

PROJECT DEFINITION DOCUMENT

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BSC COMPUTER SCIENCE | CITY UNIVERSITY LONDON

IN3007 – INDIVIDUAL PROJECT

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1.PROJECT COVER

Title of Degree	BSc Computer Science
Project Title	Traffic-Sign Detection & Recognition System (TSDR)
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Project Description	The purpose of this project is to successfully implement a TSDR system that utilizes convolutional neural network and machine learning algorithms to help identify each traffic sign to then recognize what each sign means, any potential variations of a sign that is fed into the system can then be automatically classified accordingly. Upon completion embedded systems within the automotive industry e.g. self-driving cars or similarly 'driver alert' systems inside cars need to understand the roadway environment around them to help aid and protect drivers.
Proprietary Interests	All code and design produced for this project remains the intellectual property of the project owner: Saffan Ahmed. The owner will retain the right to have full ownership of both the codebase and the compiled application.
Promises Made	No further promises have been made.
Signature	_____
Date of Signature	_____
Word Count	1419 Words

2.PROJECT PROPOSAL

2.1 PROBLEM TO BE SOLVED

Traffic sign detection recognition systems (TSDR) have been introduced to overcome road-safety concerns. These systems are widely adopted by automotive industry whereby safety critical systems are developed for car manufacturers and recently now being embedded into self-driving cars ¹. As demand rises, safety regulation would also increase, which encourages the TSDR system to be improved in terms of accuracy and eventually made intuitive. The system itself can detect and recognise traffic signs from static images from a camera to dynamic video feeds from image sensors ². In adverse traffic conditions, the driver may not notice traffic signs, which may cause accidents. In such scenarios, the TSDR system comes into action. The main objective of the research on TSDR is to improve the robustness and efficiency of the TSDR system. To develop an automatic TSDR system is a tedious job given the continuous changes in the environment and lighting conditions. Among the other issues that also need to be addressed are partial obscuring, multiple traffic signs appearing at a single time, and blurring and fading of traffic signs, which can also create problem for the detection purpose ³. For applying the TSDR system in real-time environment, a fast algorithm is needed. As well as dealing with these issues, a recognition system should also avoid erroneous recognition of no signs.

This research aims to develop an efficient TSDR system for Automotive Engineers professionals within the transportation industry. TSDR system would detect and classify a collection of 43 individual traffic-signs taken from real-time environment into different classes for recognition.

(1) ***Tesla Traffic Light & Stop Sign Control Manual Updated.***

Available at: <<https://cleantechnica.com/2020/06/24/tesla-traffic-light-stop-sign-control-manual-updated/>>

(2) ***Charles III University of Madrid, Getafe, Spain, 2009.***

Available at: <<https://core.ac.uk/download/pdf/30041513.pdf>>

(3) ***Vision-Based Traffic Sign Detection and Recognition Systems: Current Challenges.***

Available at: <https://www.researchgate.net/publication/332996426_Vision-Based_Traffic_Sign_Detection_and_Recognition_Systems_Current_Trends_and_Challenges>

2.2 PROJECT OBJECTIVES

Primary Objectives

1	Create a model that is able to distinguish between 43 traffic sign classes using only their images with an accuracy score of over 95%.
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Sub-Objectives

Due to the large selection of traffic sign types and their very similar features, to ensure the success of the project a large amount of data must be acquired.

1	Collect at least sufficient training data (minimum of 40 images) that replicates variation of the same image for each individual class of images of the dataset.
2	Pre-process the existing image sets of (43 traffic sign classes) to improve image quality that would ensure better accuracy for image detection. This would involve improving the contrast of each traffic sign as well as the resolution. Also ensure each traffic sign accounts for skewed classes.
3	Train the processed data using convolutional neural network model taking into account varying activation functions and layers sizes and record the accuracy of using different metrics.
4	Create a function that outputs all results from training (accuracy metrics).
5	Implement a script that loads the training model of traffic signs that will help then classify new input images.
6	Continually increment the images to be processed and test the selected models on it. Compare models accuracy results and tweak whereby necessary.

