Project Phase III Report

On

Flex Lens

Submitted for the requirement of

Project course

BACHELOR OF TECHNOLOGY

ELECTRONICS & BIOMEDICAL ENGINEERING

Submitted to:
Supervisor's Name:

Submitted By:

NAME: **ROLL NO:**
Rohan Ghosh **3180700554102**

Co Supervisor Signature

ELECTRONICS AND BIOMEDICAL ENGINEERING
GURU JAMBHESWAR UNIVERSITY OF SCIENCE AND TECHNOLOGY, HISAR, INDIA
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NAME: ROHAN GHOSH
ROLL NO: 3180700554102

ABSTRACT

Object detection is one of the most basic and central tasks in computer vision. Its task is to find all the interested objects in the image, and determine the category and location of the objects. Object detection is widely used and has strong practical value and research prospects. Applications include face detection, pedestrian detection and vehicle detection. In recent years, with the development of convolutional neural network, significant breakthroughs have been made in object detection. This paper describes in detail the classification of object detection algorithms based on deep learning. The algorithms are mainly divided into one-stage object detection algorithm and two-stage object algorithm, and the general data sets and performance indicators of object indicators.

Handwritten character recognition (HCR) is the detection of characters from images, documents and other sources and changes them in machine-readable shape for further processing. The accurate recognition of intricate-shaped compound handwritten characters is still a great challenge. Recent advances in convolutional neural network (CNN) have made great progress in HCR by learning discriminatory characteristics from large amounts of raw data. In this paper, CNN is implemented to recognize the characters from a test dataset. The main focus of this work is to investigate CNN capability to recognize the characters from the image dataset and the accuracy of recognition with training and testing. CNN recognizes the characters by considering the forms and contrasting the features that differentiate among characters. Our CNN implementation is experimented with the dataset NIST to obtain the accuracy of handwritten characters.

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1. Features/Characteristics identification

a. Objective

- The main purpose of object detection is to identify and locate one or more effective targets from still image or video data. It comprehensively includes a variety of important techniques, such as image processing, pattern recognition, artificial intelligence and machine learning.
- It has broad application prospects in such areas such as road traffic accident prevention, warnings of dangerous goods in factories, military restricted area monitoring and advanced human–computer interaction.
- Since the application scenarios of multi-target detection in the real world are usually complex and variable, balancing the relationship between accuracy and computing costs is a difficult task

b. Single Entity

- Execution of the undertaking with a little group is a quite extreme errand, yet we figured out how to keep the work underway by partitioning the venture in modules and teaming up and guaranteeing the task is finished as a Single Entity **c. Lifespan**
- The project is divided into two parts i.e., "Object detection system" as the 1st part and "Handwriting recognition system" as the 2nd part. Hence, time period of 1 month id required for completion of the process

d. Require Funds

- The project is a combined product of hardware and programmed interface. The cost depends on the number of cameras and the miscellaneous circuitry.
  Thus, the setup cost of 1 camera set is 10,000/- INR.

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e. Life Cycle

- The undertaking lifecycle began with formulating out the thought for the task.
- After effectively concluding the task, our group began to design out how the beginning stage will be executed.
- The significant terms in regards to the task were characterized and we began with the plan interaction.
- Subsequent to finishing the planning of the undertaking, the task was worked in around multi month time, being tried for any issues and afterward it will be sent as the last advance of the improvement lifecycle.

f. Team Spirit

- All through the improvement interaction, our group crossed numerous snags to accomplish the ideal outcomes. At times it took us days to determine a single bug which was very baffling as the advancement ended. In any case, keeping our expectations high and keeping us loaded up with enthusiasm and inspiration, we continued pushing ahead beating every one of the obstructions and effectively finished the undertaking

g. Risk and Uncertainty

- Project advancement represents a ton of hazard and vulnerabilities which should be dealt with during the improvement interaction. Some of them include:
    - Virtual environment crash while setting it up using Jupyter notebook in Anaconda Navigator. o Image and video lagging during testing period leading lead to creation of new start from the scratch to detect bugs.
    - Hardware and software incompatibility due to version differences.
    - Financial losses due to purchase of different sets of cameras for software compatibility and efficient functioning tests.
- Keeping a note of this large number of dangers, we worked interminably to adapt to this multitude of vulnerabilities and thought of an answer which limits the above angles.

h. Directions

- In the wake of fostering the model of the setup, we took client input about what the machine needs and where it required a few alterations.
- In view of the inputs got, we worked in the headings given by them to construct a machine that welcomes clients.

i. Uniqueness

- The algorithm used in our machine setup and the component compatibility gives our machine an edge and defines its uniqueness and further workforce for a better, smarter and efficient machine setup will lead us to patent acquisition with ease.
- Our team has trained the AI with numerous test subjects leading to 4-digit testing series.
- With upgradation in the interface and alteration won't lead compromise in its functionality, because we have assigned two members of our team for its testing.

j. Flexibility

- The task has been planned so that it is generally open to changes as expected by the client. The task is adaptable as far as utilization and changes can be made progressively whenever required

k. Sub-contracting

- Our group has complete information about each progression of the undertaking improvement cycle and needed exceptionally less external support. However, we took help from our Co-supervisor who directed us to make this venture a triumph.

l. Cost

- As referenced about the expense expected for the undertaking of 1 camera setup, regardless of whether the venture goes through certain changes, the cost won't be affected a lot.
- Need of number of camera setup is based on the field of usage,

2. Constraints Identification

a. Time

- During the arranging period of the advancement lifecycle, we zeroed in on how long we would expect for project completion.
- This guaranteed that we worked inside the time constraints.

