

**AVAILABLE  
THESIS  
2022/23  
CONCEPT REPLY**



# THESIS DESCRIPTION

## “TITLE OF THE THESIS”

Description of the operational scenery of the Thesis

What is the Thesis?

Business scenery of the Thesis

What is the Thesis for?

Technologies: list of the technologies the candidate will work with

[Start Availability Date - End AvailabilityDate]: [kk-kk-kkkk - kk-kk-kkkk]

Temporal window of availability of the Thesis for potential candidates



B3

# THESIS DESCRIPTION [B3]

## “Electricity Meter”

*A solution that will allow the consumption of professional and industrial machinery to be monitored using the Electricity Meter or Water meter*

*The candidate will work on:*

- *Embedded Development to collect data and send to the cloud*
- *Cloud Development to store data*
- *Dashboard to visualize data collected*

Technologies: SW development (C, C++), C#

[Start Availability Date - End Availability Date]: [01-06-2023 - 31-12-2023]



B3

# THESIS DESCRIPTION [B3]

## **“EoL control driven by AI”**

*A solution which will allow to verify in EoL if electronic components manufactured comply with the specifications. For this purpose, AI algorithms will be created that will identify the components made correctly from those that have errors.*

*The candidate will work on:*

- *Embedded Development on ST*

Technologies: Embedded SW development

[Start Availability Date - End Availability Date]: [01-06-2023 - 31-12-2023]



# THESIS DESCRIPTION

## “Digital Twins for Manufacturing” 2/2

*Contribution to design and development of Industry4.0 industrial monitoring techniques for industrial plants, providing quantitative indications on plant risk situations and on recommended preventive actions.*

*The candidate will work on:*

- *Contribution to Design and development of the Software Layer implementing the Digital Twin of the project*
- *Contribution to the implementation/tuning of the AI neural network to automatically analyse data from the field of operation*
- *Elements of Edge Computing techniques to feed digital twin from the operational field*

PoC Case study: 1° Use Case: chemical plant of fluid mixing.  
2° Use Case (forecasted): automated AGV to carry on raw materials in a silicon manufacturing company

Technologies: SW development (Python), Deep Learning, Feature Extraction, Anomaly Detection

[Start Availability Date - End Availability Date]: [01-06-2021 - 30-07-2023]



# THESIS DESCRIPTION

## **“Local Charging for electric 2-3 wheels vehicles”**

*Contribution to design and development of a mobile App to help the end-user find the most convenient recharge point, also enabling the payment.*

*The candidate will work on:*

- *Design and development of an application that allows to find, reach and pay for electric recharge in the context of a city environment*
- *Design and develop custom mock interfaces to demonstrate the end-to-end functionalities*

Technologies: Kotlin (android) or Swift (iOS) for the app

[Start Availability Date - End AvailabilityDate]: [01-02-2023 – 30-06-2023]



# THESIS DESCRIPTION:

## ***“INTEGRATED MONITORING IN CIRCULAR BIOECONOMY”***

*Contribution to design and development of an application for monitoring of waste and bioproducts in a scenario of circular economy, where Distributed Ledger Technologies can improve trust in the tracking of provenance and of the transformation steps.*

*PoC development in collaboration with a remarkable consortium of Italian partners.*

The thesis requires to explore and integrate information from various sources, including data produced by IoT devices (potentially a large number, demanding high capacity requirements), through a Edge gateway and a DLT gateway, which enable exchange of data with other systems and with the distributed ledger IOTA. The thesis is about design and development of a mobile/cross application showing relevant data to different stakeholders, and allowing exchange of trustable data.