Optional-Objectives

1	Training a faster R-CNN model from scratch to localize and recognize 47 types of traffic signs to the existing 43 types.
2	Annotate and prepare each set of traffic sign images for object detection. Object detection enables you to not only recognize the traffic sign but also localize where the input frame of the traffic sign is.
3	Classify different traffic-signs using support-vector machine classifier which in turn would enable you to compare the accuracy of results from different classifiers.

2.2 PROJECT BENEFICIARIES

Automotive engineers of large-scale firms who specialize in the developing technology closely related to self-driving cars or similarly driver alert systems inside cars will benefit from having a software built specifically for them. This project will enable engineers to significantly improve their image recognition of traffic-signs / road signs for existing systems thus enhancing the safety protocols for road-awareness and overall, the quality of their safety critical systems. However as mentioned above, this project will only construct a small piece of the desired system, which is being able to classify individual traffic sign image from a variation of each images (also skewed).

This project will aim to reinforce other researchers to further improve classifications different variations of traffic signs.

3.WORK PLAN

Phase 1 - Initial Research & Planning

- **Initial Research**
 - Research existing technology for image recognition and traffic-road sign regulations.
 - Read up on existing research papers relating to traffic / road sign recognition.
 - **Professional Development Documentation (PDD)**
 - Create a project report highlighting the research topic, problem to be solved, beneficiaries and potential risks associated with undertaking project.
 - **Programming Research**
 - Refresh knowledge of Python Programming fundamentals.
 - Learn to use Machine Learning tools of Python: Keras, OpenCV, CNN, NumPy, TensorFlow & Matplotlib.
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Phase 2 – Data Acquisition & Pre-Processing

- **Acquire Dataset**
 - Research and acquire a dataset that will be used for the training model. Once data is found, download the dataset creating local copies.
 - **Pre-Processing Dataset**
 - Pre-process dataset to improve image quality: improving resolution and contrast of each input image. This ensures high accuracy of results.
 - Pre-process would involve 43 classes of each image with total images equaling collection of 50,000 images used for training.
 - Each image should have variations of itself being skewed.
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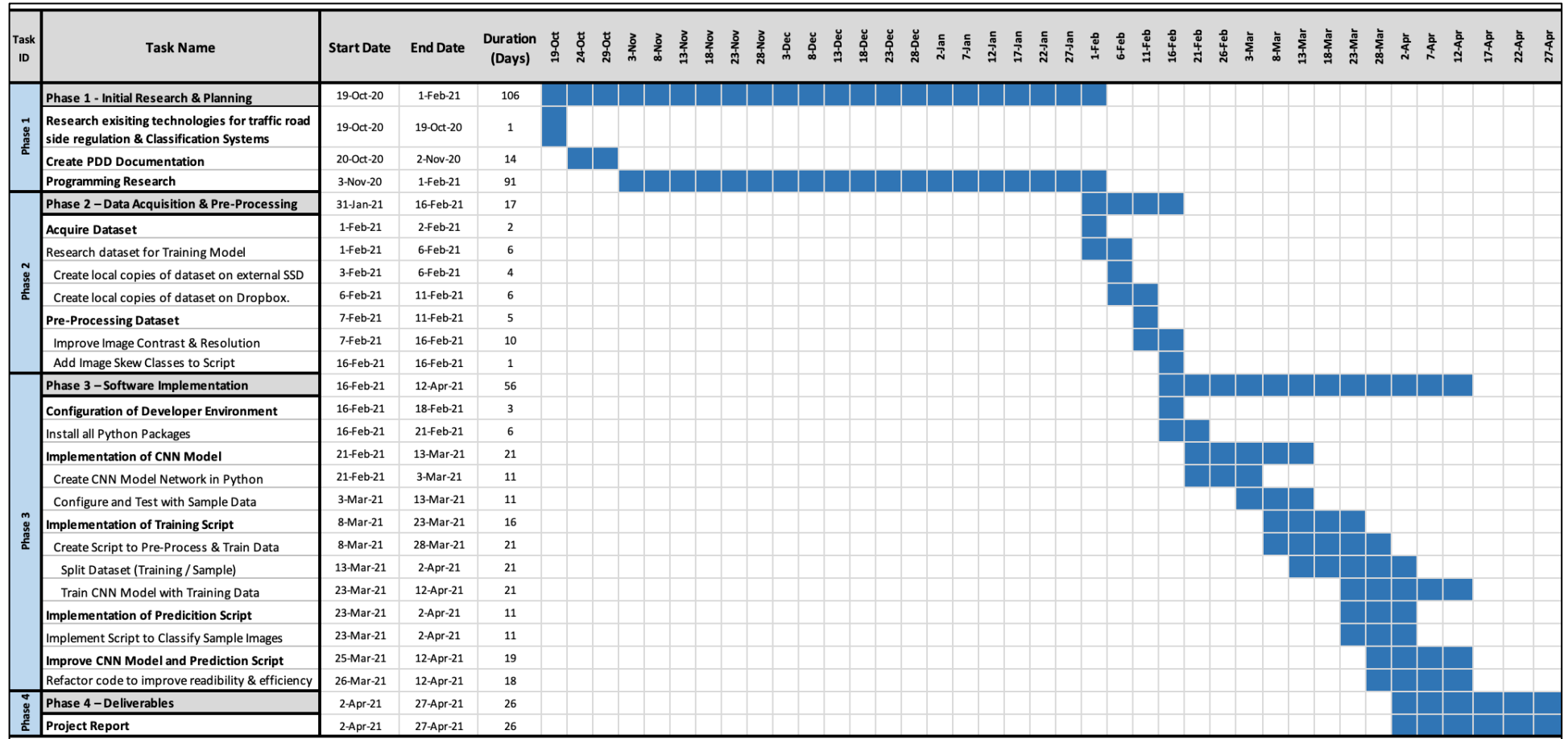
Phase 3 – Software Implementation