b. Cost

- While sorting out the funds expected to effectively complete the venture, we put forth a most extreme line we can spend for the undertaking and guaranteed that regardless of whether additional assets are required, the cost constraints won't be impacted.

c. Scope

- As currently referenced in the venture plan, our undertaking is fairly interesting and many haven't planned anything like this. Therefore, the scope constraints preclude from the conversation as we did a very great job by the decision of the venture

d. Quality

- Our group has made an honest effort to hold the nature of the venture within proper limits. Rest, the client input will permit us to make alterations as required monitoring the quality constraints

e. Benefits

- Being one of a kind in its own particular manner, it has a ton of advantages. The advantages of the application don't appear to stop just like a stage which is

connected with endlessly learning is a continuous cycle in any individual's life

f. Risk

- As currently talked about, the improvement of an undertaking offers a great deal of dangers that might be of some value, however holding them within proper limits is what we truly need to focus on
- The improvement has been done so that it has not surpassed the gamble resilience and gives an effective as well as easy to use insight

3. Analysis of features and finalization subject to constraints

The project required a great deal of reasoning on how and what highlights ought to be carried out. Keeping every one of the essential important prerequisites a venture ought to have as well as drawing out a few less executed ideas, we have summed up certain highlights the application contains as follows:

• **CNN**

The convolutional neural network, or CNN for brief, could also be a specialized kind of neural network model designed for working with two-dimensional image data, although they're going to be used with one-dimensional and three-dimensional data.

Central the convolutional neural network is the convolutional layer that gives the network its name. This layer performs an operation known as “convolution”.

In the context of a convolutional neural network, a convolution may be a linear operation that involves the multiplication of a group of weights with the input, very similar to a standard neural network. as long as the technique was designed for two-dimensional input, the multiplication is performed between an array of input file and a two-dimensional array of weights, called a filter or a kernel.

The filter is smaller than the input file and therefore the before the sort of multiplication applied between a filter-sized patch of the input and the filter may be a scalar product. A scalar product is that the element-wise multiplication between the filter-sized patch of the input and filter, which is then summed, always leading to one value. Because it leads to 1

value, the operation is conventionally represented and mentioned because the “scalar product”.

Using a filter smaller than the input is intentional because it allows an equivalent filter (set of weights) to be multiplied by the input array multiple times at distinct points on the input. Specifically, the filter is applied systematically to every overlapping part or filter-sized patch of the input file, left to right, top to bottom

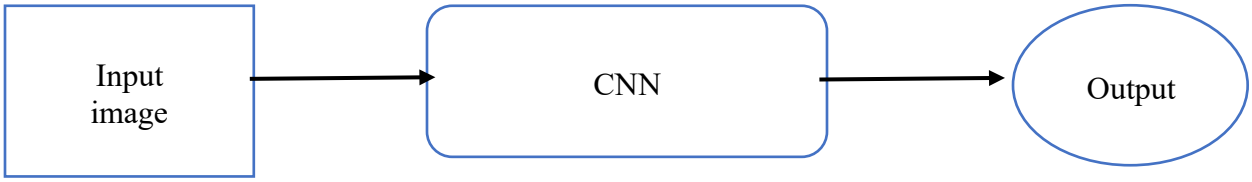

Fig: Sample block diagram indicating the flow of image processing using CNN

This systematic application of an equivalent filter across a picture may be a powerful idea. If the filter is meant to detect a selected sort of feature within the input, then the appliance of that filter systematically across the whole input image allows the filter a chance to get that feature anywhere within the image. This capability is usually represented and mentioned as translation invariance, e.g., the total altogether concerns in whether the feature is present instead of where it should had been present.

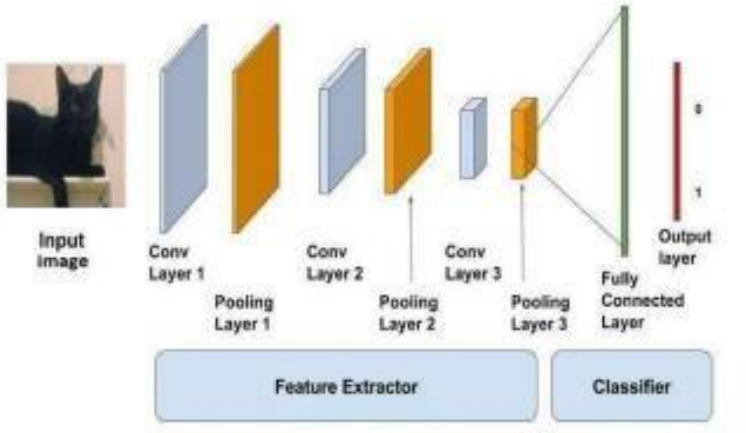

Fig: Image classification using CNN

- **OpenCV**

  Open CV stands for open-source computer vision. it's a group of libraries in Python. it's a tool by which we will be able to manipulate the pictures, like image scaling, etc. This supports and helps us in developing real time computing applications. It mainly concentrates and targets on image processing, video capture and analysis. It includes several features like face detection and also object detection. Currently OpenCV supports differing types of programming languages like C++, Python, Java etc., and it's available on various platforms including Windows, Linux, OS X, Android etc.

- **Training the data set:**

  The data set is typically the gathering of knowledge. the info set could also be collection of images or alphabets or numbers or documents and files too. the info set we used for the thing detection is that the collection of images of all the objects that are to be identified. Several different images of every and each object is typically present within the data set. If there are a greater number of images like each object within the datasets then the accuracy is often improved. The important thing that's to be remembered is that the info within the data set must be labelled. there'll be actually 3 data set. they're the training data set, the validation dataset and therefore the other one is testing data set. The training data set will usually contain around 85-90% of the entire labelled data. This training dataset are going to be training our machine and therefore the model is obtained by training the info set. The validation data set consists of around 5-10% of the entire labelled data. this is often used

for the validation purpose. the opposite data set is that the testing dataset and it's want to test the performance of our machine.