Technologies: SW development, mobile/Cross application development (IONIC framework, e.g. with Angular), integration with back-end (e.g. Node js) and with IOTA libraries

[Start Availability Date - End AvailabilityDate]: [02-11-2022 - 30-05-2023]



B5

# THESIS DESCRIPTION

## **Multi-user Unconstrained Human Eye Gaze tracking with AI in the wild for industrial and commercial applications**

*Understanding the human eye gaze is very relevant in marketing and industrial applications, because an automated reaction can be executed by a cooperating robot and/or attention statistics can be elaborated. Recently, the availability of inexpensive cameras and AI algorithms have made possible to capture the direction of eye gaze of multiple people together in various field depths and lighting setups.*

*The candidate will work on:*

*Adapting and improving eyegaze algorithms for different cameras and AI-on-chip setups*

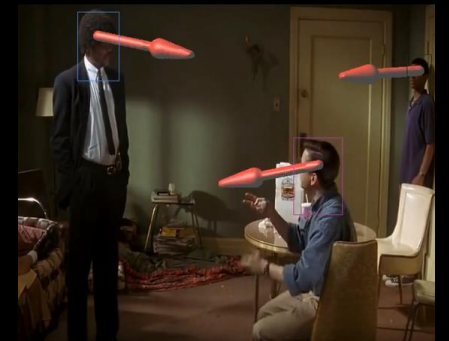
*Contribution to the implementation/tuning of the AI neural network to automatically capture the eyegaze vector from the field of operation*

*Create heat maps to determine the attention point and other eye-movement related parameters for commercial applications*

PoC Case study: Use Case: attention analytics applied in real time to a full-size holographic display in REPLY's lab

Technologies: SW development (Python), Deep Learning (usage of AI Notebooks like Google Colab are a plus), Feature Extraction, C/C++, Open CV

[Start Availability Date - End Availability Date]: [01-05-2023 - 31-12-2023]





# THESIS DESCRIPTION

## Torque and Speed estimation for electric motors using AI techniques

*Electric motors play a crucial role in various applications, especially in industrial and transportation systems. To ensure the efficient operation of these systems, it is essential to accurately estimate the torque and speed of the electric motor.*

*By processing data from various sensors, AI algorithms can learn the relationship between motor inputs and outputs, providing accurate estimates of torque and speed in different conditions. The candidate will work on:*

- Adapting and improving NN-based algorithms for different motors for torque and/or speed estimation*
- Contribution to the implementation/tuning of the AI neural network to create a "sensor-less sensor" capable of self-learning and estimating torque/speed*
- Create an experimental setup on a MCU from ST with Cube.AI acceleration.*

PoC Case study: Use Case: mid-size electric motor torque sensorless sensor based on STM MCU with Cube.AI

Technologies: SW development (Python), Deep Learning , embedded programming C/C++, Open CV

[Start Availability Date - End Availability Date]: [01-05-2023 - 31-12-2023]



# THESIS DESCRIPTION [B5]

## “EDGE COMPUTING PLATFORM – DATA MANAGEMENT ON THE EDGE”

Concept Reply stands at the forefront of **software, firmware** development and **data manipulation**.

We are actively working on **cutting-edge projects** that shape the future of next generation industrial edge computing platform.

This thesis has the goal of

- Enhance the current microservices architecture of Concept Reply Edge Industrial Platform (CREI) by integrating cloud orchestration mechanisms (e.g. Azure IoT Edge)
- Implement new industrial protocols drivers for the newest industrial machinery
- Develop an administrative dashboard for managing the entire platform
- Build a web portal to manage data gathered by storing, filtering, aggregating, analyzing them to present data business value on dedicated market scenario web dashboards.

Technologies: Linux, Docker, Kubernetes, Golang, Rust, Reactjs, network protocols

[Start Availability Date - End AvailabilityDate]: [05-06-2023 - 29-12-2023]

Temporal window of availability of the Thesis for potential candidates



B5

# THESIS DESCRIPTION [B5]

## “IOT CYBERSECURITY ON SMART DEVICES”

Concept Reply stands at the forefront of **software** and **firmware** development for **next-gen connected devices**, with a strong emphasis on **cybersecurity**. We collaborate with **industry leaders** across diverse sectors, actively engaging in **cutting-edge projects** that shape the future.

This thesis has the goal of

- investigating the current best practices in connected devices software and hardware security, based on current research and Common Criteria
- implement these best practices in custom Linux-based operating systems, using Yocto
- secure firmware/software development and deployment
- build a web-based application (Rust and ReactJS) to automatically track and manage vulnerabilities found in the operating system or applications dependencies after deployment

Technologies: Linux, Yocto\*, computer networking, ReactJS, Rust\*

\*: not a requirement, learn it during the thesis!

