Temasek Defence Systems Institute

Persistent Perimeter Surveillance Using Multiple Swapping Multi-Rotor UAS

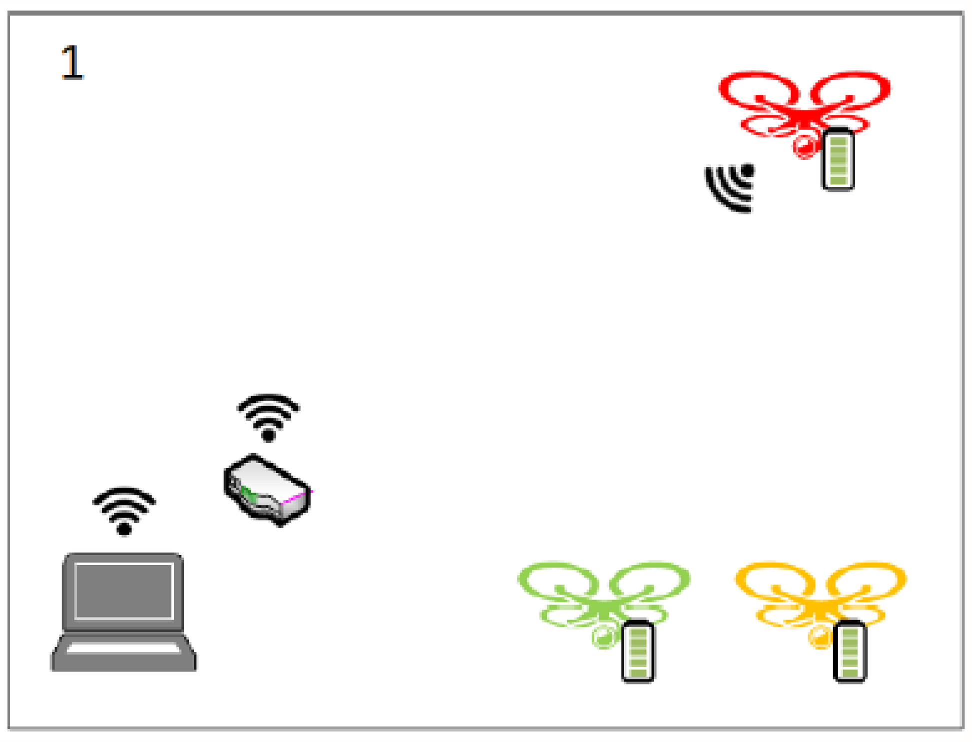
Teo Choon Pei, Jeremy
Oleg A. Yakimenko

Objective

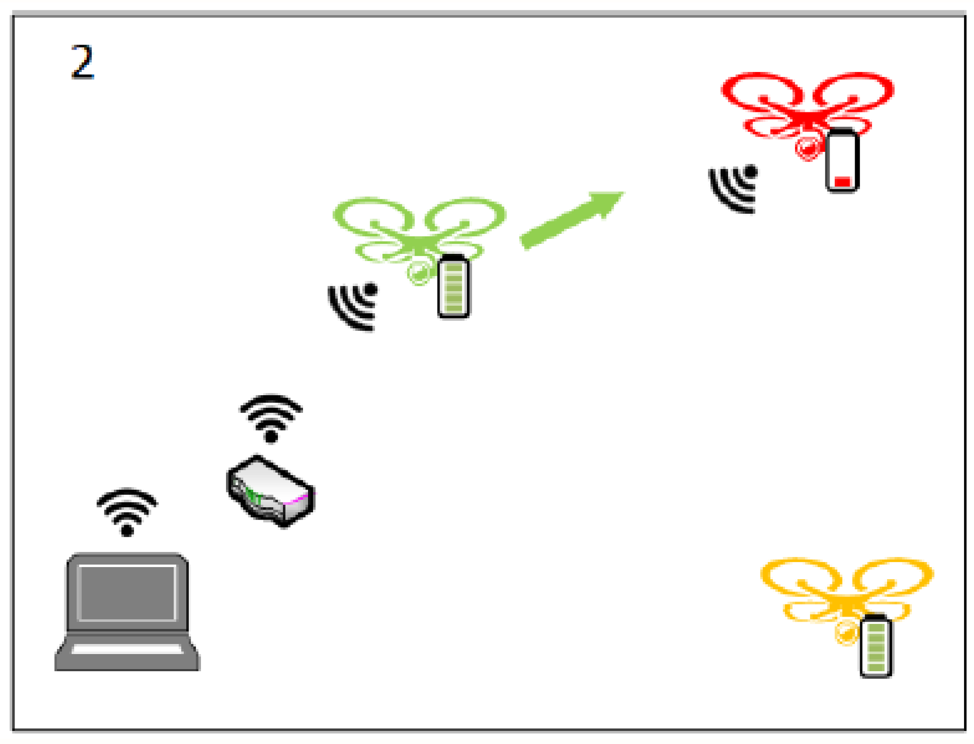
The focus of this thesis is to explore the feasibility and limitations of using a small multi-rotor unmanned aerial system (SUAS) to provide persistent perimeter patrol by swapping SUAS autonomously.

