**Parking Lot Hawk**

*Team #34: Fady Zekry Hanna, Winnie Trandinh, Muhammad Ali, Muhammad Khan*

Parking in a busy parking lot can be frustrating and time-consuming experience. Time wasted when trying to find a parking spot is not only an inconvenience for visitors, but also results in wasted vehicle energy and lost productivity for drivers and event hosts.

Existing solutions, such as employing parking lot officers or installing vehicle counters in the parking lot, have limitations. While parking lot officers can communicate parking spot availability to visitors, they are limited in their ability to monitor large swaths of the parking lot accurately. Vehicle counter technology is expensive and requires precise installations, making it unfeasible for outdoor, seasonal, temporary, and parking lots with limited resources.

ParkingLotHawk aims to address this gap in the market. ParkingLotHawk is an aerial drone that autonomously flies over parking lots, sharing a live camera feed and an occupancy trace along the way. An occupancy trace, a stretch goal for this product, is a series of past drone locations marked with whether that location was occupied by a vehicle or not.

The ParkingLotHawk is controlled through an application running on the parking lot authorities' personal computer (Operator’s PC), without the need for an RC Controller. The user can instruct the drone to move toward a desired location by clicking on a satellite map, created from stitching Google Earth images. The user interface also contains a parking lot recognition feature that is used to warn the Operator if their requested location is not within a parking lot.

The drone can communicate with the PC within a 20m radius, using a custom Wi-Fi network that operates without the need for internet access. The Wi-Fi network is created using a USB Router that connects to the Parking Lot Operator’s PC.

A key challenge of this project to build a custom drone rather than purchasing a ready-made one. A custom fabricated mechanical frame was designed and virtually analyzed in SolidWorks. Electrical components were purchased and wired together. A companion circuit board was purchased for running the flight control software, Ardupilot. A multi-stage tuning process was followed to fine-tune the flight control software for the custom fabricated frame.

The final product fulfills the requirements to be considered a minimum viable product. The drone implements each of the required operation states, such that the user can autonomously launch, move, and land the drone through the user interface.

The final product passed the unit tests assigned for the user interface, drone software modules, mechanical design and electrical design. The integration, system and stress tests described in the VnVPlan verified the drone’s flight dynamics and the implementation of operation states. The verification process proves that the ParkingLotHawk is a minimum viable product.

Some stretch goals of the project were also completed. The team added a parking lot recognition feature that warns the user when the drone could exit the parking lot onto civilian area. Furthermore, an occupancy map is created during flight, it indicates free and occupied points around the parking lot was created.