

AVAILABLE THESIS  
2021/22  
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



# THESIS DESCRIPTION

## “Digital Twins for Manufacturing” 1/2

*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:*

- *Real-time data collection from multiparametric sensors tracking assets, machineries (e.g. RTLS, vibration monitoring sensors, energy consumption, mixing pumps, flow and pressure meters, etc.) to feed a digital twin of the assembly line;*
- *Contribution to Design and development of the Software Layer implementing the Edge Computing side of the project*
- *Elements of AI techniques and Digital Twin development for product life-cycle management and preventive maintenance*

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), EdgeX Framework, Docker containerization, Digital Twin integration

[Start Availability Date - End Availability Date]: [01-06-2021 - 31-12-2022]



# 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 - 31-12-2022]



# THESIS DESCRIPTION

“AI techniques for Fashion industry”

*Contribution to design and development of neural networks based on computer vision to help the textile industry stop overproduction and enable fashion brands to embrace a customer-centric personalized production model.*

*The candidate will participate to the creation of a Tool with AI elements that brings transparency to the global supply chain and responds to trends and changing customer demands.*

PoC Case study: within a startup in the area of Fashion

Technologies: Deep Learning, Feature Extraction, Anomaly Detection, SW development, Tensorflow

[Start Availability Date - End Availability Date]: [01-01-2022 - 31-12-2022]



# THESIS DESCRIPTION

“USP agent and client implementation for IoT device”

USP (TR-369) is standardized protocol to manage, monitor, update, and control connected devices, IoT endpoints, user services and home networks. It has been developed especially for CPE as evolution of the CWMP.

Study the possibility and the advantages of extending the use of USP to IoT devices.

Find the minimal requirement for implementing a USP agent on IoT module.

Identification and Analysis of the different USP supported MTP for the specific use case (e.g. MQTT, WebSocket, STOMP)

Definition of a Cloud Architecture to perform remote access and USP based Big Data ingestion

Optional : Identification and Analysis of USP based Discovery Authentication and Authorization, for IoT devices

Device Proxy in IoT Gateway to support IoT devices with different technologies (e.g. Z-Wave, ZigBee, WiFi)}

PoC Case study: *Implementation of a complete IoT solution based on USP (Agent, backend, Client).*

Technologies: C/C++, Python, Android, Embedded development, Cloud, Mobile development, Backend Development

[Start Availability Date - End Availability Date]: [01-01-2022 - 31-12-2022]



# THESIS DESCRIPTION

“End-to-end IoT cybersecurity with Azure Sphere chipset”

*Billions of new devices are connected every year, so it's more important than ever to protect them from malicious intrusions. The graduate student will contribute to data protection, privacy, physical security and infrastructure with the Azure Sphere security service based on an innovative MCU that is the result of Microsoft's decades of experience in hardware, software and cloud services to provide a security solution turnkey for IoT devices.*

*The candidate will work with:*

*-the development team of an IoT gateway with integrated security at the chip level that will deal with the prototyping and engineering of a security companion device for embedded devices;*

Technologies: C, C ++, Python. Knowledge of Visual Studio Code and cross-link compilation are preferred. Each student will be provided with an AVNET development board equipped with an Azure Sphere chipset.

[Start Availability Date - End Availability Date]: [01-06-2021 - 31-12-2022]



# THESIS DESCRIPTION

## “Digital Twins for the Cultural Heritage”

The Digital Twin (DT) paradigm, together with IoT-enabled devices, can help site managers in both the preservation and the valorisation of the cultural heritage, providing analysis and simulations of data captured by onsite sensors, risk models of threats to the site integrity and corresponding preventive solution predicted in the DT environment .

### Business scenery of the Thesis

In a R&D project, configuration of a proper Digital Twin framework to acquire data from IoT devices (e.g., sensors used for monitor air quality or other environmental parameters linked to the risks faced by the cultural heritage sites. Proof-of-concept of a possible data flow and application

Technologies: open source (EdgeX, InfluxDB, Ditto) frameworks for Digital Twin programming, microservices, MQTT

[Start Availability Date - End AvailabilityDate]: [20-10-2020 - 20-05-2022]

Temporal window of availability of the Thesis for potential candidates



# THESIS DESCRIPTION:

## *“DLTs TO TRACK PROVENANCE IN CIRCULAR ECONOMY”*

*Contribution to design and development of an application using Distributed Ledger Technologies (blockchain-like technologies) applied to a Use Case scenario of circular economy, where such technology can improve trust and track provenance and supply/transformation chain steps. PoC development in a remarkable consortium of italian partners.*

The thesis requires to explore and evaluate the application of DLTs to a case study scenario related to circular economy, where such technology can improve trust. Data to be certified can be produced by IoT devices (potentially a large number, demanding high capacity requirements). The thesis is about the evaluation, in such scenario, of IOTA technology, a “blockless” architecture (using the directed acyclic graph instead of the blockchain), feeless and more scalable than conventional blockchains.

Technologies: SW development, IOTA, IoT

[Start Availability Date - End AvailabilityDate]: [5-02-2021 - 30-09-2021]



# THESIS DESCRIPTION:

## “APPLICATIONS OF FOG COMPUTING TECHNIQUES TO SMART CITIES CONTEXTS”

Contribution to design and development of a constellation of sensors and Edge Devices capable of collecting, processing and transmitting data from the field of operation to the SOA framework in a Smart City context.

