Mobile Vision Based Risk Detection: Using computer vision to detect potential risks in a Parrot AR.Drone 2.0

Report Name	Outline Project Specification
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1 Project description

This project will be focused on developing a risk detection system for a parrot AR Drone 2.0 using a vision-based system. This will allow the drone to focus avoid potential upcoming risks through it's main camera, as the drone doesn't have any other methods for avoiding collisions due to it normally being manually controlled.

This would also provide a myriad of possibilities in what the drone could help do; this includes things like assistance for those poor of sight, leading in search and rescue through sight and general collision avoidance through sight. Currently, the drone operates via user input for control and relies on their vision through the cameras on the drone and their outside view of the drone to avoid collisions. This is fine for personal use and some photographic use, however for autonomous flight, the drone needs to be able to detect these collisions on it's own.

In order to do this, a computer vision based system to attempt to detect particular risks through the cameras would be implemented. It's likely that the principal of relative motion in optical flow will be used to do this, as objects that are closer to the drone will appear to be moving faster, however this will require further investigation into different methods of determining risks through vision. The plan will also involve starting with a very limited scope of risks, for example detecting only red shapes initially and then generalizing from there. This limits the scope at the start of the project to a suitable level, then allows for further expansion of the scope as the project goes on.

In order to complete this project, an agile methodology consisting of sprints, iterative process improvement and a personal kanban system [3] will be used. Early on in this process, a system for my workflow will be set up and the methodology and my motivation behind my decisions will be written up.

2 Proposed tasks

Set up and write up methodology This task will allow for a clearer idea of how the work will progress, keeping work moving forward throughout. It also helps keep an idea of how the methodology has changed, as there will be a written record of how it started. This will be done very early on in the project, before any work commences, at the same time as the research.

Set up version control This version control will be hosted on github and used for back-up and easy roll-backs. This is necessary in order to make sure any mistakes in development can be rectified easily and it also allows for tracking of the progress of the project overall. Seeing as this is a very easy task, it's to be done within the first week.

Research This task is to gain further understanding of the technology which will be used and the concepts that the system will be based off of. It will be done within the first 2 or 3 weeks of the project.

- **Vision based risk detection systems** Here, research on preexisting vision based systems for risk or collision detection will take place. This is done to gain a clear view of the type of system that should be implemented, what different layers it will need and anything else it will entail.

Parrot AR Drone 2.0 API/SDK In this task, there will be investigation of the API and SDK [1] of the drone being used as a platform for the system. This is to gain an understanding of the system before development gets underway, to improve development time.

Development This will be split into a few sub tasks and will be started once research is completed:

Vision This will be the development of the Vision-based system and is likely to be the main part of the project. This will involve detection of potential risks, determining if they are a risk and sending the appropriate information to the controller.

Drone controller This is the part of the project that will be controlling the drone itself, sending commands to perform particular movements. This is necessary for applying the vision system to the drone, as it controls the drones movements and sends the camera feeds into the vision system.

Testing This task is intertwined in both the previous development tasks and will be done in both. During both tasks, I will be doing continued testing of the vision and controller, in order to make sure it's working correctly and does what it is intended to do. Also, integration testing will be taking place to check overall functionality when applied to the drone.

Meetings and progress/process tracking Throughout the project there will be weekly supervisor meetings to discuss progress and to help solve any problems that can't otherwise be solved. In order to keep these meetings properly informed, progress and process tracking will be taking place through the form of documentation in the repository. This will include progress made, any changes that have been made to the process and reasoning behind the decisions I made.

Demonstration preparation During the time on this project, there will be 2 demonstrations, both of which will need to be prepared for beforehand. This preparation will involve implementation on the drone, making sure all the technology is usable (charged, working, accessible) and preparation of what information needs to be expressed to show progress. For the mid-project demonstration it's hoped that basic risk detection of a simplified risk (E.g A designed risk like a red square/circle). In the final demonstration, the drone should have a fully implemented vision system, with appropriate reactions to the risks. These plans are subject to change however, depending on how much has been completed at the time of the presentations.

Final report write up The final report will mostly be written once development has finished, however the report will have some parts that are written during development, after particular parts of development have finished. This document will have sections that can't be completed during development however, such as critical analysis of the process over the project and progress made.

3 Project deliverables

Drone software Any software produced as part of this project is contained in this deliverable. This will be submitted in the technical hand-in and will also be available within version control. This will also contain any extra material used as part of the technical work such as libraries or any other acknowledged work from another source.

Demonstration notes These will be notes used for the demonstrations, consisting of two sets of notes. One of the sets will be for the mid-project demonstration and the other for the final demonstration. They are to be added to the appendix of the final report.

Research notes As part of the research into different vision techniques to be used in this project, a set of notes on these techniques will be produced. These will be discussing the advantages and disadvantages of different techniques, along with critical analysis for the purpose of this project. These will be included in the appendix of the final report.

Final report The final report will discuss the work done on the project and acknowledge any work used for the project. It will also include an appendices, which will document additional supporting material.

Annotated Bibliography

[1] "Parrot for developers," http://developer.parrot.com/, accessed February 2016.

A starting page for developers, allowing access to the SDK for the parrot drones.

[2] "User guides for ar.drone 2.0," http://ardrone2.parrot.com/support/, accessed February 2016.

The user guides for the AR.Drone 2.0, with safety guidelines in the quick start manual.

[3] J. Benson and T. D. Barry, "Personal kanban," http://www.personalkanban.com/, accessed February 2016.

This site provides an explanation and guide for "Personal Kanban", which is a kanban system for personal work flows.