Benefits of the Study

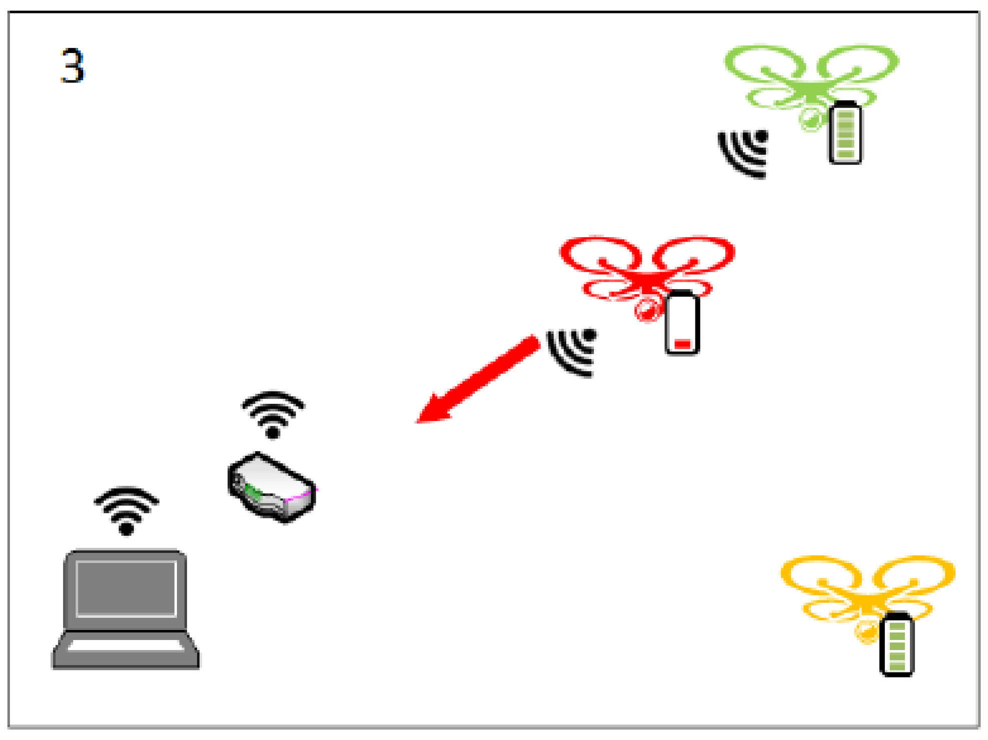
The System would allow the military to minimize the number of patrollers and the installation of new surveillance infrastructure while also minimizing any coverage gaps. The solution also gives the military the capability to do early risk assessment and provides more reaction time by flying the SUAS to the incident site faster than any patroller likely could without any harm.



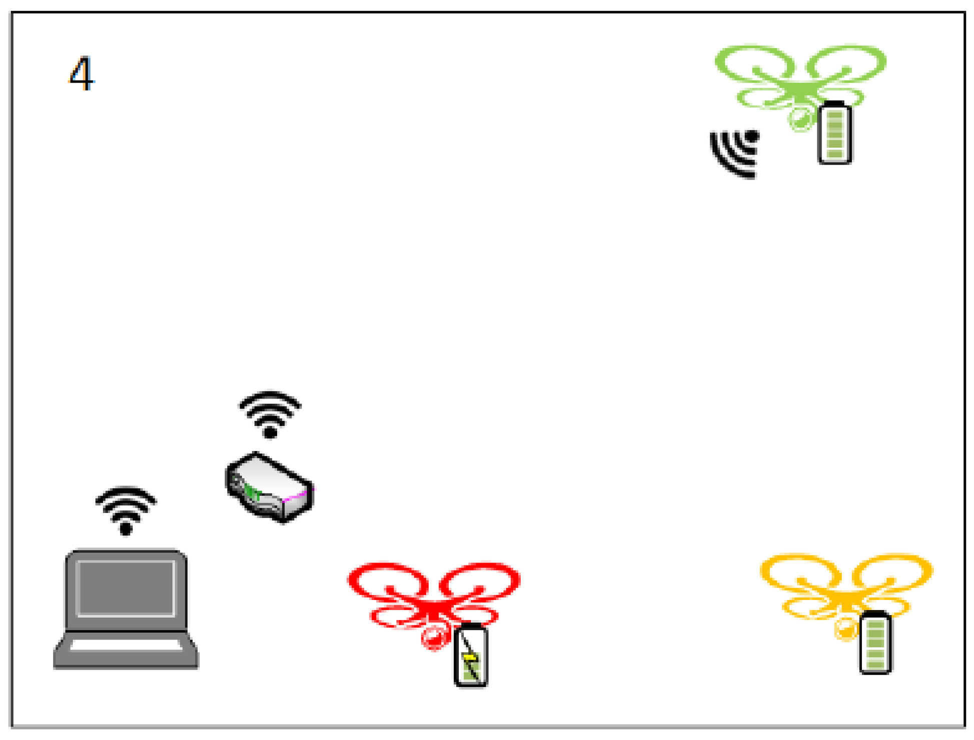
System monitors Patrol UAS battery level



System launches Replacement UAS



Replacement UAS takes over patrol duties & low battery level UAS fly back to launch point



Low battery level UAS charges for next launch

Figure 1: SUAS Swapping Process. Source: Herzog (2017).

