MSc Project Report

**COMP0112 Research Project – Final Review**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Mobile Virtual Annotator**

William Herbosch

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

A report submitted in part fulfilment of the degree of

**MSc (Hons) in Computer Graphics,**

**Vision and Imaging**

**Supervisor: Prof Niloy J Mitra**



Department of Engineering / Computer Science

University College London

2018 - 2019

**Declaration / Disclaimer**

This report is submitted as part requirement for the MSc Degree in “Computer Graphics, Vision & Imaging”, at University College London.

It has been substantially prepared on the basis and results of my own work. Where other published and unpublished source materials have been used, these have been explicitly acknowledged and indicated as such in the text.

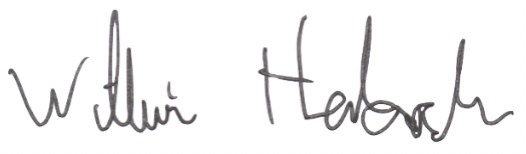
The report may be freely copied and distributed provided the source is explicitly acknowledged.

Word Count: --- (Max: 120 pages)

Student Name: William Herbosch

Date of Submission: Sept 1st 2019

Signature:



**Table of Contents**

Abstract………………………………………………………………………………

Project Specification…………………………………………………………………

Chapter 1: Introduction

* 1. The Problem
  2. ---
  3. ---
  4. ---
  5. ---
  6. Theory and Related Literature

Chapter 2: Background

* 1. ---
  2. ---
  3. ---

Chapter 3: Analysis and Design

* 1. ---
  2. ---
  3. ---

Chapter 4: Implementation

* 1. ---
  2. ---

Chapter 5: Testing

* 1. ---
  2. ---

Chapter 6: Results

* 1. ---
  2. ---

Chapter 7: Conclusions, Evaluations and Further Work

* 1. ---
  2. ---

Chapter 8: User Manual and Installation Help

* 1. ---
  2. ---

Project Timeline

Bibliography

Appendix

A.1 ---

A.2 ---

**Abstract**

This document serves as the Final Report for the Virtual Annotator project. Its purpose is to document and detail the many software engineering aspects and the developments of machine-learning based programs undertaken throughout the project lifespan. It does this by ---

combining individual reports describing specific neural network structures operating on different datasets and with different levels of complexity, processing them using various learning oriented libraries and third-party software and then testing whether they have sufficiently “learned” by examining their learning experience and evaluating their accuracy of prediction labelling once they are fully trained.

These --- can then be ---

These programs can then be further optimised by using their outputs as feedback to adjusting their input parameters.

The report also entails ---

The report also entails how the training process of these neural networks can be visualised in an attempt to display the technological benefits and possibilities of artificial neural networks as a whole.

Finally,

Finally, it details the development of a system that can take in handwritten digits, convert it to a suitable format and produce accurate labelling for those digits, once having trained on the MNist dataset.

A good abstract:

Annotation or note making within a digital space --- , from --- to ---.

(Presents a problem) A recurrent issue with

(Say how others achieved it but what is lacking)

This paper proposes…

What we found…

**Project Specification**

All work produced for this project can be found on the Project’s GitHub page:

[https://github.com/WHerbosch/UCL\_MsCGVI\_ResearchProject](https://github.com/WHerbosch/UCL_MsCGVI_ResearchProject/tree/master/Documents)

Chapter 1:

**Introduction**

This section’s objective is to introduce the reader to the problems presented by this project. It provides the goals that are to be achieved, the motivation behind taking on this project and lists all material initially surveyed.

**1.1 The Problem**

The primary goal of this project is to develop an annotation system that will allow the user to obtain information from and ‘make notes’ within a given image or, ideally, live video feed. This information ---

dimensionality and object classification.

The secondary goal would then be to expand upon this framework by allowing user to carry out relevant tasks within an AR environment by accommodating the system for smartphone devices, allow the system to work across multiple smartphones and potentially make it readily available on mobile app storefronts.

This is an independent project and is therefore not being produced as a requested deliverable for third-party developers; it is a project of pure academic interest and achievement.

Chapter 2:

**Background**

This section aims to provide an adequate understanding of relevant topics and current developments within the field. It is to inform the reader on current trends and any present-work done regarding said topics and to provide key foundations for how this project’s work was attempted to solve or further aid in the understanding of the problem at hand.

**2.1 -**

Before

Neural Networks

Network Initialization and Methodologies

Semantic Segmentation

Chapter 3:

**Analysis and Design**

--- gives a high-level overview of the project’s design process, including any change made throughout the project’s lifespan.

**-.- -**

While

Compare Initial Design to Final Design

Write about interesting differences, and why they were made (2-3)

If some parts weren’t implemented, mention what was implemented and what wasn’t

If the reason for not getting something implemented is interesting, write about that as well

Chapter 4:

**Implementation**

--- explains written code used for the programs and discuss important aspects of it.

**-.- -**

The

For code details (not complete scripts but highlight key parts, statements, loops or methods)

Discuss the most important aspects

Give a rational of what you discuss ???

Chapter 5:

**Testing**

… verify that the system works as envisioned.

**-.- ---**

The

Chapter 6:

**Results**

… details of the experiments used during testing, their preference over other experiments and the importance of internal parameters and their affects on results.

**-.- -**

While

Chapter 7:

**Conclusions, Evaluation & Future Work**

… show what was achieved and what could have been improved upon, plus self-critique.

**-.- ---**

*PROFESSIONAL ISSUES*

Consider the ethical and social implications that might influence the final product and provide suitable countermeasures.

