A generic framework for integration of advanced analytics components into event-driven SCADA systems

PhD student Zlatan Sičanica, mr. sc. comp.

Mentor: Assoc. Prof. Boris Milašinović, PhD
University of Zagreb Faculty of Electrical Engineering and Computing

UNIVERSITY OF ZAGREB
Faculty of Electrical Engineering and Computing

1. Introduction

Supervisory Control and Data Acquisition (SCADA) systems have been a critical tool for managing power systems for several decades. These systems allow operators to monitor and control power generation, transmission, and distribution, ensuring that electricity is delivered reliably and efficiently to consumers. With the recent advances in artificial intelligence, SCADA systems have become even more powerful, with features like **measurement forecasts**, **anomaly detection**, and **intrusion detection**.

This research explores how machine learning and soft computing can be used to enhance SCADA features, from optimizing power generation and transmission to identifying and preventing cyber attacks. Specifically, we investigate the various ways these technologies can be integrated into SCADA systems to improve their accuracy, efficiency, and security.

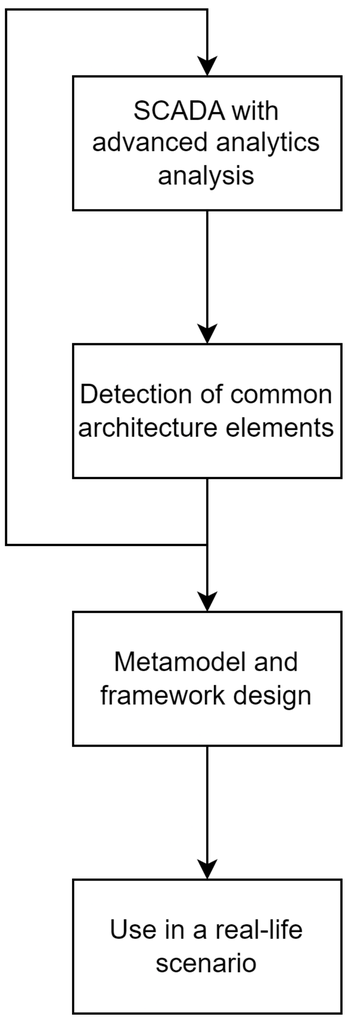
2. Problem Description

This research focuses on enhancing event-driven SCADA systems with advanced analytical features to improve real-time decision-making and predictive maintenance. Our contributions include:

- Specification of a generic framework that produces advanced analytical components for event-driven SCADA systems
- A metamodel that unifies SCADA data and datasets used by the analytical component
- An advanced analytics framework prototype demonstrating the framework's effectiveness

By streamlining the integration of machine learning and artificial intelligence into SCADA systems, we aim to create new features and business cases in event-driven SCADA systems.

3. Methodology

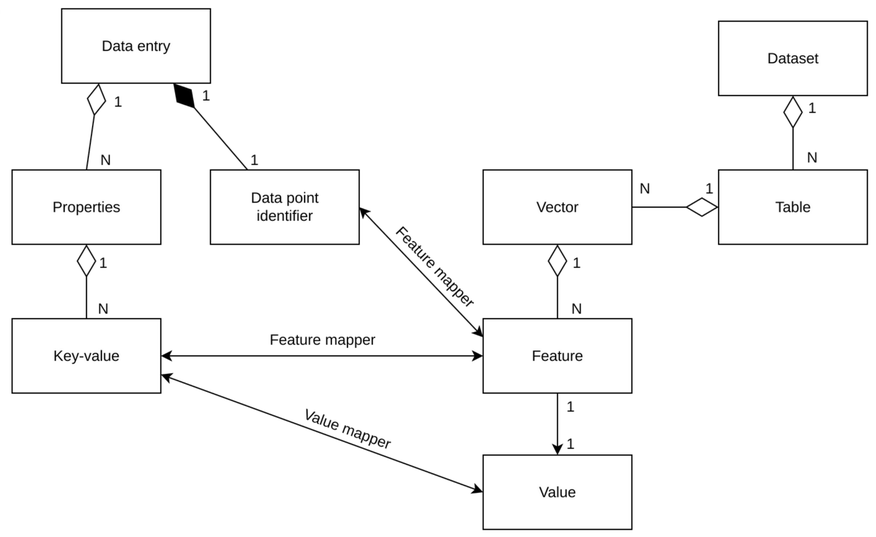


The methodology taken to achieve the research results involved analysis of existing SCADA systems with advanced analytics capabilities. Findings from that analysis are used to detect common architectural elements. Additionally, looking at the datasets and how they are created from SCADA data helps in understanding how the two are connected.

