Politecnico di Torino

N-MON

SYSTEM REQUIREMENT REVIEW

Presented by Group - G

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OVERVIEW

- Problem
- Objectives
- State of the Art
- User requirements
- Functional requirements
- Technical requirements
- WBS
- Gantt Chart

PROBLEM

- **Real-world impact: *Organized cargo theft*,** sophisticated criminals target high-value goods from luxury brands, electronics, and pharmaceuticals.

- **Multi-Billion Dollar Problem:** Cargo theft results in annual losses of over €8.2 billion in Europe [1] and up to $35 billion in the US [2]. A single stolen truck can represent a loss of millions of dollars.

- **A Key Vulnerability: GNSS Jammers** Thieves use cheap, easily acquired jammers to disable GPS tracking, making a truck disappear from monitoring systems and allowing them to steal its entire cargo undetected.

References:
[1] Trans.info Supply Chain Analysis: https://trans.info/en/supply-chain-threats-418475
[2] National Insurance Crime Bureau: https://www.nicb.org/prevent-fraud-theft/cargo-theft

OBJECTIVES

Main Goal

- To develop a compact and cost-effective monitoring system that detects and classifies GNSS jamming interference in real-time to protect high-value assets during transit.
- To provide an autonomous system that enhances the security of fleet management by immediately alerting stakeholders of jamming events, allowing for rapid response.

Specific Objectives

- Develop a portable monitoring station deployable on vehicles to continuously analyze GNSS frequency bands.
- Integrate advanced signal processing and a Artificial Intelligence algorirthms to accurately identify and classify different types of jamming signals
- Create a user-friendly interface to provide clear, immediate visualization of the GNSS signal status
- Ensure an automatic alert to a central control station the moment jamming is detected

STATE OF THE ART

Basic Telematics Features	N-MON	Defense-Grade Anti-Jamming (Military CRPA Systems)
How it works: simple RF power detection. If the device detects a sudden, strong spike in radio energy that covers the weak satellite signals, it flags a jamming event and sends an alert	**How it works:** real-time signal processing with a Neural Network for intelligent interference classification	**How it works:** can identify the direction of a jamming signal and create a "null" in that direction. They don't just detect, they actively mitigate the attack
Limitations: not intelligent, can't classify threats and can be unreliable having a high rate of false alarms	**Our goal:** To provide an intelligent, low cost, and autonomous solution that fills the gap	**Limitations:** systems can cost up to a hundred thousand dollars per unit. They are too large, power-hungry, and costly to ever be deployed across a fleet of commercial trucks

USER REQUIREMENTS

UREQ_1	the user shall be able to deploy and operate the system simply by connecting power and network, without complex configuration procedures
UREQ_2	user shall have a simple, intuitive way to see if GNSS signals are clean or compromised, and what type of interference is disrupting them
UREQ_3	automatic warning shall be delivered to the central station when jamming is detected, without user action

FUNCTIONAL REQUIREMENTS

The system shall be able to perform the following operations:

FREQ_1	continuously monitor GNSS signals (L band) multi-constellation
FREQ_2	acquire and then process GNSS signals to extract time-frequency representations
FREQ_3	integrate Artificial Intelligence to correctly identify and classify jamming interference across multiple interference types with different power of jamming signals JSR
FREQ_4	provide the user a simple UI to visualize the output of the AI algorithm and signal status
FREQ_5	automatically send an immediate warning if jamming is present to both the UI and a control center

TECHNICAL REQUIREMENTS

The system will need the following technologies and tools to be implemented :

