SATNAC

THE AI DRIVEN

HYPERCONNECTED FUTURE

SATNAC 2024 CO-CREATING SHARED VALUE.

Executive Summary

Telecommunication plays a crucial role in today's world, facilitating personal interactions, business operations, emergency services, and global connectivity. As digitization accelerates, the energy demands of telecommunications and information technology (ICT) are expected to rise significantly, potentially reaching 20% of global electricity consumption by 2030. This underscores the urgent need for sustainable initiatives. Openserve, South Africa's largest telecommunications provider, recognizes that today's cutting-edge technologies can quickly become obsolete. Yet, the company boldly embraces digital transformation by implementing more efficient energy monitoring and management strategies. This project is inspired by the **SATNAC 2024 Industry Solutions Challenge, Topic 4, which focuses on developing an AI-driven recommendation model** to enhance sustainability and energy management for Openserve.

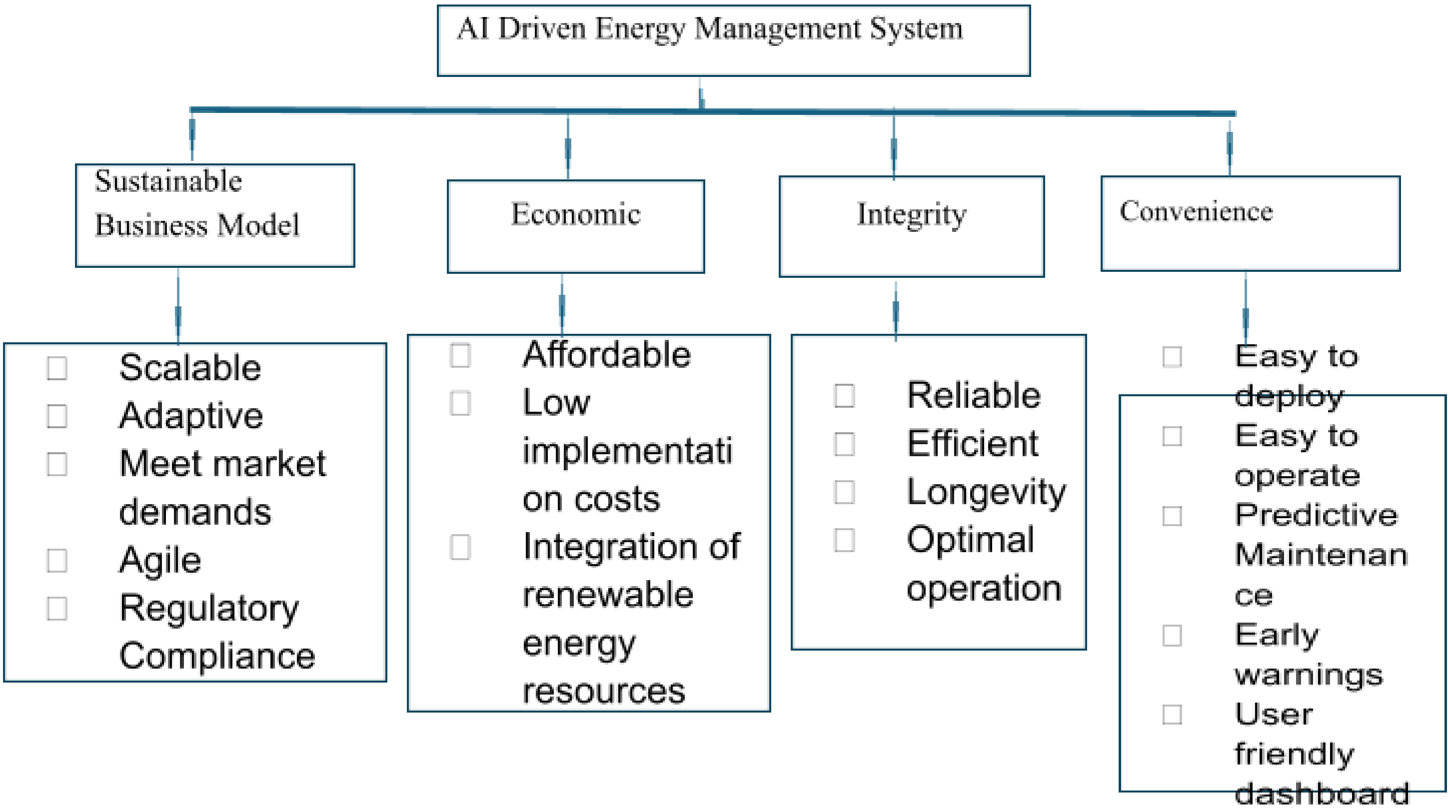
Our objective is to turn this vision into reality by deploying an AI SCADA system for forecasting and planning aimed at improving energy efficiency, optimization, and sustainability, while ensuring that network quality and delivery remain uncompromised through the use of AI. Artificial intelligence empowers smarter decision-making and streamlines operations. This paper details the comprehensive journey of designing and implementing the AI recommendation model. At the heart of our solution is an AI-driven building management system that utilises Recurrent Neural Networks (RNNs) to analyse, classify, and predict energy consumption levels across various Openserve buildings. The primary goal of our innovative approach is to optimise energy consumption rates, thereby enhancing network grid performance and facilitating early detection of anomalies. Furthermore, our solution includes a visual representation of the distribution of Openserve buildings across South Africa, displayed on an interactive map and graphs of the energy consumption levels of each building.

