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A Domain-Specific Modeling Framework for Attack Surface Modeling

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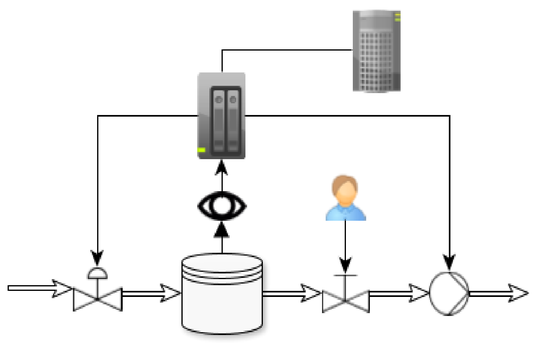
Problem: Cybersecurity of cyber physical systems & internet of things is vital. Security is a **continuous process** that runs throughout and at times even beyond the **life-cycle of a system**. Traditional methods of **security modeling** miss this life-cycle-based dynamicity.

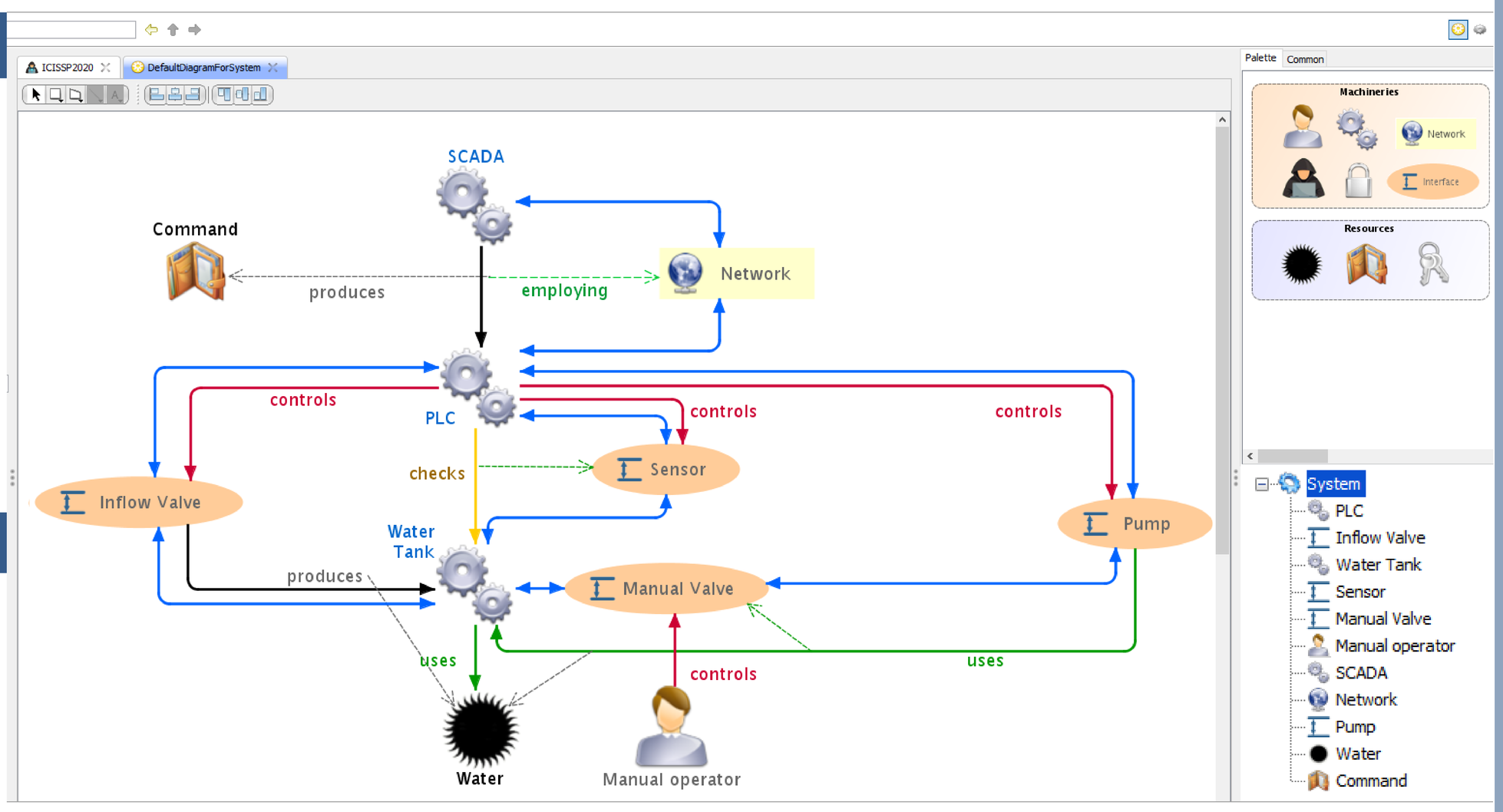
Contribution: We propose an **open-source framework** based on **Pimca**, a domain specific **systems modeling language highlighting the attack surface**[1] during cyber threat analysis[2].

