AUTOMATED PIPELINE MONITORING WITH UNMANNED AERIAL IMAGING SYSTEM

PROJECT SUMMARY

Sembcorp Industries' Jurong Island Service Corridor consists of over 200 complex pipelines, spanning 25km in distance and rising 20m aboveground. These pipelines are connected to different companies throughout the island and are used to transport vital chemical feedstock, products (comprising of liquids and gases) and utilities (steam and cooling water).

Conventionally, monitoring of the pipeline network are conducted on an ad-hoc basis, which relies heavily on manual inspection by a team of engineers. This process requires both leak detection and visual inspection for each individual pipeline using handheld devices, making it labor-intensive. This is further exacerbated by the fact that some of the pipelines rise up to 20m aboveground, mandating the use of scaffolding, boom lifts or permanent platforms to ensure the safety of the inspectors. Undetected leaks of gases and liquids from the pipelines could lead to disastrous consequences e.g. exposure to invisible and potentially harmful chemicals due to close contact required during inspections.

In the interest of ensuring a high degree of reliability and safety for pipeline operations and maintenance, research into an improved methodology using an **Automated Pipeline Monitoring** system with advanced sensors and analytics was initiated.

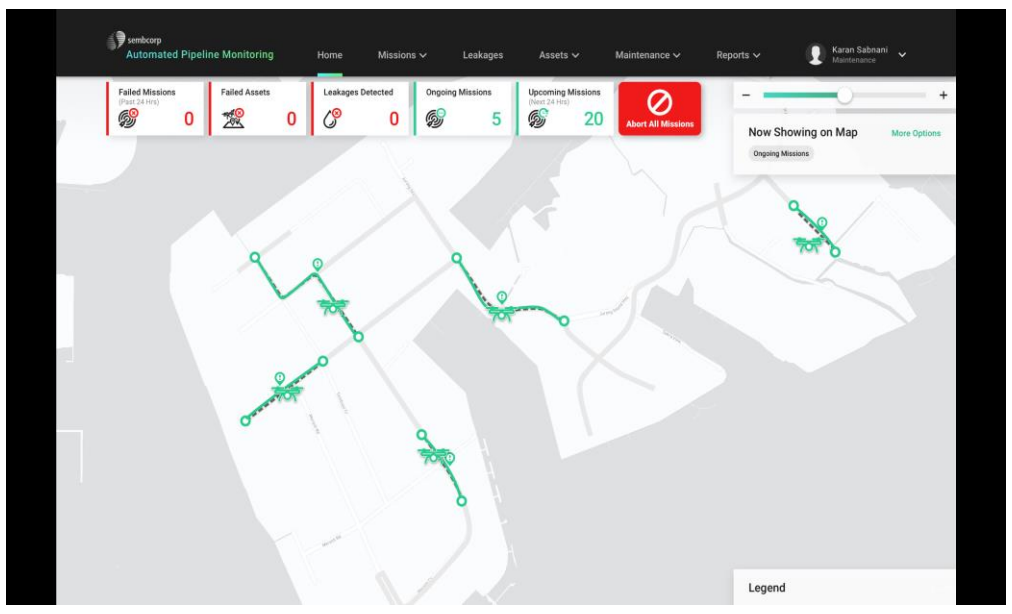

Figure 1. Overview of Automated Pipeline Monitoring System

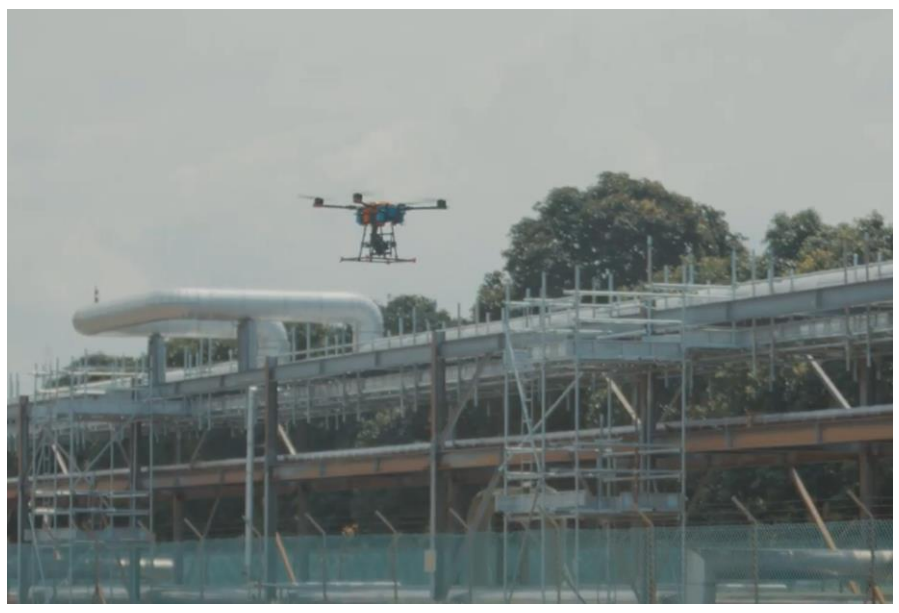

Figure 2. A UAV is flying along pipeline to capture video

PROJECT OUTCOMES

Under the Sembcorp-EMA Energy Technology Partnership, A*STAR I2R, Flare Dynamics and DNV GL have jointly developed an **autonomous Unmanned Aerial Vehicles (UAVs) equipped with state-of-the-art imaging sensors** capable of performing automated visual inspection and leak detection for pipelines such as those at Sembcorp Industries' Jurong Island Service Corridor.

