Hawkeye

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Team B9

Electrical & Computer ENGINEERING

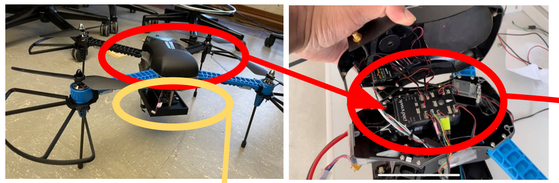
Product Pitch

Autonomous drone videography offers limitless possibilities to capture cinematic shots for vlogging or provide critical monitoring data in high stakes rescue missions enabling users to focus on the more important tasks at hand.

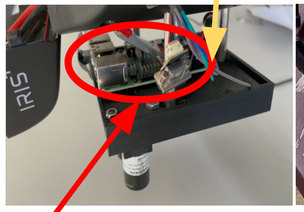
For good videography of user it is important for a drone to have good stability and tracking. We were able to achieve 90+% in both stability and tracking (in simulation).

System Description

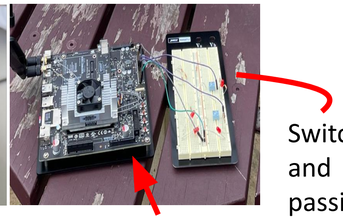
Drone



Drone Compute



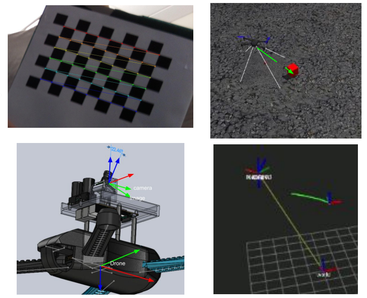
User Compute and wearable



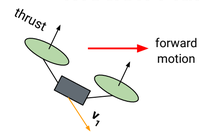
Target detection

Feed in

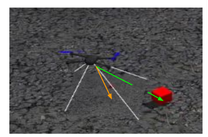
2D → 3D Position Estimate



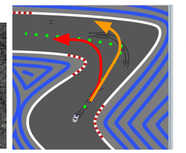
Motion Planning



Tracking vs Stability

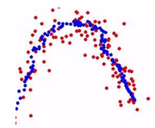


Model Predictive Control



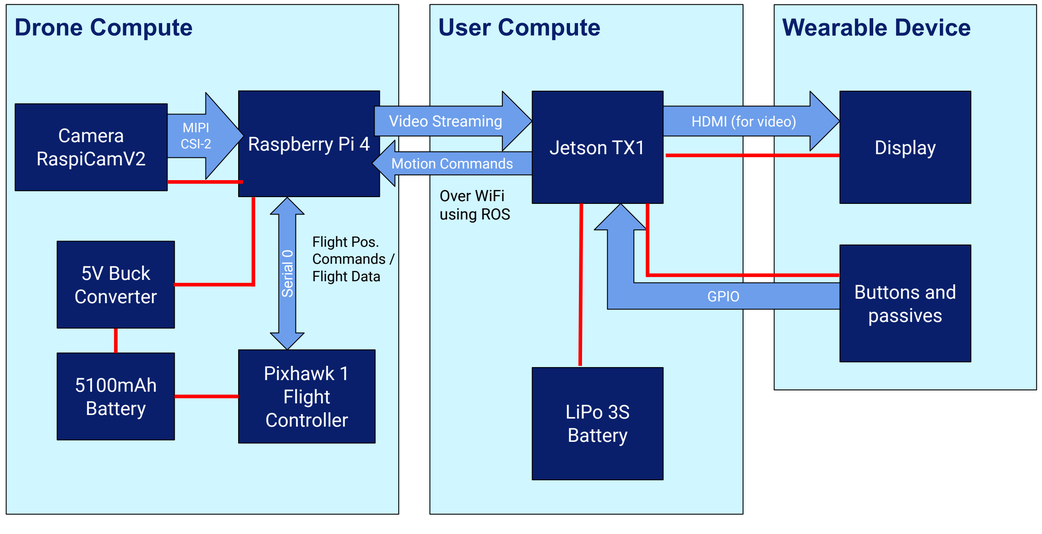
Feed In

Kalman Filter



Feed in

System Architecture

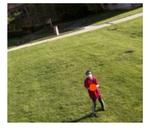


System Evaluation

Target Detection

FN: False Positive Rate
FP: False Positive

	FP Rate	FN Rate	Avg. Pixel Error
Actual	0%	14.78%	11.87
Desired	2%	10%	(N/A)

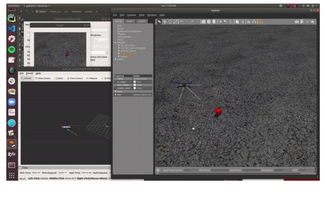


Test Size: 157 frames

Motion Planning (simulation)

Drone Tracking: % of frames where the target is within frame
Drone Stability: % of 3 second windows where drone position is stable*

Test	Tracking	Stability
Walking	100%	100%
Running	88%	100%
Both	97%	93.75%
Desired	90%	90%



Computation Frequency

Operation	Average Time Taken (s)	FPS
Capture Image	0.344	2.91
Stream Image to TX1	0.25	4
Convert Image to Cv2	7.14e-5	14006
Detect Target	2.67e-4	3745
Target State Estimation	6.50e-4	1538
Motion Planning	0.0135	74.07
Overall	**0.344**	**2.91**
Desired		**5 - 10**

***Stability measured by taking standard deviation of target (x, y) across 30 second windows and measuring the % of frames where std(x) <= width/6 and std(y) <= height/6)**

Trade-Offs

Motion Planning Costs

Cost = Tracking cost + Control Cost

	Current Design	Higher Control Cost	Lower Control Cost
Tracking	**97%**	47%	84.58%
Stability	**93.75%**	100%	43.75%

Image Compression

There IS a difference in streaming (4 FPS vs. 6.67 FPS), but that's irrelevant since it isn't bottleneck

Uncompressed: 2.91 FPS
Compressed: 2.94 FPS