DIGITAL TWIN AND INTRUSION DETECTION IN A CYBER PHYSICAL SYSTEM

Use Case of a Water Management System

Authors

Henry Chima UKWUOMA
Gilles DUSSERRE
Gouenou COATRIEUX
Johanne VINCENT

Partners

Université de Nimes

Campus France

PTDF Nigeria

IMT Atlantique
Bretagne-Pays de la Loire
École Mines-Télécom

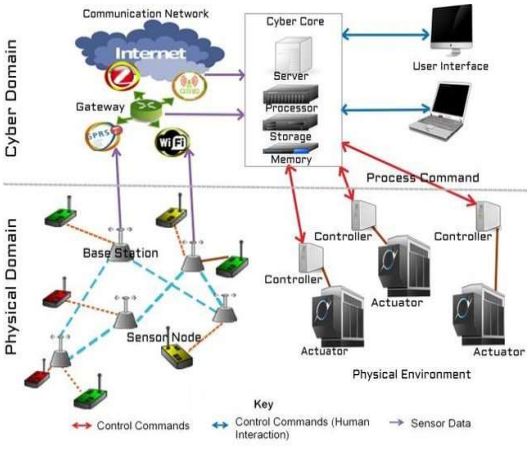
IMT Mines Alès
École Mines-Télécom

BACKGROUND

The security of Industrial Control Systems in the health sector represents a significant challenge in today's world. The occurrence of high-profile cyber security threats has penetrated the industries (health), mostly importantly with the advent of COVID-19.

Need to detect and prevent intrusions in a Cyber Physical System using machine learning via a replica (digital twin) for hospitals.

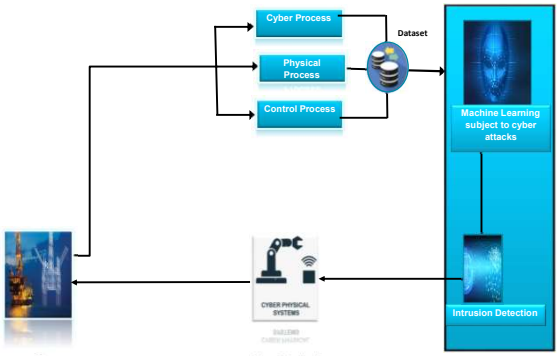
- **Digital Twin:** Digital twin is a virtual representation created to represent a real-world object such as a water management system. This study adopts a DHALSIM testbed
- **Cyber Physical System:** *A* system that consists of the coordination and combination of computational and physical components. The study adopts a water distribution network as a case study.
- **Intrusion Detection:** A tool or software program that monitors malicious activities or rule violations in a system.
- **Machine Learning:** Application of machine learning to a water management dataset for enhanced performance on a given set of tasks



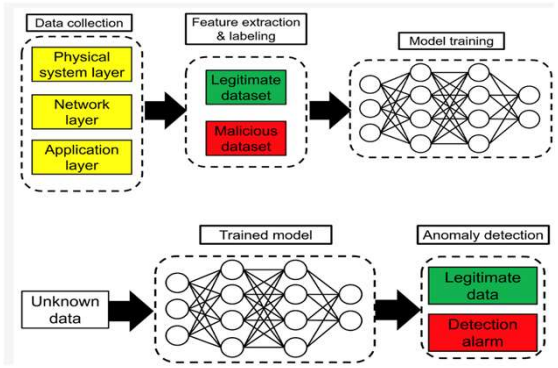
Cyber-physical system architecture
Source : Ledwaba and Venter, 2017

EXPECTED RESEARCH OUTCOMES

- **Behavioural analysis** of the CPS with and without cyber attacks via the Digital Twin.
- **A machine learning model** for the detection of intrusions in a Cyber Physical System via a digital Twin (DHALSIM testbed)
- **Ways and means to** manage a water distribution systems during cyber attacks



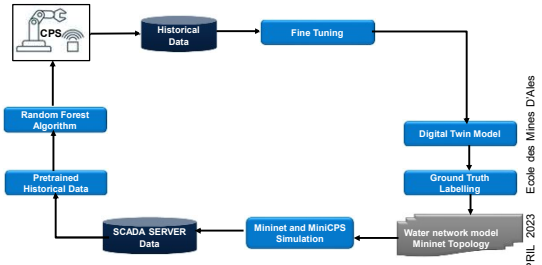
Conceptual Process Flow between the Digital Twin, Machine Learning Model for Intrusion Detection and the Cyber Physical System



Cyber- Physical Intrusions Detections system
Source: Kim and Park, 2021

RESEARCH OBJECTIVES

- **To examine existing machine learning models** deployed for cyber security in a water management system with the intention of designing an Intrusion Detection model for securing data in a Cyber Physical System (CPS).
- To establish if the machine learning models used for **Intrusion Detection in CPSs** can guarantee data security in respect to an enhanced cyber security for a hospital management system.
- **To evaluate and validate** the proposed model.
- **To** improve crisis management through simulation (Tabletop Exercises). How a Hospital Management System could **anticipate, react and a manage** a hospital water system, in times a system is hijacked for malicious intentions.



Conceptual Operation of Cyber-Physical System and Digital Twin

Contact : henry.ukwuoma@mines-ales.fr