

Vision Based Autonomous Landing of UAV

Mentor

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UAV

- Unmanned Aerial Vehicle
 - AR DRONE
- Vision Based Helipad Detection
- Autonomous Landing



Image source : Google Images

Previous Work

- Unmanned
- Vision based target tracking
- Manually controlled landing

Motivation

- Crashes due to human error

Image source : Google Images

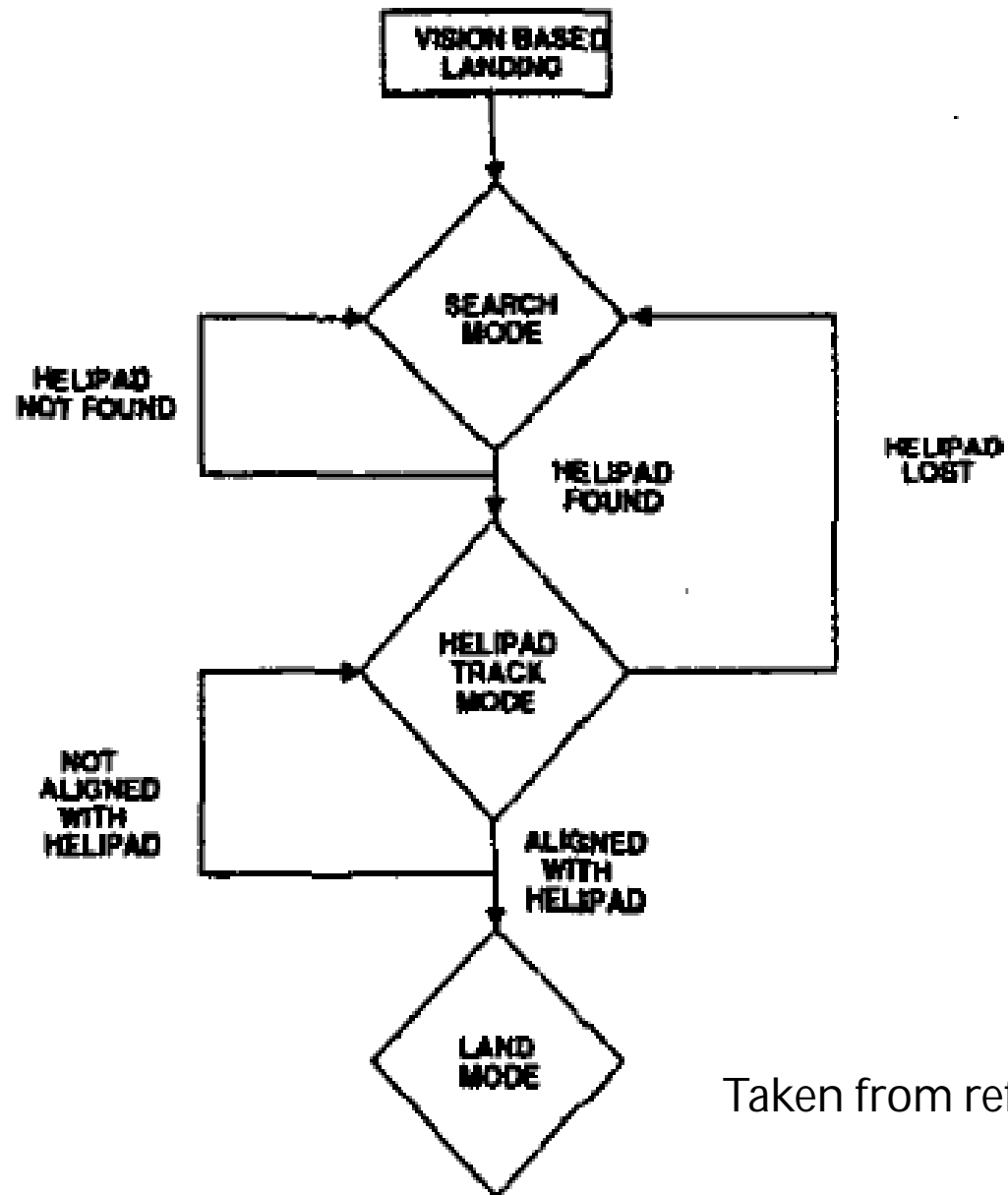


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graph TD; Task[Task] --> VBT[Vision Based Tracking]; Task --> CA[Control Architecture];
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Task

Vision Based
Tracking

Control
Architecture



Taken from reference no 1

Vision Algorithm

- Thresholding and Filtering

$$Y = 0.299 * R + 0.596 * G + 0.211 * B$$

Courtesy : Reference paper 1

- Segmentation and Connected Component Labelling
- Object Recognition and State Estimation

Vision Algorithm

- Optical Character Recognition
- Detecting the character "H"
- First, second and third moments are sufficient

Control architecture

- AR.FreeFlight 2.0
 - Android App
 - Controls Motion with Human Instructions
- Our Aim: Make it Autonomous

References

1. Vision-based Autonomous Landing of an Unmanned Aerial Vehicle by Srikanth Saripalli', James E Montgomery and Gaurav S. Sukhatme in Proceedings of the 2002 IEEE International Conference on Robotics & Automation Washington, DC May 2002
2. Courtney S. Sharp, Omid Shakemia, and S.Shankar Sastry,"A vision system for landing an unmanned aerial vehicle," in In Proceedings of IEEE International Conference on Robotics and Automation, 2001, pp. 1720-1728.
3. R.Gonzalez and R.Woods, ***Digital Image Processing***, Addison-Wesley, 1992.
4. http://www.24-7pressrelease.com/attachments/016/press_release_distribution_0169459_30112.jpg
5. http://willyloman.files.wordpress.com/2009/09/cid_post-impact_2.jpg
6. Ryan Miller, Bemard Mettler, and Omead Amidi, "camegie mellon university's 1997 international aerial robotics competition entry," in ***International Aerial Robotics Competition***, 1997.



THANK YOU!!!

QUESTIONS??



Thresholding

- Threshold - 80% of between the minimum and maximum gray scale values.
- Normalized value of 1 to pixel above threshold and 0 to one below threshold.

Filtering

- 7x7 Median filter for noise rejection
- Replaces each pixel value by the median of its neighboring pixel values

Invariant Moments

- The (p+q)th moment of an object $f(x,y)$ is :

$$m_{pq} = \sum_i \sum_j i^p j^q f(i, j)$$

- The center of gravity of the object is specified by:

$$\bar{x} = \frac{m_{10}}{m_{00}} \quad \bar{y} = \frac{m_{01}}{m_{00}}$$

- Central Moments about the center of gravity is:

$$\mu_{pq} = \sum_i \sum_j (i - \bar{x})^p (j - \bar{y})^q f(i, j)$$

- Object orientation Θ is:

$$\theta = \frac{1}{2} \arctan\left(\frac{2\mu_{11}}{\mu_{20} - \mu_{02}}\right)$$

Formulae from Reference 1