- **Developing a real time object detector:**

  For developing a true time object detector using deep learning and open cv we'd like to access our web cam during a really effective way then the thing detection is to be applied to each and every frame. we should always install open cv in our systems.

  The deep neural network module should be installed.

  Firstly, we should always import all the specified packages:

  i. From imutils.video we'll import VideoStream
  ii. From imutils.video we'll import FPS
  iii. we'll import numpy as np
  iv. we'll import argparse
  v. we'll import imutils
  vi. we'll import time
  vii. we'll import cv2

The next step is to construct the argument parse then we should always parse the arguments.

--prototxt: provide path to the Caffe prototxt file.
--model: provide path to the pre-trained model.
--confidence: The minimum probability threshold to filter weak detections. The default value is given as 20%.

The next step is to initialize CLASS labels and corresponding random COLORS.

Each object when it's detected, it's surrounded by a box with some predefined color. Thus, we assign each object a specific color.

After that we'll load our model and that we will provide the regard to our prototxt and also to our model files.

With the assistance of imutils we'll read the video and that we will set the number of frames per second. Now with this some predefined numbers of frames are going to be loaded per

second. Each frame is analogous to the image. Now these images are going to be given because the inputs to the model.

The model will process the input image and produces the output image which consists of labels. in additional practical sense the input raw image is given to the model. Now the model processes the input image. within the output image all the things are identified and every object is surrounded by an oblong box and therefore the name of the object is additionally displayed. we'll be only observing the output video stream but not the input video stream.

- **Outcome:**

Here, in this project we've considered around 15 to 20 objects to be detected during the training. Some of those include 'person', 'car', 'train', 'bird', 'sofa', 'dog', ''plant', 'aero plane', 'bicycle', 'bus', 'motorbike', etc.

The output of this project displays the objects detected with a rectangular box around the object with a label indicating its name and therefore the exactness with which the object has been detected on the top of it. It can dig out any number of objects existing during a single image with certainty.

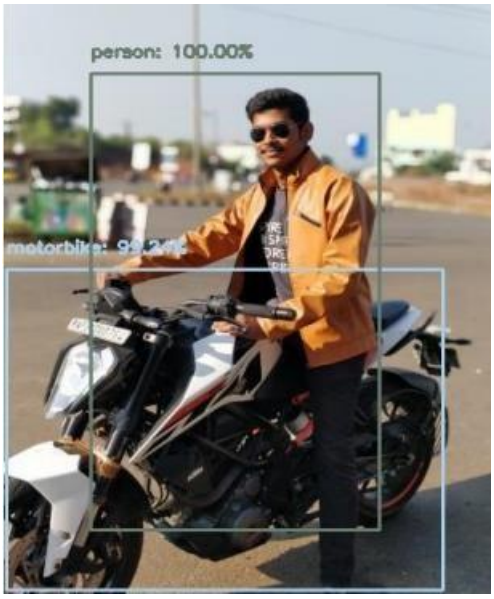

Fig 1

Fig 2

Fig 3

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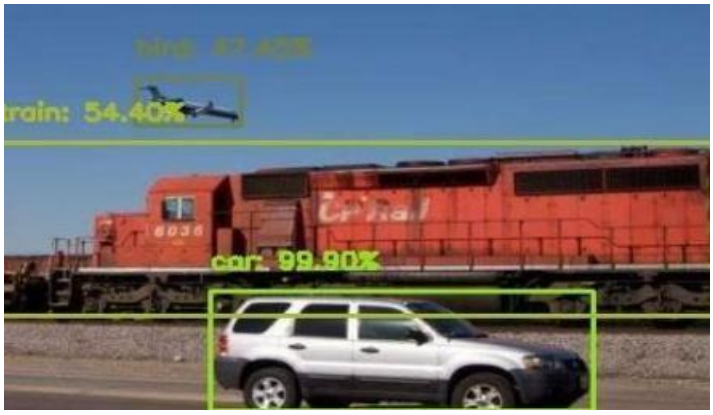


Fig 4

Fig 5

- **Application:** ○ Face detection perhaps be a separate class of object detection. We wonder how some applications like Facebook, Faceapp, etc., detect and recognize our faces. this is often a sample example of object detection in our day-to-day life. Face detection is already in use in our lifestyle to unlock our mobile phones and for other security systems to scale back rate.

    - Object detection is additionally utilized in tracking objects like tracking an individual and his actions, continuously monitoring a ball within the game of Football or Cricket. As there's an enormous interest for people in these games, these tracking techniques enables them to know it during a better way and obtain some additional information. Tracking of the ball is of maximal importance in

any ball-based games to automatically record the movement of the ball and adjust the video frame accordingly.