Chapter 8:

**User Manual and Installation Help**

The purpose of this section is to provide assistance for the installation and usage of programs made during this project. This was made with the intent to aid any reader who is interested in attempting these to work for themselves, or to help out in their own projects. It mentions the installation process, lists the software to be downloaded from the Internet, where to find it, and how to properly use it once set up properly.

**-.- -**

**Project Timeline**

This section of the Final Report represents a workbook log of all the activities that were carried out during the project’s development cycle. Not only does it entail whether time was managed wisely and effectively for the work carried out over the course of two terms, but it also represents a form of self-evaluation and reflection on actions taken, whilst detailing the struggles that were encountered as the proof-of-concept programs were developed.

**Bibliography**

*[1] A. von Kapri, Annotating 2D Objects in Augmented Reality, Columbia University of New York, 2007, video showing AR 2D circles fixing their positions on edges of a leaf.*

*[2] EON Reality, AR 3D Annotation, EON Reality, 2017, video showing models in AR and how they can be applied for training/educational purposes.*

*[3] S. White, L. Lister and S. Feiner, Visual Hints for Tangible Gestures in Augmented Reality, Columbia University, 2017, paper investigating gesture-based communication between the user and AR system, their meanings within the system and which are most optimal.*

*[4] A. Gee, P. Escamilla-Ambrosio, M. Webb, W. Maylo-Cuevas and A. Calway, Augmented Crime Scenes: Virtual Annotation of Physical Environments for Forensic Investigation, University of Bristol, 2010, conference proceedings that describes a system for annotating objects within a crime-scene environment through AR to aid forensics in collecting potential evidence.*

*[5] L. Gul, Studying gesture-based interaction on a mobile augmented reality application for co-design activity, Springer International Publishing, 2018, documentation for a series of user-studies for understanding behaviour while using mobile AR applications as a means for how to better design such systems and their interfaces.*

*[6] J. Glover, Unity 2018 augmented reality projects, Packt Publishing, 2018, book on how to model and integrate creations in Unity for develop AR applications for ARKit.*

*[7] S. Shekar and S. Haney, Swift Game Development, Packt Publishing, 2018, book for understanding AR game development by learning IOS 12’s Swift coding language for ARKit.*

*[8] J. Linowes and K. Babilinski, Augmented Reality for Developers, Packt Publishing, 2017, book for building AR applications through Unity and ARKit.*

*[9] J. Mern, K. Julian, R. Tompa and M. Kochenderfer, Visual Depth Mapping from Monocular Images using Recurrent Convolutional Neural Networks, Stanford University, 2018, article that presents methods to estimate object distances for flight-based systems by producing depth maps using deep neural nets.*

*[10] W. Hurst and C. van Wezel, Gesture-based interaction via finger tracking for mobile augmented reality, Springerlink, 2012, article that investigates finger tracking for gesture-based AR for mobile device touch screens.*

*[11] J. Shim, Y. Yang, N. Kang, J. Seo and T. Han, Gesture-based interactive augmented reality content authoring system using HMD, Springer-Verlag London, 2016, article on the proposition of a gesture-based AR system applied to virtual objects intended to introduce AR creation and usage on a simplified level.*

*[12] L. Ng, S. Oon, S Ong, A. Nee, GARDE: a gesture-based augmented reality design evaluation system, International Journal on Interactive Design and Manufacturing, 2011, article that displays the benefits of both physical and virtual prototyping in design evaluation using AR.*

*[13] IKEA, Place, Ikea, 2017, smartphone app used for visualising true-scale Ikea products within a real environment.*

*[14] W. Sherman and A. Craig, Understanding Virtual Reality: Interface, Application, and Design, Morgan Kaufmann Publishers, 2002, book on VR where one section highlights the fundamentals of AR annotation systems and provides some real-life examples such as the Daqri Smart Helmet.*

*[15] Y. Chang, B. Nuernberger, B. Luan, T. Hollerer and J. O’Donovan, Gesture-Based Augmented Reality Annotation IEEE VR 2017 Demo, University of California, 2017, series of videos that demos some features of a developed annotation system that allows for ‘air-drawing’.*

*[16] JetBrains, PyCharm, JetBrains, 2010, a Python IDE*

*[17] Spyder Project Contributors, Spyder, AnacondaInc, 2009, a Python IDE*

*[18] N. Silberman, P. Kohli, D. Hoiem and R. Fergus, NYU Depth Dataset, New York University, 2012, dataset of distance images that will be used to train the networks for this project.*

*[19] Apple, ARkit, Apple Inc, 2017, application for using AR systems on IOS devices.*

*[20] P. Hyett, Github, Microsoft, 2008, web-based source-code management system.*

*[21] G. van Rossum, Python, Python Software Foundation, 1990, an interpreted, high-level, general purpose programming language.*

*[22] W. McKinney, Python for Data Analysis, O’Reilly Media, 2012, book on Python syntax*

*[23] H. Percival, Test-Driven Development with Python, O’Reilly Media Inc, 2014, book on Python syntax*

*[24] Cambridge, Cambridge Advanced Learner’s Dictionary, Cambridge University, 1995, proper definition of the term ‘annotator’*

*[25] J. Grayson, Python and TKinter programming, Manning Publications, 2000, book on Python GUIs*

*[26] Alias Systems Corp, Maya, AutodeskInc, 1998, 3D computer graphics application*

*[27]*

*[28]*

*[29]*

*[30]*

*[31]*

*[32]*

*[33]*

*[34]*

*All UML Diagrams were developed using UMLet:* [*http://www.umlet.com*](http://www.umlet.com)

*All graphs (i.e. scatterplots, etc) were generated from corresponding data-tables fed into Excel.*

*All remaining figures in this document were either scanned (and credited) from their original source material or designed/created using a combination of Keynote, Preview and Adobe PhotoShop.*

**Appendix**