1.Problem Statement

Openserve, South Africa's largest telecommunications provider, operates extensive fibre optic networks and facilities that house critical network equipment. These facilities consume significant energy and contribute to carbon emissions, posing challenges to Openserve's sustainability goals. To support its green initiative, our solution aims to develop a recommendation model that quantifies energy consumption and identifies opportunities for savings across Openserve's sites. This model will analyse key metrics influencing energy use, enabling Openserve to optimise its energy consumption and effectively transition to alternative energy sources.

With this challenge, the Electric Minds teams strives to attain the following outcomes:

- AI-Driven energy optimization model
- Quantify energy savings potential sites
- Monitor and evaluate impact of energy management on Openserve network grid
- Enhance energy efficiency and Power Usage Efficiency
- Facilitate Sustainable Practices



The Openserve company faces several significant challenges related to high energy consumption in its buildings, especially the data centres and terrestrial network sites where its network infrastructure is located. This project aims to address pain points incurred by Openserve due to high energy consumption which can impact operational costs, environmental sustainability, and overall efficiency. This includes incurring escalating energy costs, which can account for a substantial portion of their operational expenses. This trend is exacerbated by the increasing demand for data and connectivity, leading to higher energy consumption across networks. This consumption translates into significant carbon emissions, contributing to climate change. With rapid advancement of technologies, such as 5G, enhanced connectivity and speed, require more energy to operate. The company faces the challenge of balancing the benefits of new technologies with their energy demands.

2. Proposed Solution Overview

The objective of our system is to create an AI-driven Supervisory Control and Data Acquisition (SCADA) system designed specifically for the monitoring, controlling, and analysing of Openserve buildings, processes, and infrastructure. Our solution is fundamentally centred on harnessing AI to enable intelligent monitoring and automation, reflecting our commitment to advancing operational efficiency and decision-making capabilities.

This solution is more focused on Data centre and terrestrial network sites where Openserve network infrastructure is based, therefore where lots of energy is consumed. Data centres house critical components such as servers, storage systems, and networking equipment. Terrestrial network sites house base stations, routers and switches, access points, customer premises equipment (CPE), fibre optic cables, microwave links, power supply units and network management systems. Energy consumption in terrestrial network sites is a critical concern as the demand for data transmission and connectivity continues to grow.

To address this challenge, our innovative solution aims to develop AI-powered SCADA systems to provide real-time monitoring and control of energy consumption across equipment in data centres and network sites. The ideology is to collect data from sensors including temperature sensors, humidity sensors, power sensors, airflow sensors, leak detection sensors, vibration sensors, wireless sensor networks (WSNs), packet loss sensors, latency sensors, traffic sensors, smart metering and devices. This data is analysed and processed by control systems including HVAC control systems, Programmable Logic Arrays and SCADA systems. Our solution harnesses AI algorithms to optimise the intelligence of the system. For instance, normal automated cooling systems respond when set point temperatures have been reached. With AI, the system can detect anomalies when the equipment temperatures behave differently, perhaps equipment is overheating, through AI we can tell that the equipment is malfunctioning. Early reactive maintenance can be done.

This project can take 28 months to implement through the following steps:

- Planning and identifying critical sites that consume lots of energy especially urban sites and ways to enhance predictive maintenance, enhanced monitoring, operational efficiency for about one month.
- Data collection and system requirements analysis for about 2 months for Openserve buildings.
- System architecture design for 3 months by selecting appropriate AI frameworks such as Machine Learning Algorithms or data processing frameworks for handling large datasets.
- Development phase of AI models for about 5 months for training, testing and validating Openserve sites energy consumption level i.e in this project RNN was used.