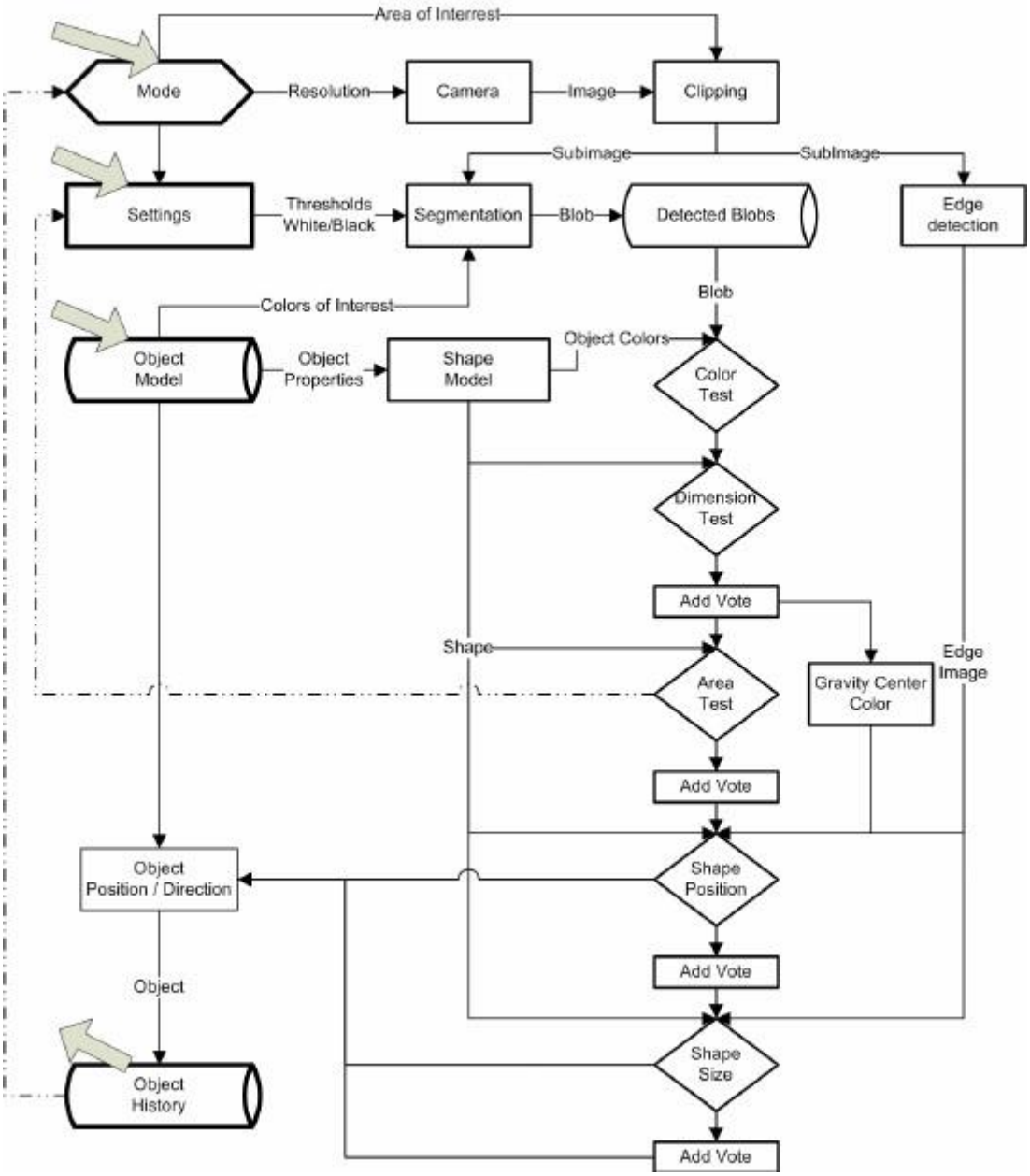
- this is often one among the main evolutions of the planet and is that the best example why we'd like object detection. so as for a car to travel to the specified destination automatically with none human interference or to form decisions whether to accelerate or to use brakes and to spot the objects around it. this needs object detection.

- In recent times, we've encountered an application in smart phones called google lens. this will recognize the text and also images and search the relevant information within the browser without much effort.

- **Conclusion:**

  Deep-learning based object detection has been a search hotspot in recent years. This project starts on generic object detection pipelines which give base architectures for other related tasks. With the assistance of this the 3 other common tasks, namely object detection, face detection and pedestrian detection, are often accomplished. Authors accomplished this by combing 2 things: Object detection with deep learning and OpenCV and Efficient, threaded video streams with OpenCV. The camera sensor noise and lightening condition can change the result because it can create problem in recognizing the objects. generally, this whole process requires GPU's rather than CPU's. But we've done using CPU's and executes in much less time, making it efficient. Object Detection algorithms act as a mixture of both image classification and object localization. It takes the given image as input and produces the output having the bounding boxes adequate to the number of objects present within the image with the category label attached to every bounding box at the highest. It projects the scenario of the bounding box up the shape of position, height and width

