning techniques will be very useful to me for this mission, or for a next one. Because life is long and my career is ahead of me, because my INSA training and the ISS master's degree have above all taught me how to learn, and because I still have a lot to learn from the upcoming experiences.