- Integrate the AI model with the SCADA system through API development and user interface to display AI-driven insights and alerts. This can be done for 8 months.
- Implement robust security measures through access control and data encryption.
- Test the system functionality on different Openserve buildings for 6 months.
- Deploy the AI SCADA system in a live environment through training for 6 months.
- Monitoring and continuous improvement of the AI-enhanced SCADA system through feedback loops and regular updates for 3 months.

3. Business Model

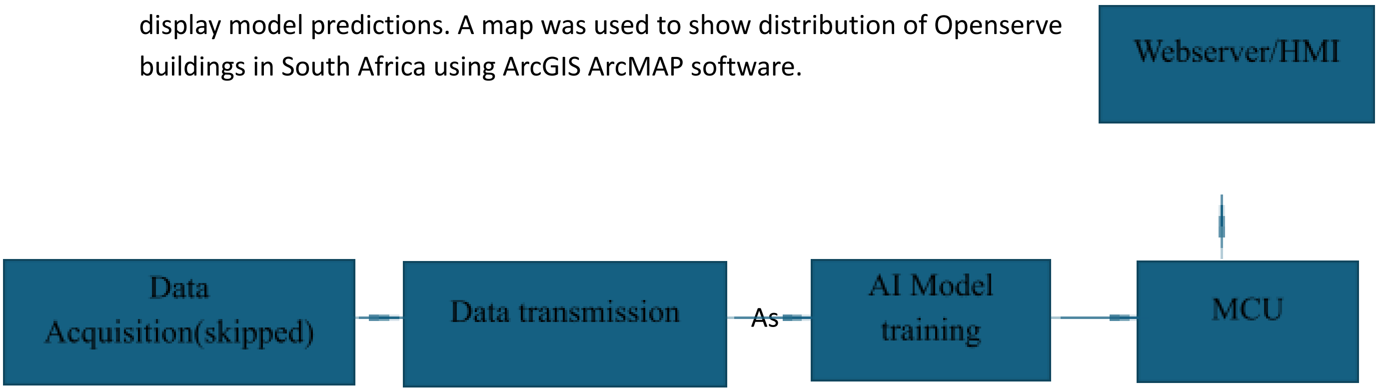
With this challenge, we as the Electric Minds team hope to effectively convert offerings into financial returns while aligning with customer needs and market demand. Customer engagement is the core value of this project through understanding customer's unique requirements. Our solution focuses on demand forecasting whereby the AI model analyses historical traffic patterns and Recurrent Neural Networks algorithms to predict future traffic trends and congestion. By forecasting when network traffic will be high, the model can allocate resources proactively to ensure the network has sufficient capacity to handle the expected demand. This ensures a scalable and reliable network, thus building trust and loyalty. By so doing, enhancing Customer Experience aligns with Openserve's mission of being the leading high-speed fixed broadband connectivity provider in South Africa. Through accurate demand forecasting allows companies to ensure that they have the right products available when customers want them. This leads to improved customer satisfaction, as customers are less likely to have network problems.

By predicting high traffic periods, Openserve can allocate resources effectively to meet customer demand. This proactive approach strives to meet customer needs and analyse network usage data like call quality, data speeds, dropout rates, and coverage gaps (in advanced stages), enhancing their overall experience with the brand. As sustainability becomes increasingly important, offering energy-efficient solutions can appeal to environmentally conscious customers. This could include green energy options or energy management services, potentially allowing for premium pricing. Customers can provide valuable feedback regarding their preferences for sustainable practices. By conducting surveys or engaging in discussions about environmental initiatives, telecom companies can better align their strategies with customer expectations, leading to more effective sustainability efforts. Network scaling can be achieved through use of network virtualization technologies like software-defined networking (SDN) and network function virtualization (NFV) enhance scalability and energy sustainability. Digital twins can monitor and optimise energy efficiency by analysing consumption data to identify inefficiencies and suggest improvements, such as enhanced insulation or efficient appliances. This approach promotes sustainable energy management throughout the lifecycle of a structure.

The cost associated with our project includes initial model deployment costs such as software development for the SCADA system (where real time data depicting energy consumption on various sections of the building will be done). Additionally, operational costs for SCADA system functionality will be incurred for the servers, data storage, cloud hosting, training staff and automation.

