

# Automated Drone Solution for External Wall Inspection for Government Buildings using AI

Wish Ref No :W-0277

20. June 2020

# Proposed Solution

An automated end-to-end solution that leads from a one-click mission execution to an annotated 3D model incl. defect report accessible via web interface by relevant stakeholders.

# Stages

1. Flight / Mission Definition
2. Flight / Mission Execution
3. Asset Transmission
4. Asset Processing (Photogrammetry / AI)
5. Report Generation

# Stage 1: Mission Definition

Using our web-based mission planner that can utilize highly accurate 3D Building Models, a survey mission for every building will be modeled. Alternatively, this can also be done by a manual initial drone flight. A simulated flight can be executed in a “Digital Twin” environment before executing the mission in the ‘real world’.

# Stage 2: Mission Execution

An on-site operator deploys the drone at the building to be inspected and can start the inspection mission with one click which will then be executed autonomously. In case of any unforeseen events the operator can terminate or pause the mission manually. The Drone's obstacle avoidance will make sure to keep a safe distance to the building facade.

# Stage 3: Asset Transmission

Images acquired by the drone camera are transmitted via 4G/5G network for processing in the cloud.

# Stage 4: Asset Processing

Based on the images acquired an accurate 3D model is generated via our Photogrammetry pipeline. All surfaces are tiled and processed in an AI (CNN based machine learning pipeline) that is trained to find relevant anomalies / defects.

# Stage 5: Report Generation

Based on the 3D model that is annotated with detected defects and anomalies, a report is generated that can be shared with relevant stakeholders. Temporal changes can be visualized to see developments of defects over time and allow predictive maintenance.

# Challenge: GPS positioning

- Flying in a dense environment with high-rise buildings is challenging for accurate GPS positioning with a drone (e.g. Multi-path effect) and can potentially lead to dangerous loss-of-control.
- Solution: We use latest generation multi-constellation RTK-GPS augmented with sensor fusion (visual odometry based) for reliable and precise positioning

# Challenge: Flight Automation

- To allow easy and safe execution of an inspection mission, it is important to automate the process preventing human error as well minimizing the need for trained staff.
- Solution: we leverage the existing BIM to plan inspection missions in advance and also execute them in a simulation ('digital twin') environment first. On site the inspection can then be executed fully autonomously by 'one click'.  
This makes the process safer and allow easy and precise repeatability.

# Challenge: Automated Defect Detection

- Relevant defects need to be detected accurately and presented in a way that allow prompt maintenance actions.
- Solution: We propose a Deep Learning approach to train a model on both public datasets as well as potential existing data. Defect Locations detected will be re-projected to the 3D-Model and can be automatically annotated with other relevant data (e.g. floor number).

# Drone

- Industrial Grade UAV
- 6-Rotor (safety through redundancy; highly stable in windy conditions)
- Lightweight: 2.2kg incl. Payload (safe)
- 4G/5G connected
- Camera Payloads: high resolution visual light or thermal cameras



# Web Management Interface

SKY DRONE Realtime

Kwai Chung CT2

10:32 (GMT+8)

cell 5G connected 100% 15m/h 6.7m 100%

Dashboard Realtime Mission Assets Settings Profile

Base Station CONNECTED

Mission Control Return To Home Safety Zone Pause Altitude 67m Camera 00:32:16

Camera Control

SKY DRONE Assets

Kwai Chung CT2

10:32 (GMT+8)

Dashboard Realtime Mission Assets Settings Profile

2019-09-13 - 7 Items

2019-09-12 - 16 Items

2019-09-11 - 11 Items

SKY DRONE Missions

Kwai Chung CT2

10:32 (GMT+8)

Dashboard Realtime Mission Assets Settings Profile

Create New Mission

DATE	TIME	MISSION NAME	DRONE	CREATED BY	DESCRIPTION
2019-08-03	11:00	Perimeter 1	S023	Jason Wu	Perimeter 1 Patrol
2019-08-03	08:00	East Corridor	S023	Jason Wu	Eastern Corridor Patrol and Mapping
2019-08-02	14:37	-	S023	API	Triggered by external event
2019-08-02	11:00	Perimeter 1	S023	Jason Wu	Eastern Corridor Patrol and Mapping
2019-08-02	09:00	East Corridor	S023	Jason Wu	Perimeter 1 Patrol
2019-08-01	11:30	Perimeter 1	S023	Jason Wu	Eastern Corridor Patrol and Mapping
2019-08-01	19:43	East Corridor	S023	Jason Wu	Perimeter 1 Patrol



# Project Stages

1. Define Project Scope and Deliverables
2. Deploy drone hardware and software
3. Create Mission Plans for POC
4. Conduct test flights
5. Train Neural Network (AI) for defect detection
6. Improve end-to-end pipeline based on tests

# About Sky Drone

Sky Drone specialized in fully automated drone solutions that leverage cloud computing power by being connected to the 4G/5G network.

Intro Video of our fully autonomous drone solution:  
<https://bit.ly/37Y28RD>