[Start Availability Date - End AvailabilityDate]: [05-06-2023 - 29-02-2024]

Temporal window of availability of the Thesis for potential candidates



# THESIS DESCRIPTION [B5]

## “MULTI-ROBOT MISSION PLANNING WITH ROS AND MOVEIT”

Concept Reply provides **tailored** software solutions for **connected robotics**, revolutionizing their functionality, security and maintainability. Our expertise in **Robot Operating System (ROS)** and software integration enables us to interface multiple robots to solve complex missions.

This thesis includes

- investigation of the state-of-the-art for multi-robot mission planning and ways of abstracting and representing the flow of the mission (e.g. behavior trees)
- implement a software solution using ROS that takes in input an abstract representation of a multi-robot mission and execute it on simulated and/or real robots
- develop some multi-robot mission example use-cases (industrial scenarios and others)

Technologies: ROS\*, MoveIt\*, Gazebo\*, Linux, Python, C++, computer networking

\*: not a requirement, learn it during the thesis!

[Start Availability Date - End AvailabilityDate]: [05-06-2023 - ]

Temporal window of availability of the Thesis for potential candidates



# THESIS DESCRIPTION [B5]

## “ROBOT ARM: PERCEPTION AND GRASPING WITH ROS AND MOVEIT”

Concept Reply revolutionizes connected robotics through tailored software solutions, enhancing functionality, security, and maintainability. Our expertise lies in leveraging **digital image processing, computer vision, point clouds, ROS, and Moveit** to enable smart **manipulation** in collaborative robotic arms.

This thesis includes

- investigation of the state-of-the-art for robot perception and grasping
- implement, and integrate with ROS and Moveit, a perception pipeline able to identify and locate objects to manipulate while recognizing and avoiding obstacles
- implement, and integrate with ROS and Moveit, a grasping pipeline able to plan pick and place tasks for objects with various shapes and materials (soft, rigid...)
- evaluate the use of deep learning techniques for perception and grasping

Technologies: ROS\*, Linux, Python, C++, computer networking, PCL\*, OpenCV\*, Moveit\*

\*: not a requirement, learn it during the thesis!

[Start Availability Date - End AvailabilityDate]: [05-06-2023 - ]

Temporal window of availability of the Thesis for potential candidates



# THESIS DESCRIPTION [B5]

## “TAILORED SOFTWARE FOR CONNECTED ROBOTICS”

Concept Reply provides **tailored** software solutions for **connected robotics**, revolutionizing their functionality, security and maintainability. Our expertise in **Linux-based** custom operating systems and the **Robot Operating System (ROS)** enables us to optimize the capabilities of connected robots.

This thesis includes

- investigation of the state-of-the-art for custom operating systems in robotics and typical functionalities they provide (missions, auth, updates, log, hardware support, sw acceleration support)
- integrate ROS on a custom embedded Linux-based OS made with Yocto for an ARM-based board with hardware acceleration
- implement security and maintainability features with Yocto, useful for real “in the wild” use-cases

Technologies: ROS\*, Linux, Yocto\*, Python, C++, embedded systems\*, computer networking

\*: not a requirement, learn it during the thesis!

[Start Availability Date - End AvailabilityDate]: [05-06-2023 - ]

Temporal window of availability of the Thesis for potential candidates



# THESIS DESCRIPTION [B5]

## “MOBILE ROBOTS: INDOOR NAVIGATION AND LOCALIZATION (ROS)”

Concept Reply revolutionizes connected robotics through tailored software solutions, enhancing functionality, security, and maintainability. To solve the problem of mobile robots indoor localization we leverage our expertise in localization systems and integrate it with ROS.

This thesis includes

- investigation of the state-of-the-art for mobile robot indoor navigation and localization
- implement, and integrate with ROS an indoor navigation algorithm for navigating inside a map while avoiding obstacles
- implement, and integrate with ROS an indoor localization system that uses the state of art technologies (e.g. RTLS) for increase the precision of the localization

Technologies: ROS\*, Linux, Python, C++, computer networking, indoor localization\*

\*: not a requirement, learn it during the thesis!