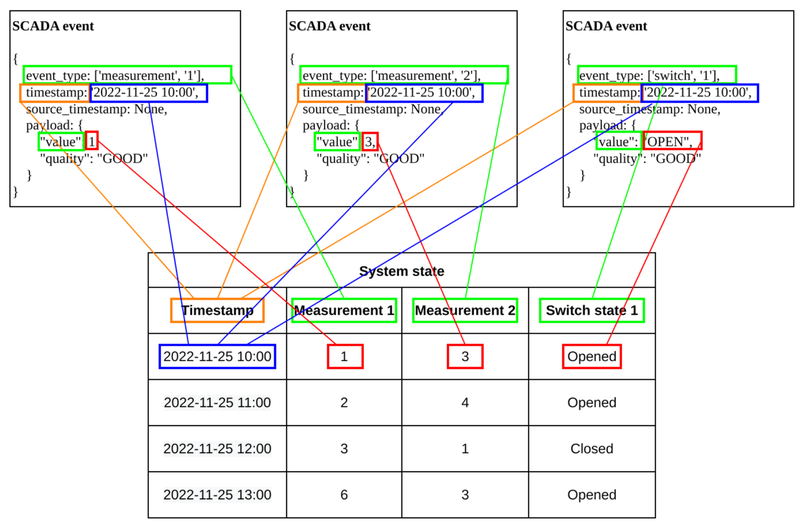
All these pieces of information help design the aggregated data metamodel, and the generic framework for advanced analytics components in SCADA systems. A framework named Artificial Intelligence Model Manager (AIMM) is developed and used in real-life power system scenarios: measurement forecast and power grid state estimation [1]. The component was integrated into Končar's Proza Hat event-driven SCADA system

4. Results

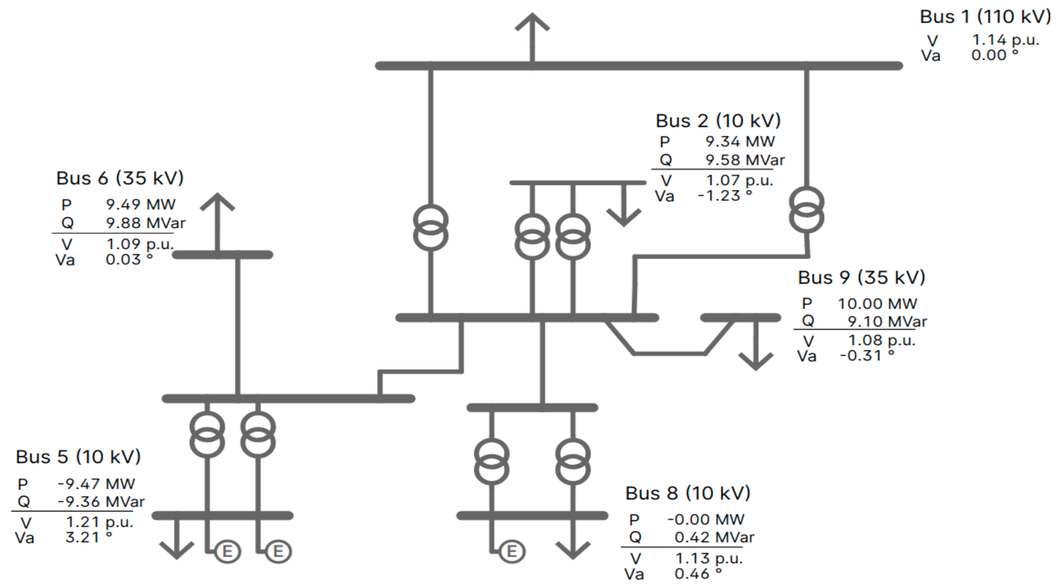
Following the methodology steps, different results can be outlined. The main research results, in this case, are the designed models and software prototypes, illustrated in the following figures.



Data metamodel



Data mapping based on the metamodel



AIMM-enhanced SCADA system performing state estimation

The resulting models, framework, and prototype show potential for practical use. The models tackle all the research use cases and the framework was developed and open-sourced, including some of the prototype examples [2].

5. Conclusion

Overall, this research is estimated as successful. All the goals and contributions are achieved, setting AIMM up as a useful tool for advanced analytics integration in event-driven SCADA systems. Future research and development expanding on the topics are also likely, as new scenarios of advanced analytics use emerge regularly.

Acknowledgments

The research has been supported by the ATTEST (Advanced Tools Towards Cost-efficient Decarbonization of Future Reliable Energy Systems) project, grant agreement No. 864298.

ATTEST

References

[1] Z. Sičanica, S. Sučić and B. Milašinović, "Architecture of an Artificial Intelligence Model Manager for Event-Driven Component-Based SCADA Systems," in IEEE Access, vol. 10, pp. 30414-30426,
[2] github.com/hat-open/aimm

Contact

Zlatan Sičanica, mr. sc. comp.
zlatan.sicanica@fer.hr
+385 99 602 7136