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Digital Twin and Intrusion Detection in a Cyber Physical System

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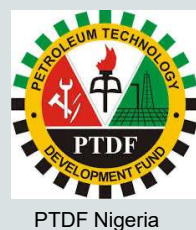
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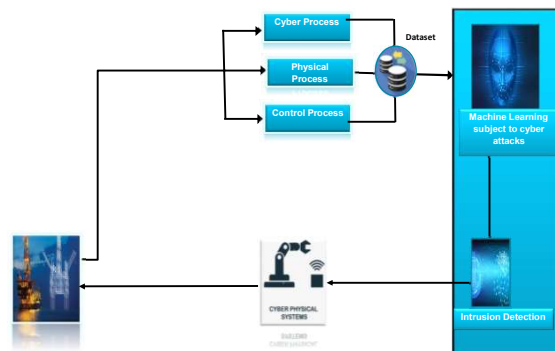


BACKGROUND

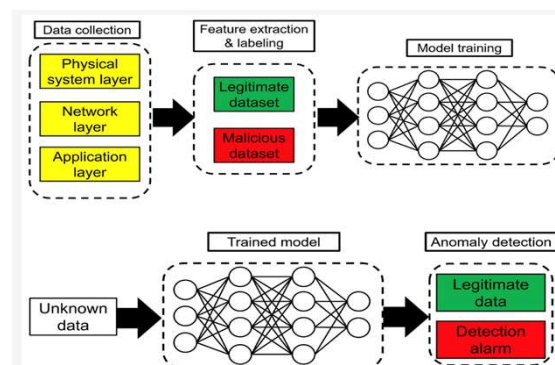
The security of Industrial Control Systems in the health sector represents a significant challenge in today's world. The occurrence of high-profile cyber security threats has penetrated the industries (health), mostly importantly with the advent of COVID-19.

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



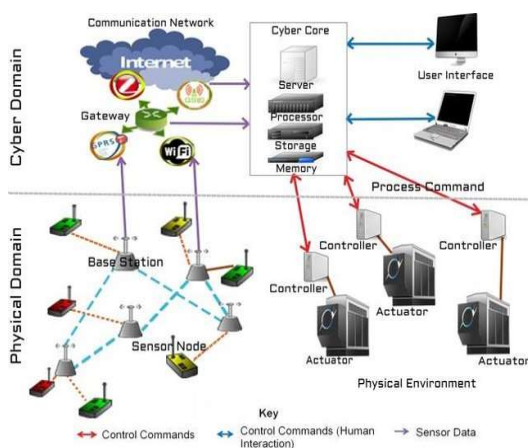
Conceptual Process Flow between the Digital Twin, Machine Learning Model for Intrusion Detection and the Cyber Physical System



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

RESEARCH OBJECTIVES

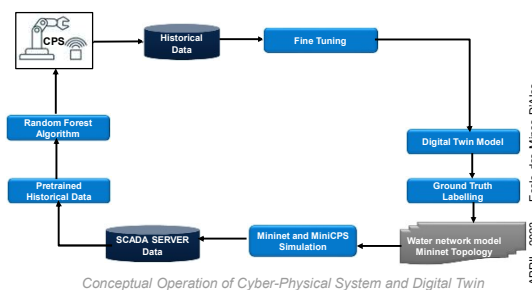
- To examine existing machine learning models deployed for cyber security in a water management system with the intention of designing an Intrusion Detection model for securing data in a Cyber Physical System (CPS).
- To establish if the machine learning models used for Intrusion Detection in CPSs can 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 manage a hospital water system, in times a system is hijacked for malicious intentions.



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 Operation of Cyber-Physical System and Digital Twin