Requirements

- Systems modeling with the intent of **highlighting** the **attack surface**
- Security concerns modeling using a **graphical** language, geared towards **automation**
- **Analysis-agnostic** attack surface modeling

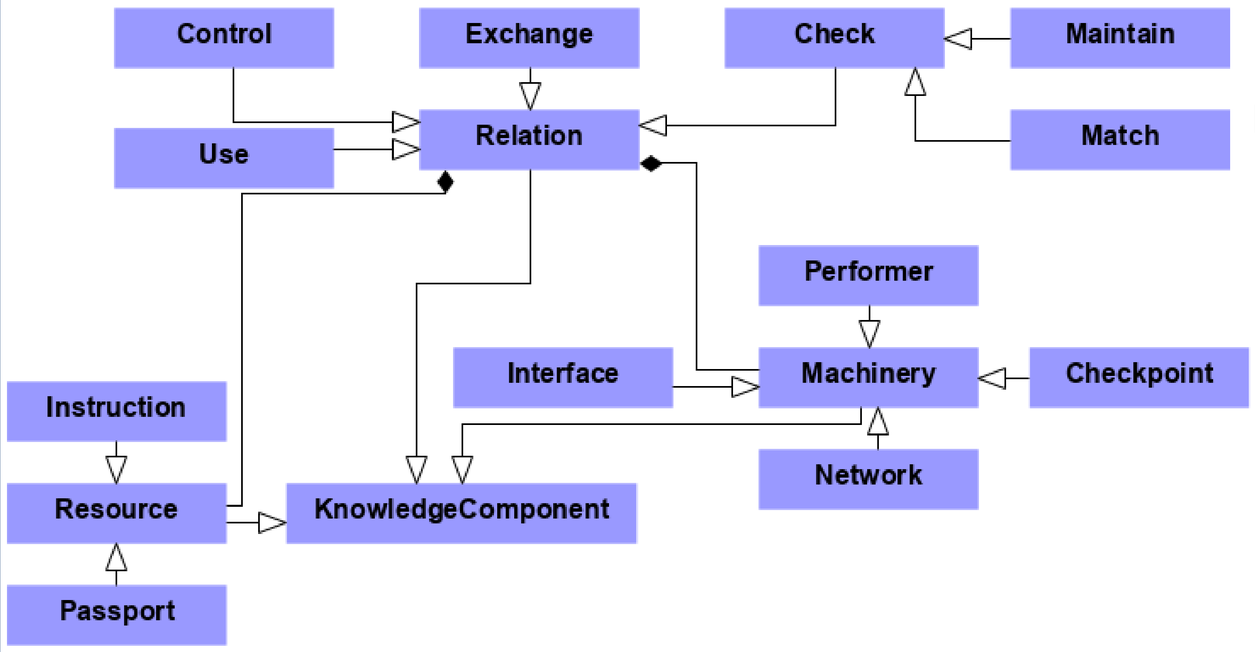
Water pump





Pimca language

- **Expressive relations** modeling complex interactions between components enable deeper security analysis and attack surface reasoning. Well-defined components also expose particular interactions and weaknesses in the attack surface.
- **Coarse-grain security-focused systems modeling** abstracts away internal architectural details and handles heterogeneous systems with ease.



Attack surface inference

1 ***How to reach the target ?***

Target: Water tank

Deducing sub-objectives using relations

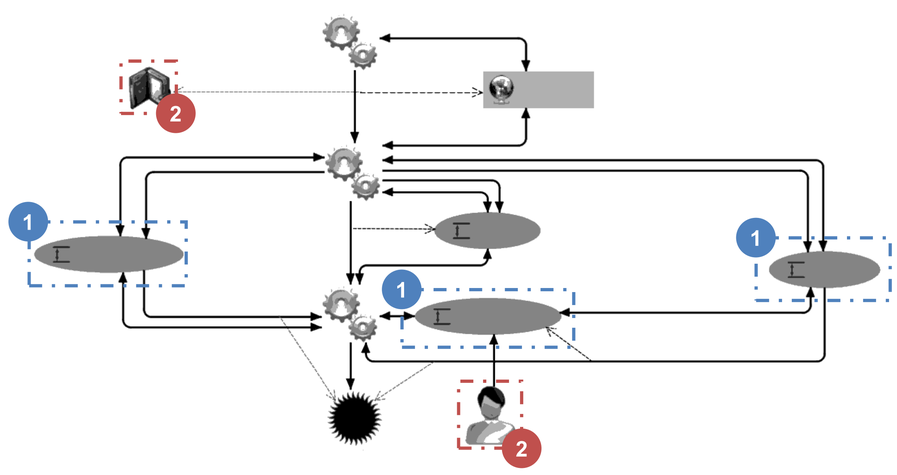
⇨ We can infer **intermediary targets**: Inflow valve, manual valve, pump

2 ***What are the targets available ?***

Capabilities: Social engineering, network access

Deducing reach based on attacker capabilities

⇨ The attack surface **extends** to: Command (through network), manual operator (through social engineering)



Conclusion: Our framework satisfies the intention of **highlighting the attack surfaces** in a system model. Preliminary validation is done on use cases, which emphasized the system modeling along with the **attack surface deduction and refinement** enabled by our framework.

Future Works: We intend to model the systems **dynamic behavior** using a component-by-component basis. We also plan to model an **executable attacker** so that we can **simulate** the system-under-attack behavior.

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1. Manadhata, P. K. and Wing, J. M. (2011). An attack surface metric. IEEE Transactions on Software Engineering,37(3):371–386.
2. Farrell, M., Bradbury, M., Fisher, M., Dennis, L., Dixon,C., Yuan, H., and Maple, C. (2019). Using Threat Analysis Techniques to Guide Formal Verification: A Case Study of Cooperative Awareness Messages,pages 471–490. Springer.