# ArUco Marker Tracking System with Tello drone(SURGE)

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## Introduction

- An ArUco marker is a synthetic square marker composed of a wide black border and an inner binary matrix that determines its id. This marker has a variety of applications in Computer Vision, including robot navigation, augmented reality, and more.
- The DJI Tello drone is a small drone with an onboard nose-mounted camera with 720p HD video streaming. It's a lightweight and affordable quadcopter, suitable for flying indoors.

Our project aims to integrate the OpenCV module that contains functions related to tracking the ArUco marker with the Tello drone. Once the marker is tracked and its coordinates are estimated, efficient control algorithms command the drone to the required location.

**GET IMAGE**
- Video stream is obtained from the drone.

**IDENTIFY MARKER**
- Using OpenCV the marker is identified

**OBTAIN POSITIONS**
- With Pose estimation, the coordinates and orientation is obtained

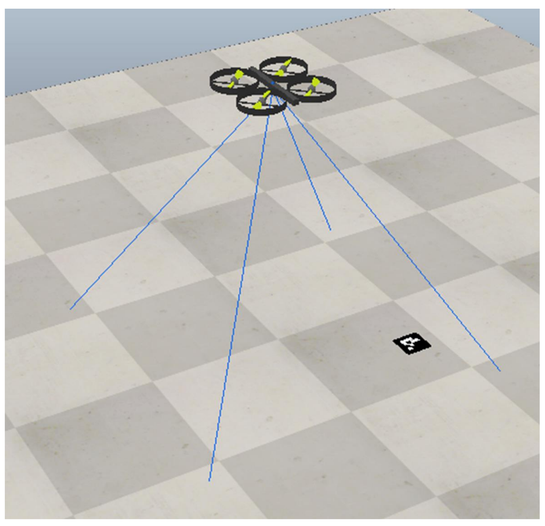
**COMMAND DRONE**
- A PID controller is used to set velocities of the drone.

## Leader-Follower Drone

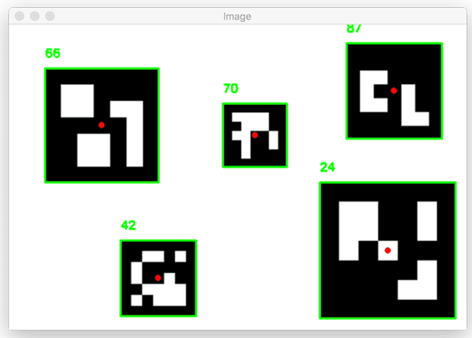
- An experiment was set up with a marker attached to the leader drone vertically on top of it, and the follower drone tracked the target drone.

## Results

- The simulations provided information about accurate marker detection when all four corners were in the image. Once the marker was identified in the image, the drone's movement to the required location was stable with reduced oscillations.

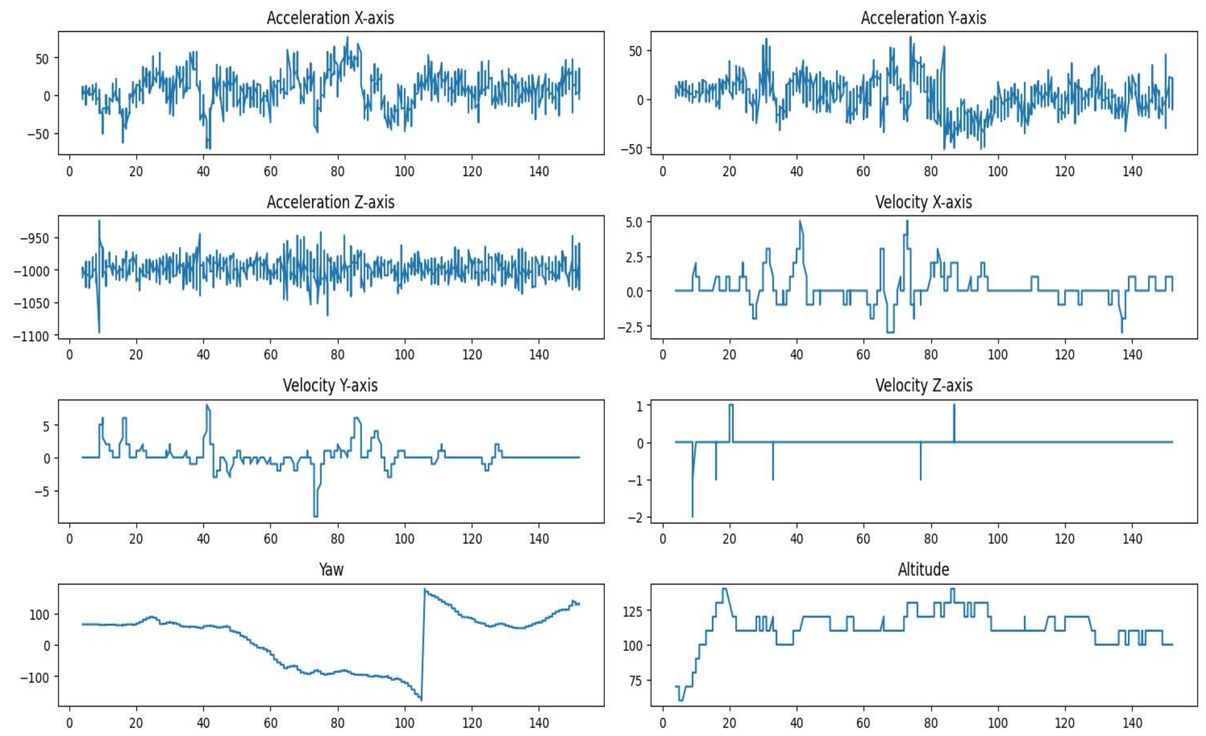


Simulation of drone landing




Tracked image of ArUco marker

- For the hardware implementation of the Tello drone, the flight stability and performance were analyzed. The values of acceleration, velocity, yaw, and altitude were plotted with time.




Analysis of Acceleration, Velocity, Altitude, and Yaw while tracking

## Conclusion

- The implemented system of marker-tracking was efficient and reliable. This can have multiple applications, including aerial surveys, mapping, surveillance, and augmented reality experiences.
- Further, the leader-follower model can be used for efficient payload transfer between two locations.
- Additionally, better control algorithms can be developed to provide improved response and stability.

## References and Acknowledgements


- https://docs.opencv.org/3.1.0/d5/dae/tutorial_aruco_detection.html
- https://pyimagesearch.com/2020/12/21/detecting-aruco-markers-with-opencv-and-python/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