4. Design selection <u>DFD Model 1:</u>



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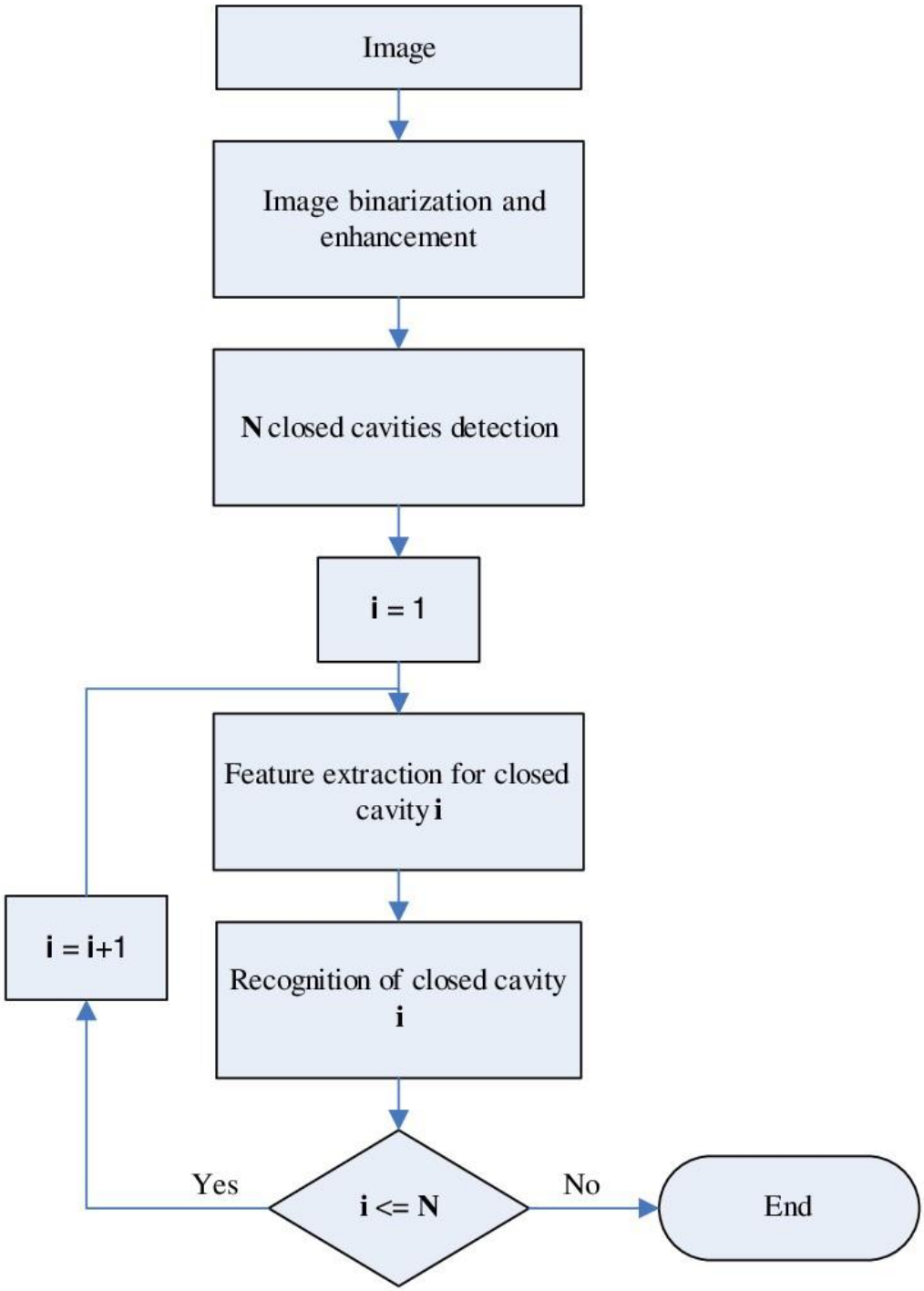
DFD Model 2:



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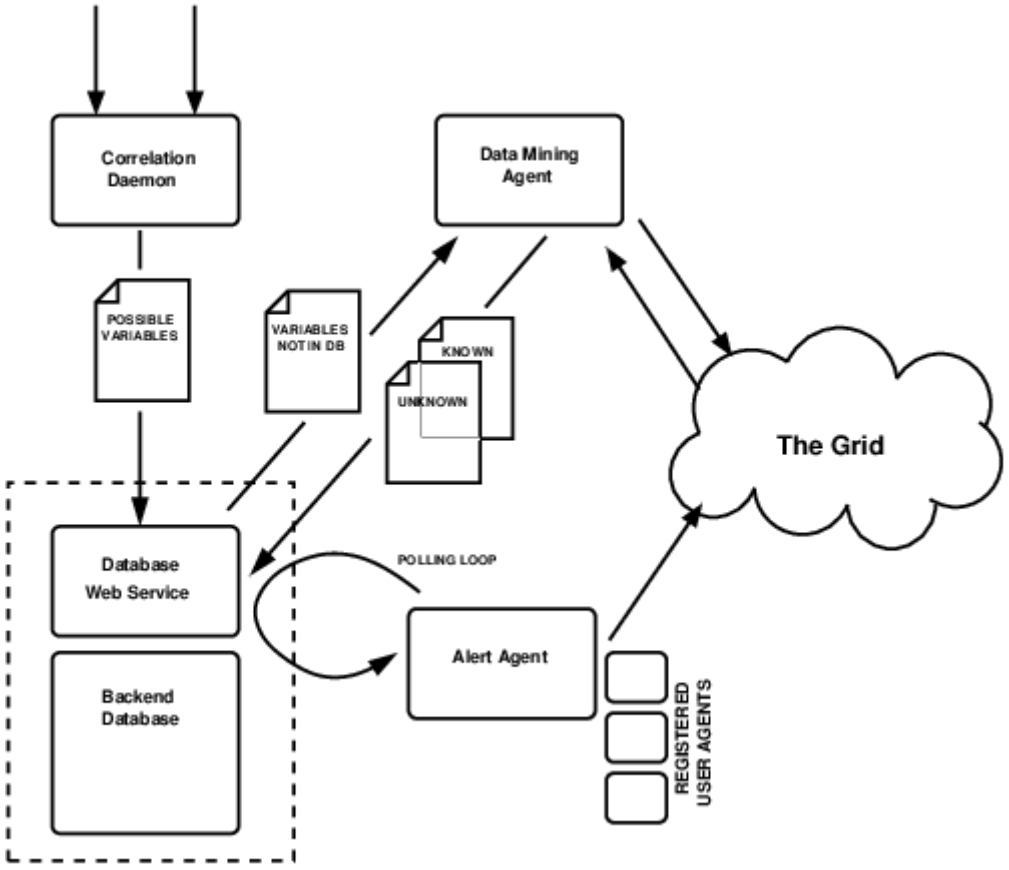
DFD Model 3:



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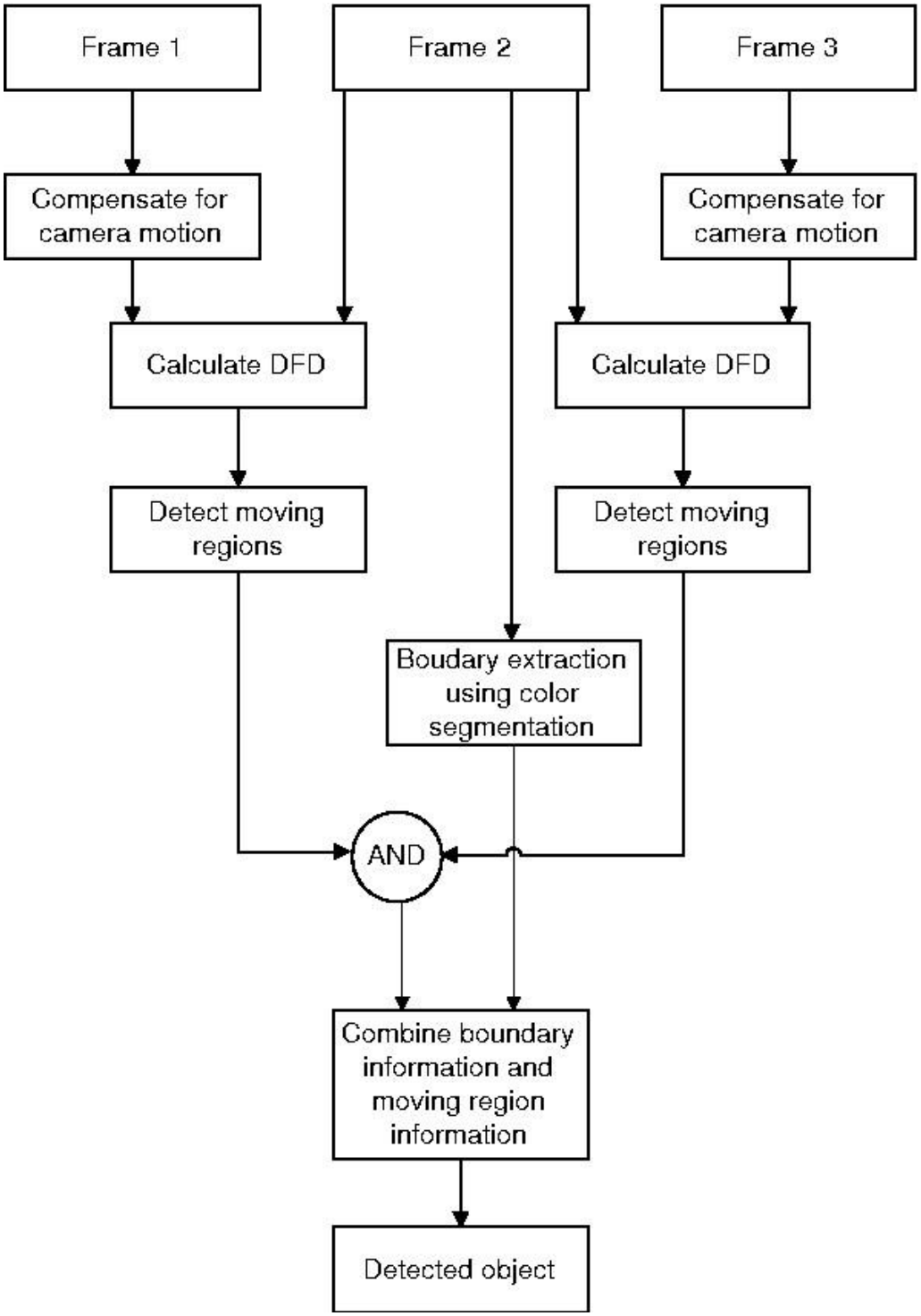
DFD Model 4:



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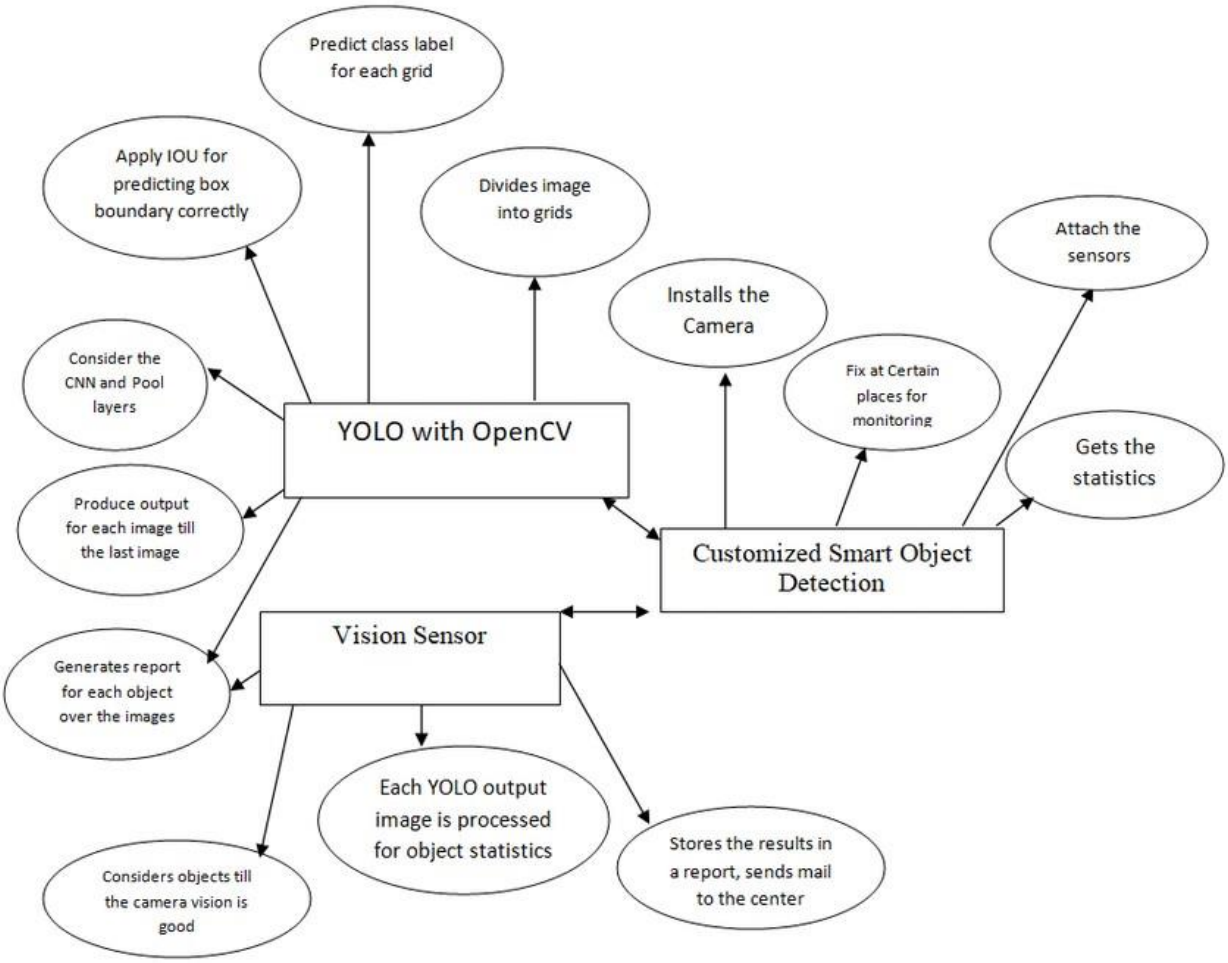
ER-Diagram



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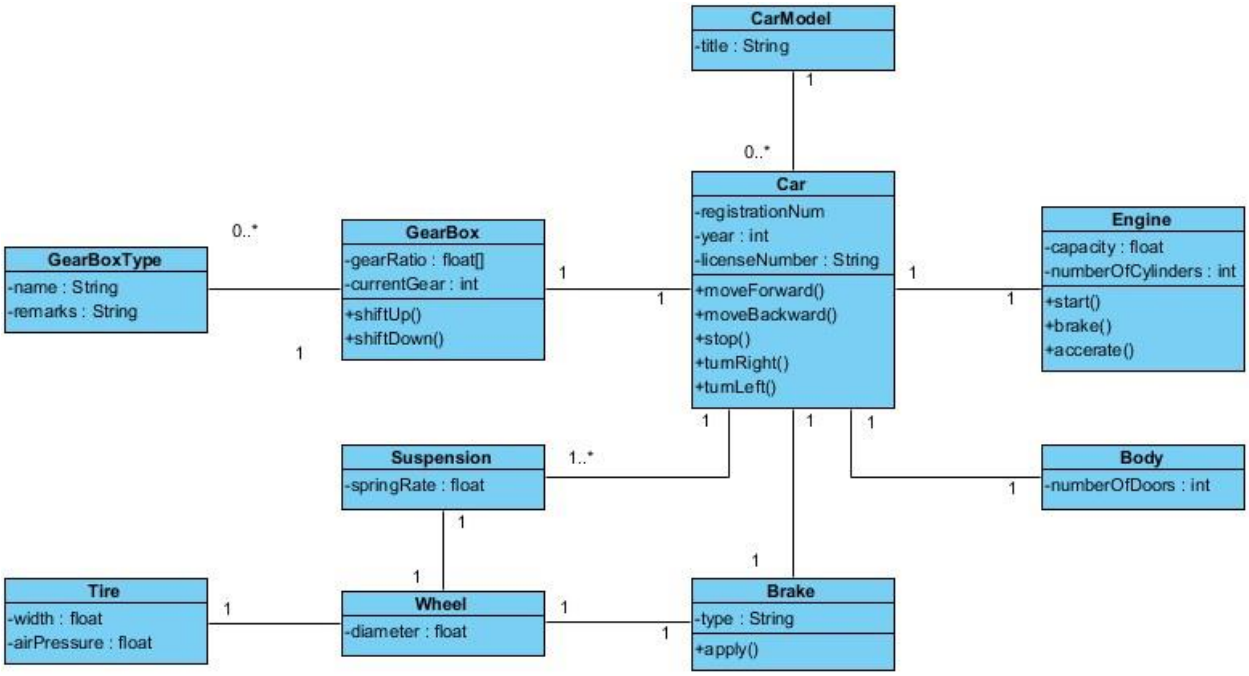
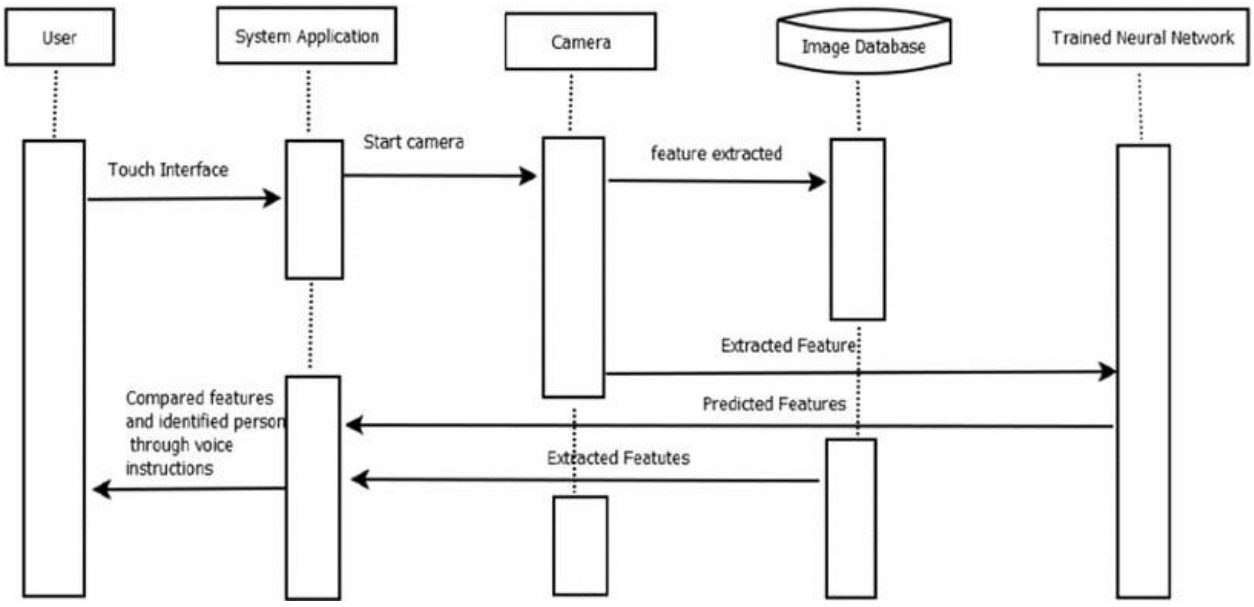
Class Diagram



