CHAPTER 1

INTRODUCTION

1.1 Introduction

The largest expense of a city is mainly because of street lights. The cost spent is huge that all the sodium vapour lamps consume more power. Currently a manual system is used where the light will be made to switched ON/OFF. The light will be made to switched ON in the evening and switched OFF in the morning. Hence there is a lot of energy wastage between the ON/OFF. Hence smart street light can be used to cut the municipal waste and mainly used to track the crimes happening at the road using panic button and camera and to prevent energy improvidence. When an emergency situation like theft, harassment is found to happen but sound is not detected, a panic button is provided at the reachable height which can be pressed by the person whoever seeing that incident. One more button is also given for the voice recording. These kind of safety measures and techniques are included in the project.

Overview of Machine Learning:

Feature Generation Automation

Machine learning algorithms can generate new features from among a limited number located in the training datasets without additional human intervention. This means it can perform complex tasks that often require extensive feature engineering. For businesses, this means faster application or technology roll-outs that deliver superior accuracy.

Works well with Unstructured Data

Training Machine learning networks with unstructured data and appropriate labeling can help businesses optimize virtually every function from marketing and sales to finance. Unstructured data which includes images, documents, and videos. Organizations currently useonly a small percentage of this data to derive useful insight. It is a field of artificial intelligence (AI) that enables computers andsystems to derive meaningful information from digital images, videos and other visual inputs. It leverages machine learning models to identify and classify images by using predefined, labelled categories.

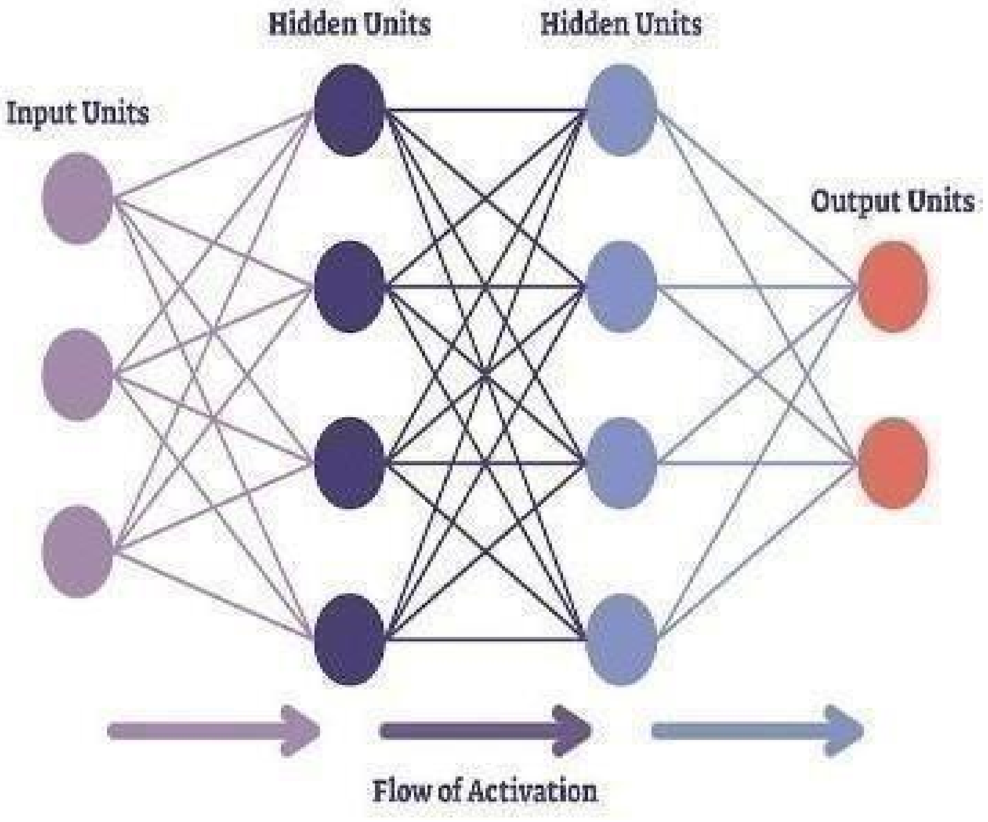


Figure 1.1: Structure of Neural Networks

- **Better Self-Learning Capabilities**

The multiple layers in deep neural networks allow models to become more efficient at learning complex features and performing more intensive computational tasks, i.e., execute many complex operations simultaneously. It outshines machine learning in machine perception tasks and holds ability to make sense of inputs like images, sounds, and video like a human would, that involve unstructured datasets.

- **Supports Parallel and Distributed Algorithms**

A typical Machine learning model takes days to learn the parameters that define the model. Parallel and distributed algorithms address this pain point by allowing machine learningmodels to be trained much faster. Models can be trained using local training with GPUs, or a combination of both.

- **Cost Effectiveness**

While training machine learning models can be cost-intensive, once trained, it can help businesses cut down on unnecessary expenditure. In industries such as manufacturing, consulting, or retail, the cost of an inaccurate prediction or product defect is massive. It often outweighs the costs of training machine learning models.