[Start Availability Date - End AvailabilityDate]: [05-06-2023 - ]

Temporal window of availability of the Thesis for potential candidates



B5

# THESIS DESCRIPTION [B5]

## “ROBOT FLEET: REMOTE COMMAND AND CONTROL CENTER”

Concept Reply provides **tailored** software solutions for **connected robotics**, revolutionizing their functionality, security and maintainability. We are developing a software system for a command and control center to manage fleet of heterogeneous robots remotely.

This thesis has the goal of

- investigating the available products and current research in remote operation of different robots
- participating in the development of specific features in a web-based application, written in Rust and ReactJS, that supports the teleoperation, monitoring and mission control of several connected robots

The student will be involved in design and architecture meeting for the new features. The development will span both frontend and backend, covering the integration with ROS and our APIs on the robots.

Technologies: ReactJS, Rust\*, Linux, computer networking, ROS\*, Python

\*: not a requirement, learn it during the thesis!

[Start Availability Date - End AvailabilityDate]: [05-06-2023 - ]

Temporal window of availability of the Thesis for potential candidates





# THESIS DESCRIPTION:

## “TRIPS - Transport Intelligence for Safe Mobility”

*Contribution to design and development of PoC focused on the data acquisition from the IoT sensors and camera positioned on drone for visual accident assessment and real time data visualization.*

The thesis requires design and development of system able to provide images and video contents using 5G technology from the drone webcam to enhance the image quality of the reference satellite images and to allow real time accident assessment. Those data should contain the metadata related to drone position, network performance (throughput, latency, packet loss...). To reach this out the drone should be equipped with the following items: computing unit, battery pack, suitable multispectral web cam, sensors for distance & environment measurement, GNSS unit.

Technologies: 5G, GNSS, multimedia content elaboration

[Start Availability Date - End Availability Date]: [01-01-2023 - 30-06-2024]



B4

# THESIS DESCRIPTION:

## Powering IoT with LoRaWAN

*Contribution to design and development of sensing platform and software tool for analysing and real-time monitoring of smart cities use cases. PoC development focused on the data acquisition from the IoT devices using LoRaWAN technology- for monitoring and real time data visualization.*

The thesis requires design and development of IoT sensors network prototype using LoRaWAN technology for real -time monitoring of smart cities use cases.

Technologies: LoRaWAN, Micropython/C, embedded

[Start Availability Date - End Availability Date]: [15/05/2023 - ?]



# THESIS DESCRIPTION

## **“IOT: INCIDENT DETECTION AND DIAGNOSTIC IN A LOCAL OR DISTRIBUTED ENVIRONMENT”**

*The new routers are connected through USP over MQTT and allows geographically near-real time monitoring.*

*The aim of the thesis is to analyse and build a predictive algorithm based on a model, trained using the information collected from the routers. A new controller/agent will be developed for diagnostic elements gathering (software, hardware, telemetry, environment)*

*The new controller can send the information to backend for a distributed computation but also act locally through the BLE, when Internet is not available.*

PoC Case study:

1° Use Case (local): agent development feeding on-device ML algorithm for local detection of potential single device issues.

2° Use Case (distributed): agent development feeding on-cloud ML algorithm for remote detection of potential distributed device or network issues.

Technologies: USP, MQTT, Machine Learning (Deep Learning), IoT, Java / Python, Anomaly Detection

[Start Availability Date - End Availability Date]: [01-06-2023 - 30-11-2023]



# THESIS DESCRIPTION

## “Internal Vacation Tracker Tool”

*Design and develop a tool to request, approve and track all the vacations and absences of the members of the Concept team. Design a multi-layered approval processes and configurable permissions for the different users.*

*The candidate will work on:*

- *Design and develop the user-interface to
  - *file new vacation/absence requests*
  - *Approve requests for PM, managers and partners of the company*
  - *List all vacation for a given user or team**
- *Design and develop the data model and backend to support the scenario*

Technologies: React / React Native, AWS services for the backend, or other technologies that could fit the scenario (both for the frontend and backend) if preferred and upon agreement