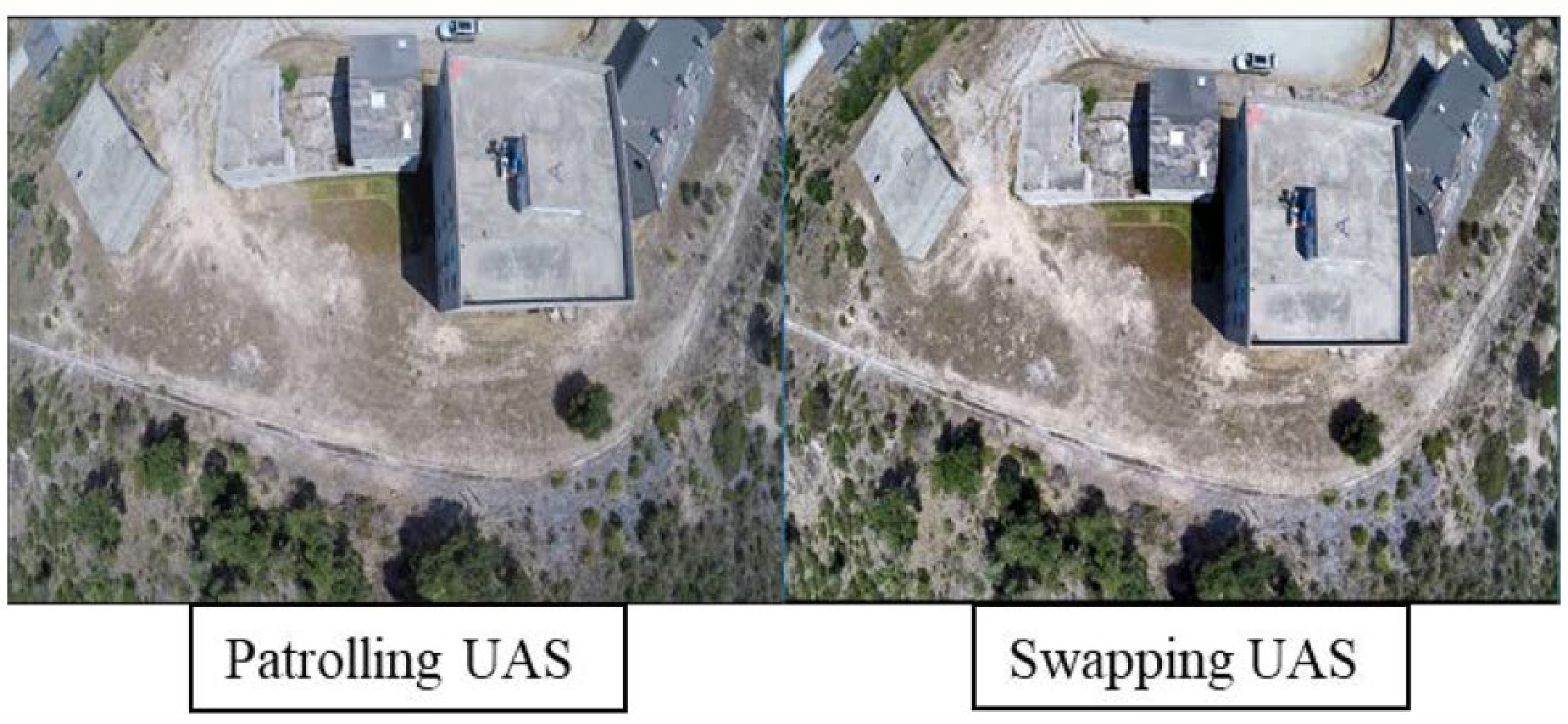


Figure 2: Screenshots of Videos during SUAS Swapping at Impossible City.

Results

The results showed that the SUAS could be swapped autonomously and was able to maintain consistent FOV during the swap. By monitoring the battery level and autonomously swapping quadcopters, the system showed that endurance can exceed the capability of a single quadcopter and possibly perform 24/7 persistent surveillance, or until the system fails mechanically.

Future Work

In testing of the SUAS, a few potential challenges were identified, and thus, some of the future work recommended include (1) Determining the feasibility of tracking moving targets during SUAS swapping, and (2) Developing a mechanism to replace batteries automatically.

Reference: Herzog, Julian. 2017. "Unmanned Aerial Vehicles, Plain Black SVG Icon." Last modified July 8, 2017. https://commons.wikimedia.org/wiki/File:Aerial_Photography_UAV_Icon.svg

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