List of Acronyms

AI: Artificial Intelligence

ML: Machine Learning

CDBN: Convolutional Deep Belief Networks

CNN: Convolutional Neural Network

ConvNet: Convolutional Neural Network

DBN: Deep Belief Network

DeconvNet: De-Convolutional Neural Network

NN: Neural Network

ReLU: Rectified Linear Unit.

1.2 Motivation

The main benefit of smart street lights is not just saving energy. It is also making public spaces safer. Cities that uses smart lighting technology as a tool to improve safety, detect crime, assist during emergencies and better serve the citizens. Usage of smart street light reduces energy cost and usage with flexible dimming controls. Using smart street light increases pedestrian satisfaction through improved safety measures.

Motivation for using smart street light includes, there are lower chances of the automatic street light system overheating & risk of accidents is also minimized. Cost of operating automatic solar street lights is far less when compared to the conventional street lights. The automatic street light system is eco-friendly & hence helps in reducing the carbon footprint. Lowered repair and maintenance costs with the monitoring software. Using smart street light reduces carbon emissions and light pollution.

Motivation for using smart street light also includes, smart lighting is an advanced way to light your home. Smart LED bulbs contain software that connects to an app, smart home assistant, or other smart accessory so you can automate your lights or control them remotely, eliminating the need for traditional wall switches. Street lighting prevents the illegal works and anti-social activities on the roads. Street lighting reduces the accident rate during night. Street lighting also helps in reducing the crimes at night. The feature of changing light intensity and automatic switch on and off according to the need allows it to conserve energy. It is also easy to integrate with other smart solutions, such as smart parking, to provide advanced solutions. During the day, we need light to help us feel awake and alert. At night, we need less light to signal to our bodies it's soon time to doze off. An automated lighting control system that turns lights on and off on a timer is a great way to ease our bodies and minds through the day.

1.3 Problem statement

The street light is one of the huge expenses in a city. The cost spent is huge that all the sodium vapour lamps consume more power. Instead we use light emitting diode(LED). With the rise of deep learning, it is important to develop effective methods to overcome.

Input :

A dataset of real images of objects has been collected. The dataset should be large and diverse, sensors like LDR(Light Detection Resistor) to detect sunlight and Camera to record video.

Process:

1. Data Collection: Gathering a large and diverse dataset of real images of objects that is used for training and testing the deep learning model.
2. During the training phase, the deep learning models will learn the features and patterns, they target the objects.
3. During the testing phase, the images with or without objects undergoes for testing.

Output:

1. Based on the sunlight and objects presence smart street lights changes intensity of light.
2. Smart poles are connected with camera will detect various abnormal activities occur on road like accidents, harassment etc.
3. The sound will be detected with the help of inbuilt mike in camera and camera will turn towards the detected sound.
4. The live footage will be send to the control room through email.

1.4 Objectives

- ➢ To dynamically change the brightness of bulbs.
- ➢ To host public safety.
- ➢ To Provide efficient, automatic and smart lighting system.
- ➢ To provide longer life expectancy for street lights and energy saving.
- ➢ To ensure safety by monitoring the activities that are happening on the road.
- ➢ To integrage an emergency notification system with just one click of panic button.
- ➢ To avoid unnecessary Waste of light by susing smart technologies like using LDR(Light Detecting Resistor) which will changes the intensity of light based on our requirements.

1.5 Scope

- The smart street light will help cities reduce electricity costs, lower CO_2 emmisions, and improve maintainance.
- Smart street light is a key factor to avoid fostering criminal activities.
- With auto-dimming, scheduling, and host of other capabilities, cities could see 50-75% of reduction in energy cost through smart street lighting.
- It increses public safety from the system adopted in the project. By clicking panic button it may saves many lifes.
- It is a way to reduce robberies, burglaries, property defacement, property damage, and other crimes that often happen in dark.
- As the traffic decreases slowly during late-night hours, the intensity gets reduced progressively till morning to save energy and thus, the street lights switch on at the dusk and then switch off at the dawn, automatically.
- White Light Emitting Diodes (LED) replaces conventional lamps in street lighting system to include dimming feature. The intensity is not possible to be controlled by the high intensity discharge lamp which is generally used in urban street lights. LED lights are the future of lighting because of their low energy consumption and long life.

1.6 Review of Literature.

[1] Modabbir, & Mohammad, A. (2021). Energy and Economic Analysis of Smart Technologies on Street Lighting System. 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS).

[2] Gagliardi, Gianfranco, et al. "Advanced adaptive street lighting systems for smart cities." Smart Cities 3.4 (2020): 1495-1512.

[3] Gagliardi, Gianfranco, et al. "A smart city adaptive lighting system." 2018 Third International Conference on Fog and Mobile Edge Computing (FMEC). IEEE, 2018.

[4] Abinaya, B., S. Gurupriya, and M. Pooja. "Iot based smart and adaptive lighting in street lights." 2017 2nd International Conference on Computing and Communications Technologies (ICCCT). IEEE, 2017.