PoC development in a remarkable consortium of international partners.

Smart cities are becoming a reality thanks to recent advances in technology. In the future, our cities will depend remarkably on 5G connectivity and artificial intelligence, but we have to solve the issue of High deployment costs due to “silos” from legacy systems and/or proprietary deployments with reduced or no interoperability.

The thesis requires to contribute to the architecture definition and to the development of microservices associated to the provisioning of a system with advanced interoperability features.

Technologies: microservices, K3S, EdgeX, MQTT

[Start Availability Date - End AvailabilityDate]: [01-08-2020 - May 2022]



# THESIS DESCRIPTION

## “VIBRATIONAL ANALYSIS USING MULTISENSOR DEVICES”

*Scouting of the state of the art of the topic. Contribution to the algorithm design and development of a software to analyze data from an industrial sensor detecting acceleration, angular velocity, magnetic fields, as well as environmental conditions (eg. temperature, humidity, light, air pressure, and noise).*

### **Business scenery**

*Condition monitoring and predictive diagnostic for industrial machinery is of considerable interest to prevent unexpected interruption of the operations. An edge computing platform have to acquire data from the sensor, and process them in order to provide information useful for the scope.*

### Technologies

*Industrial multisensors, EdgeX framework, Docker containerization, message brokers*

[Start Availability Date - End AvailabilityDate]: [01-10-2020 – May 2022]



# THESIS DESCRIPTION:

## *“PERSONALISED CONTEXT-AWARE DIGITAL TOUR GUIDE”*

*The thesis is based on a recently developed cultural Smart Visit solution, which leverages on specific cataloguing standards and on a set of sensors/methods for making context-aware, personalized services to visitors/tourists.*

The thesis requires to extend this solution to provide functionalities (suggestion, routing and management of visit paths; collection of feedbacks, etc) also for those cultural sites not fully compliant with the requirements of the full platform, but desiring to provide access to their ‘ready to go’ rich catalogue of digital contents associated to their artworks. Other advanced functionalities can be devised based on the available backend and data.

The solution has to be modular and adaptative in order to dynamically add/remove services.

Technologies: Java/Spring Boot technologies for backend; web/cross development frameworks and libraries (Ionic, Angular.js). Knowledge of VR/AR/geolocation/UX /web analytics concepts is appreciated.

[Start Availability Date - End AvailabilityDate]: [01-06-2021 - 28-02-2022]



# THESIS DESCRIPTION:

“SALS - Gestione della sicurezza alimentare lungo la supply chain: strumenti avanzati”

*Contribution to design and development of sensing platform and software tool for analysing and real-time monitoring of food processing process. PoC development focused on the data acquisition from the IoT devices for the food chain quality monitoring and real time data visualization.*

The thesis requires design and development of user interface to data representation of real -time monitoring of food processing and KPI analysis for the agriculture and agri-food sector (hazelnuts sector)

Technologies: SW development - WEB interface development (Angular, React, Vue), integration with back-end Node js

[Start Availability Date - End AvailabilityDate]: [01-06-2021 - 31-12-2022]



# THESIS DESCRIPTION

“Industry 4.0 Complex Solution for Manufacturing Supply Chain”

*Scouting of the state of the art and development of flexible platform for Digital Twin hosting for the manufacturing processes/products representation.*

The thesis requires definition and development of Digital Twin for *condition monitoring and predictive diagnostic for industrial machinery. Real-time time data collection using the wireless sensors and IoT Gateways for the manufacturing processes for specific use-cases.*

Technologies

*Eclipse Ditto for sensor abstraction layer, Node-RED/Node js, Docker containerization, message brokers*

[Start Availability Date - End AvailabilityDate]: [01-07-2021 – 31-12-2022]



# THESIS DESCRIPTION

“Industry 4.0 Complex Solution for Manufacturing Supply Chain”

*Scouting of the state of the art and development of flexible platform for Digital Twin hosting for the manufacturing processes/products representation.*

The thesis requires definition and development of Digital Twin for *condition monitoring and predictive diagnostic for industrial machinery. Real-time time data collection and analysis applying AI/ML techniques for preventive maintenance or quality check for the manufacturing processes for specific use-cases.*

Technologies

*ML (features extraction techniques) , TensorFlow, SW development, embedded system*

[Start Availability Date - End AvailabilityDate]: [01-07-2021 – 31-12-2022]



# THESIS DESCRIPTION

“Industry 4.0 Complex Solution for Manufacturing Supply Chain”

*Scouting of the state of the art and development of flexible platform for Digital Twin hosting for the manufacturing processes/products representation.*

The thesis requires definition of MVP of the developed platform, the possibility of creating a product with the highest return on investment compared to risk. This activity involves interaction with the market right from the idea phase in order to validate the problem / customer binomial before creating any form of prototype before the specification definition phase is over.

Technologies

*Business development, market research*

[Start Availability Date - End AvailabilityDate]: [01-07-2021 – 31-12-2022]



# 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