- **Configuration of Developer Environment**
 - Install all the necessary packages for Python using virtual environment.
 - **Implementation of CNN Model**
 - Implement CNN model using Keras Deep Learning framework.
 - **Implementation of Training Script**
 - Implement training script that will be used to split dataset, pre-process images and train CNN model.
 - **Training CNN Model using Traffic-Sign Dataset**
 - Load the dataset into CNN model to measure accuracy results.
 - **Implementing Predication Script**
 - Implement prediction script that will classify sample images through traffic-sign classifier.
 - **Make Predictions on Traffic-Sign Dataset**
 - Load pre-trained model of dataset through classifier.
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Phase 4 – Project Report

- **Project Report**
 - Create a formal report documenting project development also include references where needed.

3.1 GANTT CHART



4.PROJECT RISKS

There are few risks to this project, as the topic of traffic-signs classification has been a popular topic and so there are many resources to learn from (Medium, 2020).

Task	Risk Level	Risk	Mitigation
Coursework	Medium	Undertaking coursework for other modules can often conflict with time schedule for project development including the implementation phase.	Create a timetable for upcoming deadlines and allocate slack on timetable, just to prepare for unforeseen circumstances.
Data Loss	Medium	In the pre-processing of the data, it can result to data becoming corrupt or distorted, so it is important to create local copies of data.	Create a local copy of data for cloud storage (Dropbox) as well as physical external drive.
Learning to use Python Packages including TensorFlow & OpenCV	Medium	Learning to use certain packages for this project such as the fundamentals of TensorFlow, OpenCV for the first time would require time to practice and test to become familiar and in turn adapt for my project.	Revise online guides and tutorials to understanding the concepts and fundamentals of TensorFlow and OpenCV. Utilising Udemy, YouTube and Stack Overflow forums.
Report Writing	High	Insufficient time-management will impact the quality of report analysis.	Time-management is essential throughout all phases of the project, I will need to set extra time for myself to continue writing a report whilst undergoing coursework from other modules.