The real-time videos captured by the UAVs are then uploaded automatically to a cloud server where the developed **intelligent image and video analysis algorithm** is applied to identify possible leakages.

An AI-powered platform has also been developed as part of the Automated Pipeline Monitoring system, as shown in Figure 1. It encompasses a real-time dashboard was developed in-house and provides the operator with an overview of operations including:

- User management to manage and monitor actions performed by various user groups
- Mission management to schedule, monitor and review flights
- Asset management to monitor the status of leakages, drones and sensors

The autonomous UAVs have also been developed together with **weather-proof docking stations** that allow the UAVs to auto-charge and be deployed remotely. With this, an operator can remotely schedule inspection flights around the clock using a drone deployed in the field several kilometers away with just a few clicks on the dashboard.

Field trials performed at Sembcorp Industries' Jurong Island Service Corridor using the leak detection algorithm developed have shown an **accurate detection of leakages at up to 85%**. Additional trials are currently being performed to further harden the system and increase the accuracy of detection.

The developed solution is able to perform inspection of large areas of pipeline deployments with minimal manpower, thereby significantly reducing operational costs.

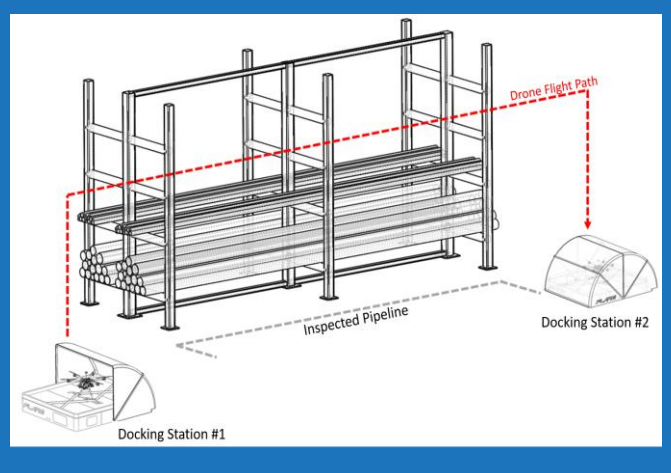

Figure 3. Test-Bed Configuration and flight path of Unmanned Aerial Vehicle

Figure 4. A docking station with coverage system and auto charging mechanism.

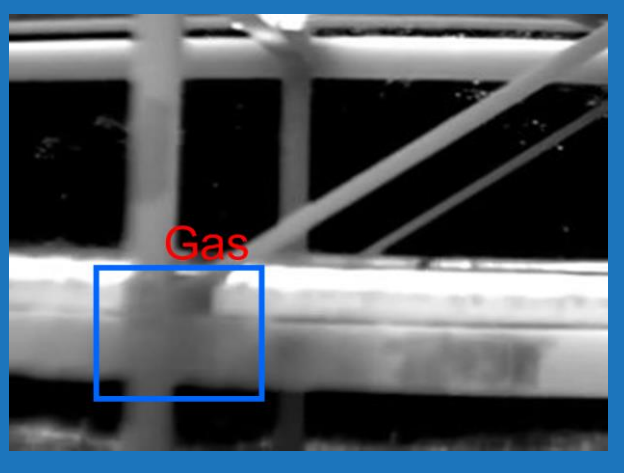

Figure 5. An infrared video that is automatically uploaded to server for analysis. The detection result is shown in a GUI.

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