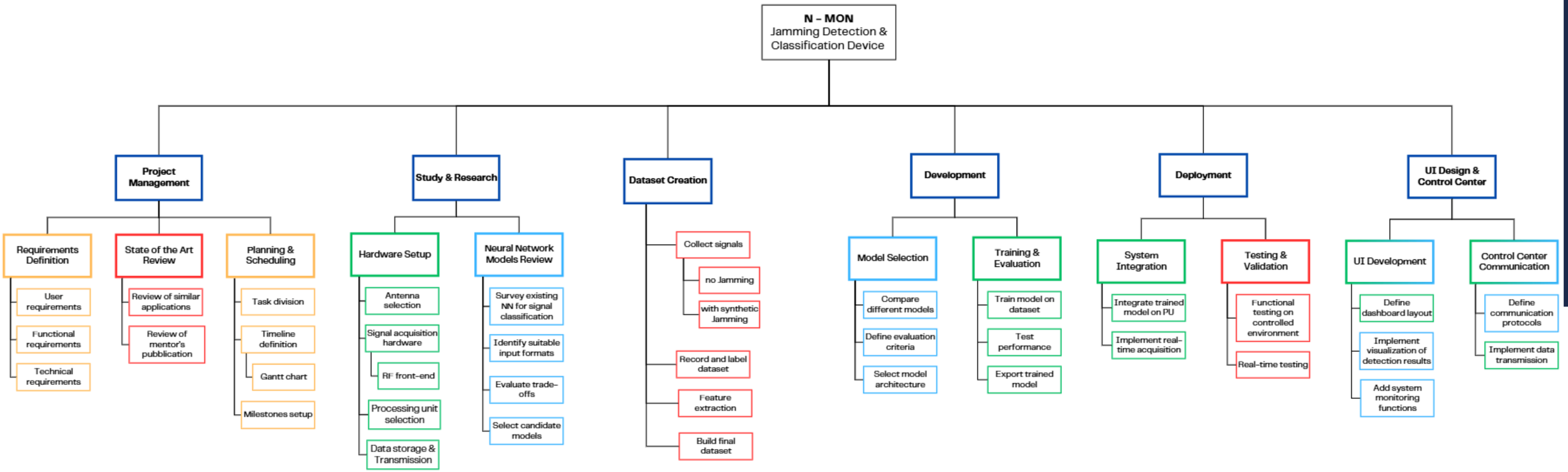
TREQ_1	Multi-band GNSS patch antenna suitable for vehicle-mounted applications, providing reliable signal reception in variable conditions
TREQ_2	An SDR-based RF front-end capable of capturing GNSS signals, with an ADC that provides sufficient sampling rate and resolution for high-quality GNSS signal processing
TREQ_3	computational unit supporting real time AI inference and signal processing operations
TREQ_4	signal processing pipeline to elaborate input data using STFT

TECHNICAL REQUIREMENTS

TREQ_5	test environment with capability to generate synthetic jamming signals with different power of jamming signals JSR
TREQ_6	communication protocols to reliably transmit alerts from the device to remote control station
TREQ_7	web based UI providing real-time status updates
TREQ_8	target cost lower than current laboratory setup
TREQ_9	reduced dimensions compared to existing laboratory setup

SysReq document here

WBS



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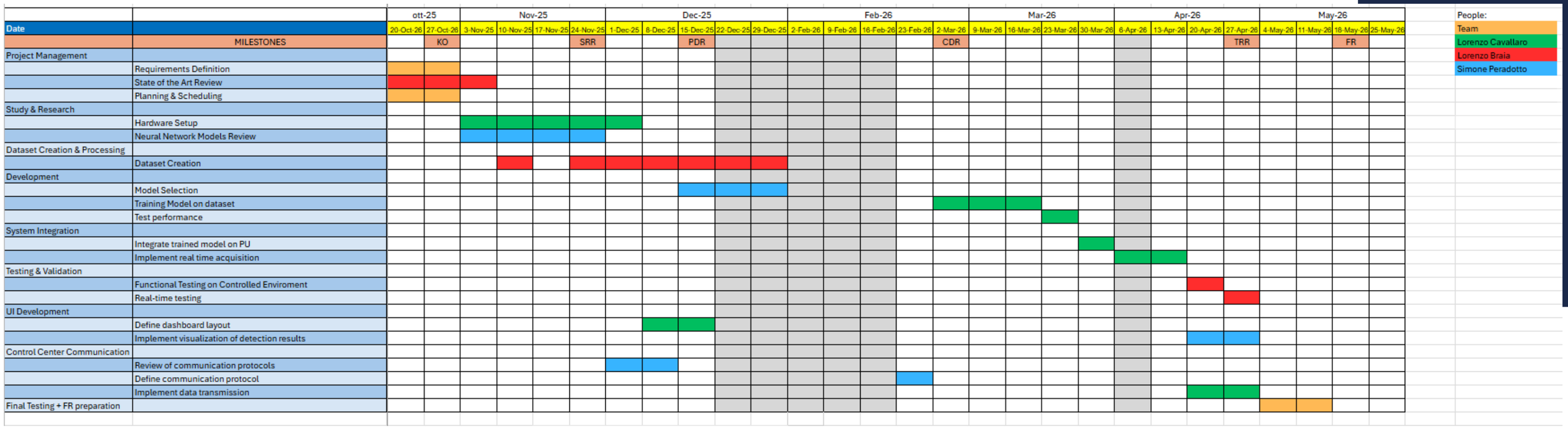
GANTT CHART



Link accessible with Polito credentials :

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THANK YOU!

For your attention