5. RESEARCH & ETHICS CHECKLIST

Computer Science Research Ethics Committee (CSREC)

<http://www.city.ac.uk/departments-computer-science/research-ethics>

5.1 PART A – ETHICS CHECKLIST

A.1 If you answer YES to any of the questions in this block, you must apply to an appropriate external ethics committee for approval and log this approval as an External Application through Research Ethics Online - https://ethics.city.ac.uk/		<i>Delete as appropriate</i>
1.1	Does your research require approval from the National Research Ethics Service (NRES)? <i>e.g. because you are recruiting current NHS patients or staff?</i> <i>If you are unsure try - https://www.hra.nhs.uk/approvals-amendments/what-approvals-do-i-need/</i>	NO
1.2	Will you recruit participants who fall under the auspices of the Mental Capacity Act? <i>Such research needs to be approved by an external ethics committee such as NRES or the Social Care Research Ethics Committee - http://www.scie.org.uk/research/ethics-committee/</i>	NO
1.3	Will you recruit any participants who are currently under the auspices of the Criminal Justice System, for example, but not limited to, people on remand, prisoners and those on probation? <i>Such research needs to be authorised by the ethics approval system of the National Offender Management Service.</i>	NO
A.2 If you answer YES to any of the questions in this block, then unless you are applying to an external ethics committee, you must apply for approval from the Senate Research Ethics Committee (SREC) through Research Ethics Online - https://ethics.city.ac.uk/		<i>Delete as appropriate</i>
2.1	Does your research involve participants who are unable to give informed consent? <i>For example, but not limited to, people who may have a degree of learning disability or mental health problem, that means they are unable to make an informed decision on their own behalf.</i>	NO
2.2	Is there a risk that your research might lead to disclosures from participants concerning their involvement in illegal activities?	NO
2.3	Is there a risk that obscene and or illegal material may need to be accessed for your research study (including online content and other material)?	NO
2.4	Does your project involve participants disclosing information about special category or sensitive subjects? <i>For example, but not limited to: racial or ethnic origin; political opinions; religious beliefs; trade union membership; physical or mental health; sexual life; criminal offences and proceedings</i>	NO

2.5	Does your research involve you travelling to another country outside of the UK, where the Foreign & Commonwealth Office has issued a travel warning that affects the area in which you will study? <i>Please check the latest guidance from the FCO - http://www.fco.gov.uk/en/</i>	NO
2.6	Does your research involve invasive or intrusive procedures? <i>These may include, but are not limited to, electrical stimulation, heat, cold or bruising.</i>	NO
2.7	Does your research involve animals?	NO
2.8	Does your research involve the administration of drugs, placebos or other substances to study participants?	NO
A.3 If you answer YES to any of the questions in this block, then unless you are applying to an external ethics committee or the SREC, you must apply for approval from the Computer Science Research Ethics Committee (CSREC) through Research Ethics Online - https://ethics.city.ac.uk/ Depending on the level of risk associated with your application, it may be referred to the Senate Research Ethics Committee.		<i>Delete as appropriate</i>
3.1	Does your research involve participants who are under the age of 18?	NO
3.2	Does your research involve adults who are vulnerable because of their social, psychological or medical circumstances (vulnerable adults)? <i>This includes adults with cognitive and / or learning disabilities, adults with physical disabilities and older people.</i>	NO
3.3	Are participants recruited because they are staff or students of City, University of London? <i>For example, students studying on a particular course or module.</i> <i>If yes, then approval is also required from the Head of Department or Programme Director.</i>	NO
3.4	Does your research involve intentional deception of participants?	NO
3.5	Does your research involve participants taking part without their informed consent?	NO
3.5	Is the risk posed to participants greater than that in normal working life?	NO
3.7	Is the risk posed to you, the researcher(s), greater than that in normal working life?	NO
A.4 If you answer YES to the following question and your answers to all other questions in sections A1, A2 and A3 are NO, then your project is deemed to be of MINIMAL RISK. If this is the case, then you can apply for approval through your supervisor under PROPORTIONATE REVIEW. You do so by completing PART B of this form. If you have answered NO to all questions on this form, then your project does not require ethical approval. You should submit and retain this form as evidence of this.		<i>Delete as appropriate</i>
4	Does your project involve human participants or their identifiable personal data? <i>For example, as interviewees, respondents to a survey or participants in testing.</i>	NO

