

Industry	Consumer Electronics
Use Case Title	Energy Optimisation Platform Data Fusion and Decision Engine Phase 2
About the Customer	The Client is a Consumer Electronics Taiwanese company. We worked on this project as a Technology Partner to NTU, Singapore & the Client
Business Problem	<p>This was the Phase 2 of the Smart Home Energy Optimization Platform. The Client wanted a solution to addresses the inefficient energy consumption and lack of automation in smart homes by leveraging AI & Deep learning for data-fusion and decision-making algorithms. Following were the business problems</p> <ul style="list-style-type: none"> ● Inefficient energy consumption and lack of automation in smart homes due to manual control and limited data utilization. ● Difficulty in processing and combining sensor data from various sources in real-time for optimized decision-making. ● Inability to generate smart recommendations based on historical data for energy optimization and detection of harmful conditions.
Solution	<p>We implemented an AI Powered Energy Optimization Platform by fusing multi-sensor data using advanced data fusion techniques. We also implemented decision engine for automated monitoring and smart recommendations.</p> <p>Stats</p> <ul style="list-style-type: none"> ▪ Data fusion engine and Decision engine Pipelines were tested for around 150 smart homes worth of data. ▪ Data was generated synthetically for each home at granularity of 1 minute for the AI Model development and Training ▪ The Models were validated real smart office environment. <p>Deployment</p> <ul style="list-style-type: none"> ▪ Data Fusion and Decision engine consisted of AI models, Real time Scalable Spark & Kafka pipelines. ▪ Various functionalities of decision engine& data fusion were exposed as an API for the third-party application integration <p>Approach</p> <p>We Generated synthetic data for smart homes to train and test the models as the real sensor data was not available to start the work.</p> <p>Synthetic Data Generation:</p> <ul style="list-style-type: none"> ▪ Developed modules to generate synthetic data comprising various sensors and camera data. ▪ Used the synthetic data for testing algorithms in a controlled environment.

	<p>Data Fusion Engine:</p> <ul style="list-style-type: none"> ▪ Developed a scalable sensor fusion pipeline to combine and fuse data from multiple sensors via the data acquisition and ingestion platform. ▪ Implemented Bayesian estimation and probabilistic association-based fusion algorithms. ▪ Deployed Bayesian estimation and probabilistic association-based fusion algorithm models using FastAPIs. ▪ Integrated the fusion algorithm models with TensorFlow Serving and TorchServe for quick iteration and deployment. <p>Decision Engine:</p> <ul style="list-style-type: none"> ▪ Developed a scalable decision engine pipeline for generating smart recommendations based on the fused data from the data fusion engine. ▪ Implemented Naive Bayes-based room occupancy prediction models. ▪ Implemented object detection models such as SSD MobileNet and YOLO for detecting harmful conditions and optimizing energy consumption. ▪ Integrated the decision engine pipeline with the data fusion engine to generate smart recommendations.
<p>Outcome</p>	<ul style="list-style-type: none"> ▪ The data fusion engine successfully fused sensor data from various sources, providing reliable and accurate insights. ▪ The decision engine processed the fused data and generated smart recommendations for optimizing energy consumption and detecting harmful conditions. ▪ Historical data acquired from smart homes was analysed to provide graph and analytics for further insights and decision-making. ▪ Optimized energy consumption by recommending the turning off of devices at the right scenarios. ▪ Enabled automatic device control based on historical data and detected harmful conditions. ▪ Automated the turning off of air conditioning systems to optimize energy consumption. ▪ Generated graphs and analytics based on historical sensor data from smart homes for better understanding and decision-making