4. Technical Details/Blueprint

To develop our solution, a clustered spreadsheet of Openserve sites energy consumption in 2023 was sorted according to energy consumption per building. Since data was given, the need for instrumentation parts with sensors and ESP 32 for data acquisition was eliminated. Google Collab was used for coding using the Python programming language. Data framework to find that there are 36 sites was used. Power factor per 30 minute interval for all the buildings was calculated by dividing real power by apparent power. Data cleaning and sorting was done to identify and rectify errors, duplicates, and irrelevant information within datasets. Data splitting to training, test and validation set was done to identify and rectify errors, duplicates, and irrelevant information within datasets. Histograms were used to show real power consumption of each building per year. Recurrent Neural Network model using tensorflow was used to train our dataset. Model evaluation was done using the test data to assess model performance and prevent overfitting. A report was then generated to display model predictions. A map was used to show distribution of Openserve buildings in South Africa using ArcGIS ArcMAP software.



Electrical Engineering students, we lacked programming skills for training our model and developing web page. We dedicated ourselves to learning these skills. through continuous learning. However, we are still learning web page development. We had a challenge downloading, opening and reading (in our code) the Openserve data since it was a very large.

5. Prototype or Proof of Concept

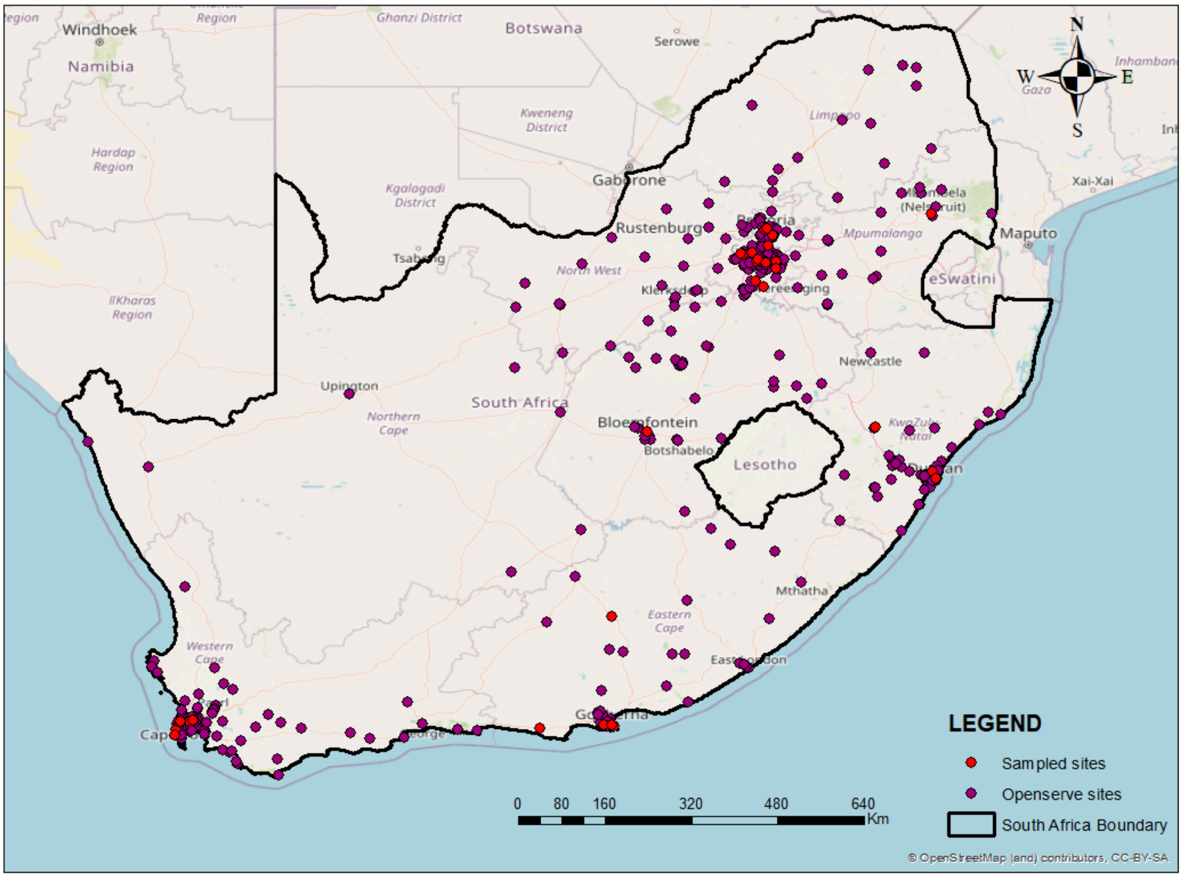
Please find the following link to our code for model training.

