

UNDERGRADUATE PROJECT PROPOSAL

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| **Project Title:** | **A Convolutional Neural Network Approach for the Recognition of Traffic Signs** |
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# **Introduction**

## **Background**

Traffic sign recognition is becoming more and more promising since the recent interested development of unman driving cars. Moreover, human error made in traffic sign misidentification has always been a risk when driving. There have been cases of death associated with misidentification of traffic signs in China over the year. However, traffic sign recognition is of great help since it is able to remind drivers of the signs, and automobile as well. The motivation for the development of traffic sign recognition system is to save lives and mitigate traffic accident as well as to improve accuracy of traffic sign recognition system. The rest of the paper is organized as follows. Section 1.2 covers the aim of this project and section 1.3 discusses the objectives of this study. Section 1.4 explains the significance and targeted audience of this project. Important and relevant literature related to this project is discussed in section 2. Section 3 details the approach, technology and the management plan of this project while the project management activities, project schedule and deliverables are presented in section 4.

## **Aim**

The aim of this project is to develop a traffic sign recognition system based on a lightweight convolutional neural network model.

## **Objectives**

The objectives are as follows.

1: Finish a background review of the existing CNN technology.

2: Design the CNN architecture.

3: Train and test the CNN architecture with a public dataset named Chinese traffic sign using appropriate technology.

4: Evaluate the model with test data and accuracy.

5: Explain the work to related audience.

## **Project Overview**

### **Scope**

The project seeks to develop a lightweight convolutional neural network (CNN) capable of identifying and classifying traffic signs which would greatly benefit road traffic management. Developing a computer vision system for traffic sign recognition with high precision is paramount.

### **Audience**

The project would bring a large benefit to government agency, automobile manufacturers, driving school owners and trainees within the domain who can utilize this computer vision technology to recognize traffic with high accuracy.

# **Background Review**

## **Brief summary of related literature**

One of common problems of CNN model is to find a balance between accuracy and the network depth since large network with small data would lead to model overfitting. It is an obvious fact that one single layer is not enough for achieving satisfactory accuracy. Haque et al. (2021) describe a light-weight CNN model for traffic sign recognition. The architecture consists of four convolutional layers, two overlapping max-pooling layers and then followed by one fully-connected layer. The authors implemented overlapping max pooling and sparsely used stride convolution to made training faster in order to reduce overfitting issue. The benefit of a light-weight structure is to lower computational cost with a considerable depth of four convolutional layers. The proposal model achieved 98.97% accuracy as the authors claimed.

Vennelakanti et al. (2019) propose a CNN Ensemble to identify traffic signs. The authors use a feed-forward network with six convolutional layers, 3 max pooling layers and 2 fully connected layers. The suggested ensemble model of three convolutional neural networks aggregates the output which is a great technique of improving the accuracy. The authors implemented fully connected hidden layers with dropout between the layers to avoid overfitting problem. The authors claimed that their proposed model achieved 98.11% accuracy for triangular traffic signs and 99.18% accuracy for the circular traffic signs. Shustanov and Yakimov (2017) suggest three CNN layers of one full-connected layer model with soft max as a classifier. The authors claimed that their model achieved 99.94% accuracy.

Moreover, Sun et al. (2019) propose a light-weight CNN classifier which consists of two convolutional layers, two pooling layers with two full connected layers and achieved test accuracy of 98.2%. The authors implemented ReLU activation function in each layer of the CNN in order to learn complex features as well as adding dropout to prevent overfitting. Alghmgham et al. (2019) suggest a CNN network with two convolutional layers, two max pooling layers with one dropout layer and 3 dense layers. The proposed model uses a large number of layers with the technique of utilizing two pooling layers to prevent overfitting problem by decreasing the dimension of feature maps. However, the novelty of their work is the utilization of leaky ReLU to overcome the problem of dead neurons which is common when normal ReLU is used. Basically, leaky ReLU does not output zero when the input values are less than zero, instead it outputs negative value. The authors claimed that their model achieved 100% accuracy. Table 1 shows the brief information of the models proposed by different authors.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Model | Convolutional layer | Pooling layers | Fully-connected layers | Soft max | accuracy |
| Haque et al. (2021) | 4 | 2 | 1 | √ | 98.97% |
| Vennelakanti et al. (2019) | 6 | 3 | 2 | √ | 98.11% for triangle, 99.18% for circle |
| Shustanov and Yakimov (2017) | 3 | 0 | 1 | √ | 99.94% |
| Sun, Ge and Liu (2019) | 2 | 2 | 2 | √ | 98.2% |
| Alghmgham et al. (2019) | 2 | 2 | 0 | √ | 100% |

Table 1. Brief information of the models

# **Methodology**

## **Approach**

This project will developed using the standard deep leaning workflow. The first stage would begin with defining the problems and the second stage will involve the search for appropriate dataset and data pre-process. More so, the third step is to design the CNN architecture for training and testing the dataset. The parameters adjustment and model optimization would be done during the training process. Evaluation of the model would be completed with test data and accuracy measurement in the fourth step. The last step is to showcase the efficacy of the model to a mixed audience.

## **Technology**

The project will be developed and implemented with the help of Google’s open-source machine learning framework, TensorFlow.

## **Version management plan**

GitHub will be used to store the progress of the program.

# **Project Management**

## **Activities**

Ob1 Finish a background review of the existing CNN technology.

A1.1 Conduct a systematic research of current CNN models.

A1.2 Complete a feature competitive analysis.

A1.3 Complete a literature review.

A1.4 Conduct the requirement gathering.

Ob2 Design the CNN architecture.

A2.1 Draw a scratch of the traffic sign recognition model including details the CNN architecture.

A2.2 Study the dataset and summary features.

A2.3 Complete GUI of the proposed product.

Ob3: Train and test the CNN architecture with a public dataset named Chinese Traffic Sign using appropriate technology.

A3.1 Pre-process the images from dataset.

A3.2 Realize the CNN architecture with code according to the scratch.

A3.3 Train the CNN model with dataset.

A3.4 Test the CNN model with dataset.

Ob4: Evaluate the model with test data and accuracy..

A4.1 Obtain the accuracy of the proposed model.

A4.2 Reflect the model.

Ob5: Explain the work to related audience.

A5.1 Complete the report.

A5.2 Conduct the presentation.

## **Schedule**

The following figure shows the schedule of activities.



Figure 1. Gantt chart

## **Data management plan**

All the related documentation would be upload to this link <https://github.com/Haleywuyile/Traffic-Sign-Recognition> on GitHub.

## Deliverables

The following are the deliverables:

1. Weekly meeting logs includes;
2. Progress report
3. Next steps and supervisor comments
4. Requirements gathering
5. Deep learning workflow model
6. Testing documentation
7. Reports includes;
8. Proposal
9. Interim report
10. Final report
11. Ethics forms
12. Useful links of literature.
13. Source code

# **References**

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