Title: Identifying aircraft from above

Name: Kai Roper-Blackman

Registration Number: 1602999

Supervisor(s): Adrian Clarke, Sebastian Halder

Second assessor: Luca Citi

Degree Course: BSc Computer Science (G400)

Contents

[Acknowledgements 4](#_Toc5112198)

[Abstract 5](#_Toc5112199)

[List of Symbols 6](#_Toc5112200)

[Project Aims and Objectives 7](#_Toc5112201)

[Methods and Technical documentation 8](#_Toc5112202)

[Data collection 8](#_Toc5112203)

[Images 8](#_Toc5112204)

[Parsing 8](#_Toc5112205)

[Histogram of oriented gradients 8](#_Toc5112206)

[Feature vector 8](#_Toc5112207)

[Libraries 8](#_Toc5112208)

[Machine learning 9](#_Toc5112209)

[Support vector machines 9](#_Toc5112210)

[Cross validation 9](#_Toc5112211)

[Tuning 9](#_Toc5112212)

[Hyper parameters and decision boundaries 9](#_Toc5112213)

[Data set 9](#_Toc5112214)

[Kernel 9](#_Toc5112215)

[Project Planning 10](#_Toc5112216)

[Momentum 10](#_Toc5112217)

[Adapting to change 10](#_Toc5112218)

[Identifying and dealing with risks 10](#_Toc5112219)

[Achievement 10](#_Toc5112220)

[Performance 10](#_Toc5112221)

[What have I learnt? 10](#_Toc5112222)

[Conclusions 11](#_Toc5112223)

[Discussion 11](#_Toc5112224)

[References 12](#_Toc5112225)

[Tables, Graphs, Figures and Equations 13](#_Toc5112226)

[Appendices 13](#_Toc5112227)

[Sustainability 13](#_Toc5112228)

[Legal 13](#_Toc5112229)

[Ethical 13](#_Toc5112230)

[Intellectual property 13](#_Toc5112231)

# Acknowledgements

A special thanks to my parents Annie Roper and Seon Blackman for supporting me throughout University.

# Abstract

We all know what an aircraft looks like, but does a computer? A seemingly simple task that can be carried out by individuals at age two, poses a complex problem to modern technology. Machine learning is a relatively new field with little research but already boasts claim to many applications such as driverless cars and face recognition systems. The development of object recognition is the center of many companies’ business models and objectives, making aircraft identification such an interesting topic to research.

Existing images of ground and aircraft are pre-processed using Histogram of Gradients to create feature descriptors. Feature descriptors describe the orientation of a gradient within an image subsection. Support Vector Machines are passed feature descriptors with labels for training. Once training is completed, the support vector machine accepts a test set and returns predictions. Large image search takes a large image and looks within a smaller area for aircraft. Search area parameters are provided by the user.

The results obtained from cross validation show an accuracy of 100% when identifying standalone aircraft. However, when searching for aircraft in larger images, accuracy drastically decreases to around 55% as some aircraft are overlooked. After optimization, the system used to identify aircraft can be applied to other identification problems with possible military and commercial uses.

# List of Symbols

SVM – Support Vector Machine

PNG- portable network graphics

px – Pixels

# Project Aims and Objectives

The original aims of this project have changed since the initial report. This was because of a change of approach to the given problem. The main object is to allow a computer to differentiate between **aircraft** and **ground** images. Assuming the this was completed successfully, it can move on to identifying aircraft of various sizes and orientations in a larger image, such as an airport and show their positions to the user.

# Methods

## Libraries

During this project, I have used a wide variety of libraries to aid the completion of this task as writing code to support these functions would be impossible to complete in the tight timescale given.

The library used to write images from PNG format to Numpy array was OpenCV. OpenCV has tools for image manipulation and other image related functions. I also used opencv to rotat

## Data collection

## Images

## Parsing

### Histogram of oriented gradients

### Feature vector

## Machine learning

### Support vector machines

### Cross validation

### Tuning

### Hyper parameters and decision boundaries

### Data set

### Kernel

# Technical Achievement

## Results

# Project Planning

## Momentum

## Adapting to change

## Identifying and dealing with risks

## Achievement

## Performance

## What have I learnt?

# Conclusions

## Discussion

# References

# Tables, Graphs, Figures and Equations

# Appendices

## Sustainability

## Legal

## Ethical

## Intellectual property