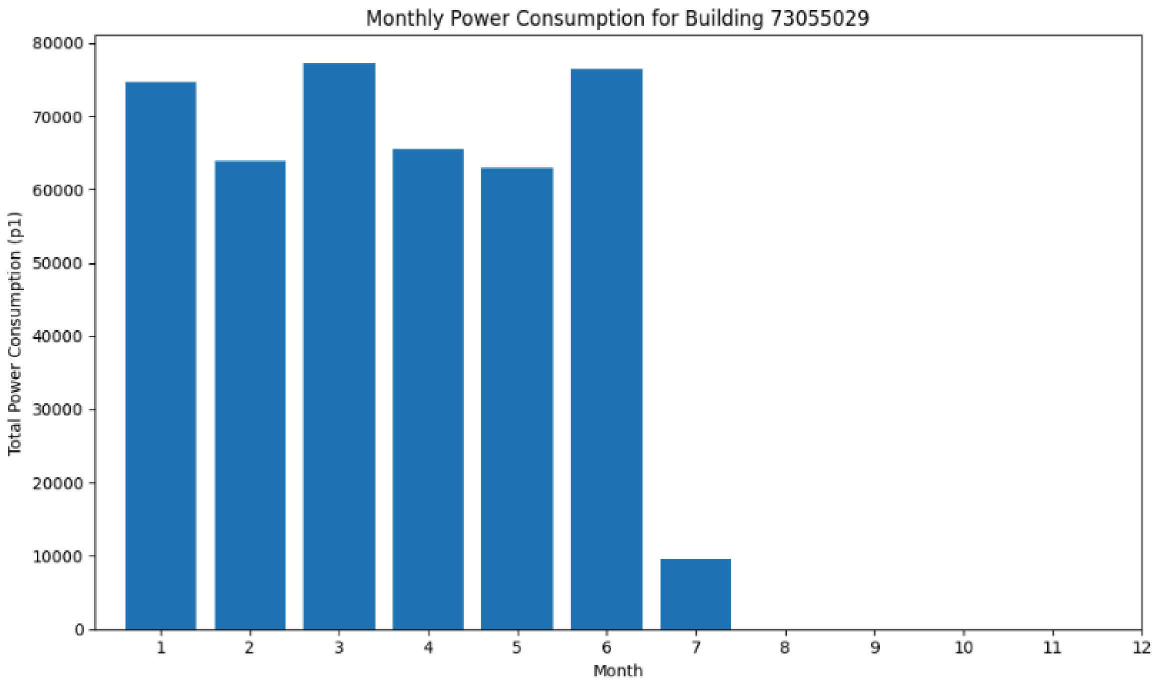
https://colab.research.google.com/drive/17wCWaABVSB0_pXtnnnJfD3O9SdfB5a1N?usp=drive_link

Link to sorted excel files of each building:

https://drive.google.com/drive/folders/1HcVkeBRtMRC435ePQJgoajmGP7Y_4TW0?usp=drive_link

OPENSERVE SERVER SITES DISTRIBUTION





Graph showing power consumption of site 73055029

6. Conclusion

In conclusion, this project has been a significant success for us, as we effectively leveraged our critical thinking and problem-solving skills to address a real-world industry challenge despite the challenge we faced. We are thrilled to have made a meaningful contribution to Openserve's green initiative by developing a sustainable and efficient energy optimization solution. This experience not only enhanced our capabilities but also reinforced our commitment to creating innovative solutions that promote sustainability in the energy sector. We look forward to seeing the positive impact of our work and continuing to contribute to initiatives that drive environmental responsibility.

We encourage the judges and stakeholders to support the implementation of our energy optimization solution by allocating resources for a pilot program within Openserve's operations. Engaging community members and industry stakeholders will enhance acceptance and broaden impact. Additionally, fostering collaborations with other organisations and experts in energy sustainability can lead to innovative improvements. Lastly, establishing a framework for ongoing monitoring and evaluation will ensure the solution's effectiveness and allow for necessary adjustments. By taking these steps, stakeholders can significantly contribute to promoting sustainable energy practices and a greener future.