

Success Story

Developing an AI-based smart monitoring and anomaly detection system for oil & gas turbomachinery

Customer

Mechademy Inc

Country

Texas, US

Industry

Oil & Gas

About The Client

MECHADEMY

Mechademy is an engineering consulting firm bringing together globally-renowned turbomachinery subject matter experts to provide the oil and gas industry with engineering consulting services, commissioning and start-up services as well as remote monitoring and troubleshooting services. They combine decades of experience in the oil and gas industry with in-depth technical knowledge in the fields of thermodynamics, rotordynamics, aerodynamics, and fluid mechanics to provide solutions and best practices that are both theoretically sound and practically feasible. They have successfully delivered millions of dollars in value to their oil and gas clients across the globe.

Technology Stack

 Apache Airflow	 amazon EMR	 kubernetes
 node.js	 React	 mongoDB.

Business Situation

Production assets in the oil and gas fields, whether offshore or onshore, are often situated in non-ideal environments and are constantly exposed to harsh operating conditions. Breakdown of such equipment leads to a lot of challenges in operational processes such as unconnected environments, frequent machine downtimes, and underperforming assets. Hence, maintenance of this equipment becomes imperative to keep up with production goals.

Mechademy wanted to develop a smart monitoring and anomaly detection system that could make use of machine learning (ML) and Artificial Intelligence (AI) algorithms in order to detect failures well before traditional protection systems or in some cases even predict impending failure. Hence, Mechademy was on a lookout for a technology partner who could turn their vision into a market-fit solution. The client zeroed-in on Unthinkable Solutions due to our unparalleled expertise in AI and industrial IoT related technologies. The key requirements were to:

- ✔ Conceptualize, design, and develop an AI based software solution that could easily be plugged into existing data historians or condition monitoring systems and detect anomalies or under-performance of equipment.
- ✔ Integrate state-of-the-art machine learning algorithms with performance modeling algorithms that allow plant personnel to gain deeper insights into the health of their turbomachinery assets.
- ✔ Analyze data from multiple (tens or even hundreds of) sensors such as acoustic sensors, accelerometers, infrared thermography sensors etc. to identify anomalies and flag sub-optimal operations.
- ✔ Train the system to analyze trends, compare them with performance modelling algorithms and present critical information in an intuitive manner such as bar graphs, pie charts, line graphs etc. on a customizable dashboard to give a bird's eye view or drilled down details about the plant's performance.

The Solution

The project began with our business analysts and software architects outlining the optimal architecture and design for the solution. They refined the functional requirements and developed a complete product vision and its development roadmap. Once the strategic plans were mutually finalized, Unthinkable's team mapped the requirements onto the technology landscape and suggested technologies such as Apache Airflow, AWS EMR, Kubernetes, Node JS, React JS, MongoDB, Data lake, and Pyspark, etc. for the solution. The user experience was one of the project's cornerstones. We focused on creating intuitive usability to facilitate platform adoption, as well as lucid visualization tools to allow for easy comparisons of complex data. Our engineers designed, developed, and deployed all the infrastructure on AWS Cloud.

The Mechademy platform receives data from more than a hundred different sensors integrated with the plant 'historian' (software that stores historical data of equipment) as input via a connector agent. The connector agent fetches the data from plant historians to Mechademy data lake. Multiple ETL pipelines (remove missing data, perform data type check, remove outliers, etc.) transforms the plant data in the desired format. The final cleaned data is then fed to various performance modeling algorithms and ML/DL algorithms.

These algorithms are trained using the historical data to identify anomalies in data and generate prescriptive alerts. These alerts help the end users in making informed decisions about the health and efficiency of the platform. The platform is also capable of plotting graphs for each data point such as raw data, processed data or output data. The dashboard can be customized for each client as per their requirements to give a bird's eye view or drilled down details about the plant's performance. Some of the other features that were included in the solution are:

- ✔ Authentication with user role group and permissions. Creating plant layouts (machine and equipment schematic) in the system.
- ✔ Configuring different machine-specific parameters.
- ✔ Editing/ Deploying/Undeploying the layouts.
- ✔ IOT Data ingestion and Complex ETL based data pipelines creation for catching anomalies and outliers.
- ✔ Generating prescriptive alerts from the machine ingestion data.
- ✔ Applying machine-specific process algorithms based on config parameters.
- ✔ Deploying the customized Machine learning and Deep learning-based models dynamically from the admin frontend.
- ✔ Creating customized dashboards dynamically as per client requirements.

The Impact

The client has been extremely satisfied by the way Unthinkable has executed their vision and have planned for further updates to the system. The platform developed by Unthinkable has indeed differentiated Mechademy from being an engineering consulting firm to being a product/service provider in the space of advanced analytics and industrial IoT. Machedemy's clients have shown keen interest in the product and have reported a whopping 80% reduction in unplanned downtime, which turned out to be a significant boost in a plant's efficiency

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