[Start Availability Date - End AvailabilityDate]: [01-02-2023 – 01-11-2023]



# THESIS DESCRIPTION

## “Android Automotive Distribution”

*Android Automotive is a version of the popular smartphone OS meant to bring the ecosystem inside cars: surveys say that by 2027, 75% of the car infotainment systems will be powered by this technology.*

*The candidate will work on:*

- *Starting from AOSP (Android source code) work to compile it to target a given board (configuration and BSP setup are required)*
- *Define best practices and processes to work on changes to the AOSP code base*
- *Customize the System UI to create a new Android distribution*
- *(and/or) work to optimize other critical part of the Android Automotive OS (e.g. Audio management, CAN-BUS management, Media base application, Phone pairing, ...)*

Technologies: C++, Java, Kotlin, C-Make and other compilation tools, repo

[Start Availability Date - End AvailabilityDate]: [01-02-2023 – 01-11-2023]



# THESIS DESCRIPTION

## “Android Auto/Carplay - In-Car Payments”

*Android Auto and Apple Carplay allow bringing in the car some of the functionalities we have on our phones, so that they are accessible while driving. Lately, both systems added the possibility to pay for parking spaces and fueling from the in-car screen.*

*The candidate will work on:*

- *Design and develop a test application that allows to pay for fuel and/or park directly from the car*
- *Design and develop custom mock interfaces to demonstrate the end-to-end functionalities*
- *Explore business opportunities that these technologies offer*

Technologies: Kotlin (android) or Swift (iOS) for the app, Javascript/Java/other for the mock application

[Start Availability Date - End AvailabilityDate]: [01-02-2023 – 01-11-2023]



# THESIS DESCRIPTION

## “Carplay - Driving Tasks”

*Android Auto and Apple Carplay allow bringing in the car some of the functionalities we have on our phones, so that they are accessible while driving. Lately, Apple added the possibilities to perform simple tasks while driving.*

*The candidate will work on:*

- *Design and develop a test application that allows to perform "driving tasks"*
- *Design and develop custom mock interfaces to demonstrate the end-to-end functionalities OR integrate with an existing service to extend its availability in the car*
- *Explore business opportunities that this technology offers*

Technologies: Swift for the app, Javascript/Java/other for the mock application or integration

[Start Availability Date - End AvailabilityDate]: [01-02-2023 – 01-11-2023]



# THESIS DESCRIPTION

## **“Onboard energy tokenization over blockchain”**

*Design and develop the onboard part of an end-to-end solution leveraging blockchain and to allowing vehicles to exchange tokens for energy interacting directly with the grid.*

*The candidate will develop a custom client on the Telematics box (or a similar hardware) able to implement the functionalities of a blockchain SW wallet*

*Interact with the vehicle network (real or simulated) to get info about the energy flows while charging*

*Interact with the grid to exchange tokens for energy (or vice-versa if applicable)*

*The candidate will also work with experts in the backend and blockchain domains to ensure the proposed solution is flexible, safe and reliable.*

Technologies: C++, blockchain, MQTT or other communication protocol

[Start Availability Date - End Availability Date]: [01-06-2023 – 01-12-2023]





# THESIS DESCRIPTION

## “V2X and C-ITS R&D”

*The C-ITS standards provides the definition of messages that "smart roads" can exchange with vehicles to inform them about the situation of the road itself, the traffic on it, and possible dangers on the way.*

*The candidate will need to implement an end-to-end scenario that allows the simulation of events on the road and the management of received data on an onboard unit.*

*Both the transmitting antenna and receiver are based on linux and working on them requires some basis in Linux. Other business logics, as well as the creation of user interfaces to show relevant information on some sort of screen.*

Technologies: C++, Kotlin/Swift/React/other frontend technology, Linux

[Start Availability Date - End Availability Date]: [01-06-2023 – 01-12-2023]



# WE'LL TOTALLY LIKE YOU IF:

- You're a fast learner, with interest in new digital technologies
- You have skills in programming
- You have knowledge of AI methodology and concepts
- We appreciate proficiency in English and interest in design of software architectures
- If interested to one of the Internships, please send an email to:  
g.nigro@reply.it

