Aircraft landing using reinforcement learning on virtual camera

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Introduction:

Unmanned Aerial Vehicles (UAVs) have been an active area of research in the last decade or so. They are cardinal in a lot of situations where human interposition becomes inconceivable, highly risky or highly expensive. Such situations include hazardous material recovery, disaster relief support, traffic monitoring etc. They also have their uses in remote sensing applications or they can be developed for geophysical exploration i.e. in oil, gas and mineral exploration and production activities e.g. the *InView Unmanned Aircraft System,* which was developed in 2010 by Barnard Microsystems Limited for the purpose of oil and gas exploration.Unmanned aircraft are uniquely capable of penetrating areas which may be too dangerous for a piloted craft e.g. UAVs have been developed recently which can fly into a hurricane and communicate near-real-time data directly to the National Hurricane Centre in Florida.

Motivation:

For a UAV to function satisfactorily one of the most momentous capability is its autonomous landing. The issue of autonomous landing has gained the attention after the US **Congressional Research Service** in its report on Pilotless Drones dated September 10, 2012 reported that despite improvements **"the accident rate for unmanned aircraft is still far above that of manned aircraft",** many a times the reason being the manual mistake by the operators while making the aircraft to land. Take, for example, one drone crash in 2006. As the operator brought the drone in for a landing, he meant to flip the landing gear button on the control joystick but accidentally hit the nearby ignition switch instead—shutting off the engine in mid-flight. The $1.5 million drone plummeted to the ground, a total loss. After this report, the essence of an autonomous landing instead of an operator-controlled landing became quite visible. We therefore are addressing this issue of the autonomous landing of an unmanned aerial vehicle.

Previous Works and Our Approach:

Our approach to the autonomous landing would be a vision based one.
Vision based robot-control have been an active topic of research in the past few years. In [3], a real time computer vision is presented for tracking a landing target but there was no autonomous landing. Some researchers like in [4] and [5], treated the problem of autonomous landing and vision based tracking in a decoupled way.
A few vision based navigation and landing system were presented in the very early years of this 21st century. Among the popular ones is by Srikanth Saripalli', James E Montgomery and Gaurav S. Sukhatme ([6]) from University of Southern California and California Institute of Technology who presented an algorithm for vision based autonomous landing of a model helicopter in an unstructured 3D environment.
Our system would locate and recognise the landing location (can be a helipad of specified

dimension) through the method of **reinforcement learning**, and would then undergo landing, following a behaviour based control architecture.

Method/Steps:

The whole process has been divided into two parts:
a) Vision Based Detection and Recognition
b) Control Architecture

a) Vision Based Detection and Recognition:
The colour images taken with the help of camera would be converted to the binary ones and then after thresholding and filtering, a reinforcement learning method will be implemented so as to make the system learn to detect the landing target.
b) Control Architecture:
Using the state estimation, the control architecture decides the desired future state and thereby instructs the aircraft to navigate in the target direction; in this case towards the landing target.

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