Sequence Diagram:



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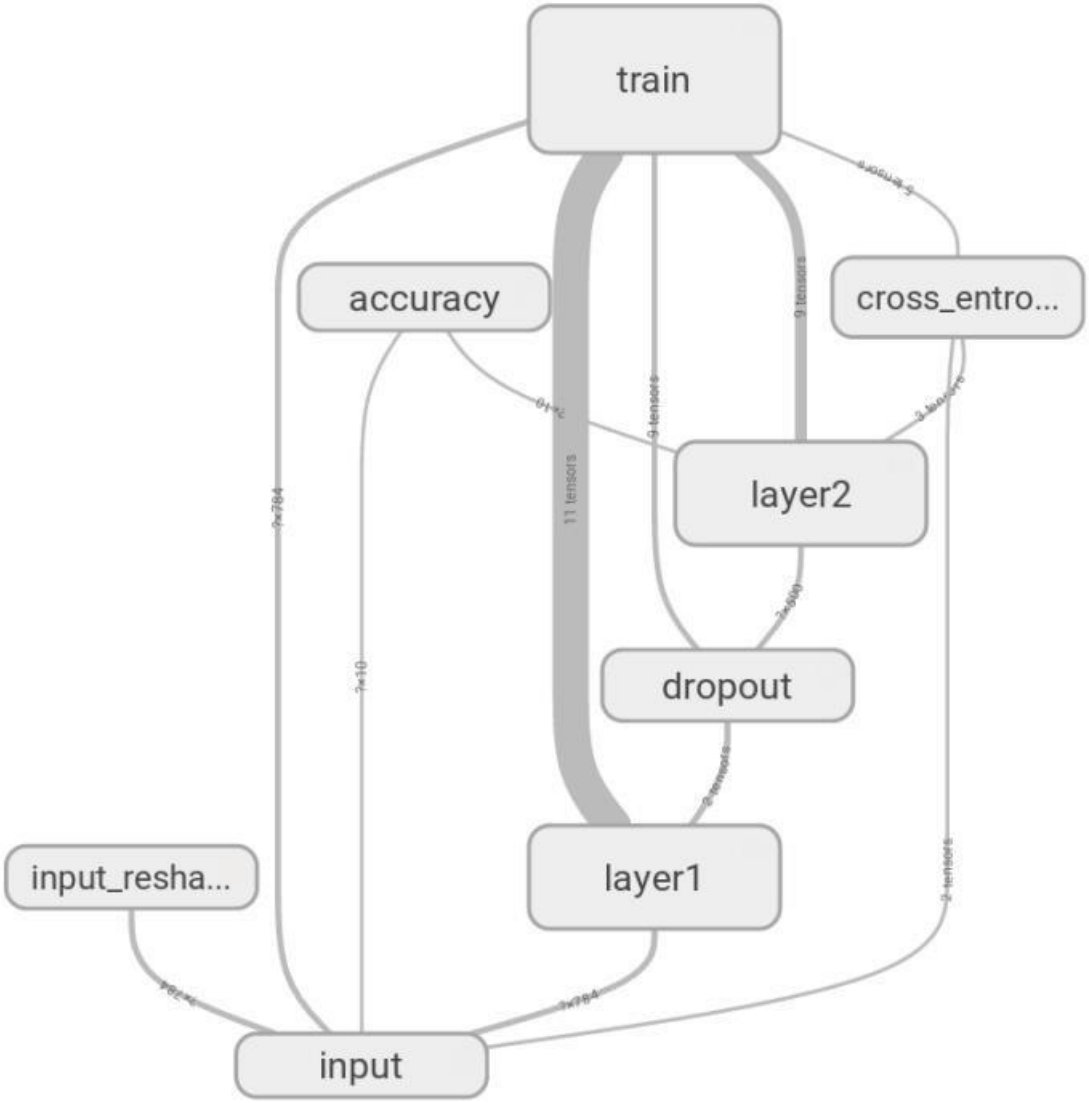
Model Architecture



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