[5] Lee, Pei Zhen, Sei Ping Lau, and Chong Eng Tan. "Predictive Control for Distributed Smart Street Light Network." International Journal of Advanced Computer Science and Applications 10.12 (2019).

1.7 Organization of the Report

The report is organized into the chapters as follows:

Chapter 1 - Introduction:

The chapter presents a brief description about Smart and adaptive street light with safety system. It includes Introduction about the topic, Motivation, problem statement, objective, scope and review of literature. It also presents a brief summary about the chapter.

Chapter 2 - System requirement specification:

The chapter 2 presents the specific requirement, software and hardware requirements interfaces used. It also presents a brief summary about the chapter.

Chapter 3 - High level Design:

The chapter 3 presents the Design consideration made, system architecture of proposed system, specification of the proposed system using use case diagram. It describes module specification, data flow diagram for every module for the proposed method. Finally, it presents a brief summary about chapter.

Chapter 4 - Detail design:

The chapter 4 briefs about the flow chart diagram and Detail functionality and description of each module.

Chapter 5 - Implementation:

The chapter 5 describes the Implementation of the process.

Chapter 6 - System testing:

The chapter 6 describes the System Testing. It is the process of evaluating a system or its component(s) with the intent.

Chapter 7 - Results and analysis:

The chapter 7 describes the Results and analysis of the cervical cancer detection.

1.8 Summary

The first chapter gives the brief introduction about the Smart and adaptive street light with safety system..The motivation of project is discussed in section 1.2. Section 1.3 presents the problem statement of the project. Section 1.4 represents objectives. The scope of the project are presented in the section 1.5. Finally, section 1.6 elaborates the reviews of literature, the important papers referred. Moreover, this overall comparison between two different papers we have reviewed here gives us a glimpse of how the accuracy of machine learning systems directly depends on the size of the training datasets- the larger the training datasets, the better the accuracy of the Trained model.

CHAPTER 2

SYSTEM DESIGN

2.1 System requirements and specifications

System requirement specifications gathered by extracting the appropriate information to implement the system. It is the elaboration conditions which the system needs to attain. Moreover, the SRS delivers a complete knowledge of the system to understand what this project is going to achieve without any constraints on how to achieve this goal. This SRS doesnot providing the information to outside characters but it hides the plan. Python is an easy to learn, powerful programming language. It has efficient high-level data structures and a simple but effective approach to object-oriented programming.

OpenCV is a library of programming functions mainly aimed at real-time computer vision. It has a modular structure, which means that the package includes several shared or static libraries.

Python is a general-purpose programming language started by Guido van Rossum, its simplicity and code readability enables the programmer to express his ideas in fewer lines of code without reducing any readability.

Hardware Requirements

- LED
- LDR Sensor
- PIR Sensor
- Panic button

Software Requirements

- Image capture and storage : Open CV
- Training and Validation : CNN algorithm
- Model building : TensorFlow, tflearn, imutil
- Programming platform : Python IDE
- Tools : IDLE(python 3.7.0) or visual Studio
- Whole Framework and Test : Flask

2.2 System Design

The system design explains the architecture that would be used for developing a software product. The architecture diagram provides an overview of an entire system, identifying the main components that would be developed for the product and their interfaces.The HLD uses possibly non-technical to mildly technical terms that should be understandableto the administrators of the system.

In contrast low level design further exposes the logical detailed design of each of these elements for programmers. High level design is the design which is used to design the software related requirements. In this chapter complete system design is generated and shows how the modules, submodules and the flow of the data betweenthem are done and integrated. It is very simple phase that shows the implementation process. The errors done here will be modified in the coming processes.

Design consideration

Following are the Design consideration taken into system for special cases.

Case - 1: Image captured but no cells detected.

This case describes when the datasets captures image, but it does not have the cells content which the system requires. In this case a warning message is displayed to the user stating the problem, that is, the user will be asked to re-enter the image until the system is able to recognizeit is a image containing cells.

Case - 2: Image captured but not clear.

This case describes when the datasets captures image, image with cells is also recognized but it is not clear. In this case the user will be asked to re-enter the cytopathology image until the system is able to get a good image else the user can go ahead with the same, results might vary.

This case describes when there are bugs in the program. In this case the system will handle thisbug and error by a concept called exception handling, and need to write assertions in the codeso that the code can report these bugs and errors, so that the user can rectify this once found. In this case the user will be asked to re-enter the cytopathology image until the system is able to get a good image else the user can go ahead with the same, results might vary. The system will handle this bug and error by a concept called exception handling.

Case - 3: Unable to get an image into buffer.

This case describes when the camera/datasets is unable to get an image into system buffer. In this case the system will report an error because it did not have any data to work with as the image buffer was empty, the system will display the error. The system can handle this as an expectation and proceed with the code by taking a random buffer values, but again this will lead to mismatch of results.

Case - 4: System bugs and errors.

This case describes when there are bugs in the program. In this case the system will handle this bug and error by a concept called exception handling, and need to write assertions in the codeso that the code can report these bugs and errors, so that the user can rectify this once found.

2.3 System Architecture

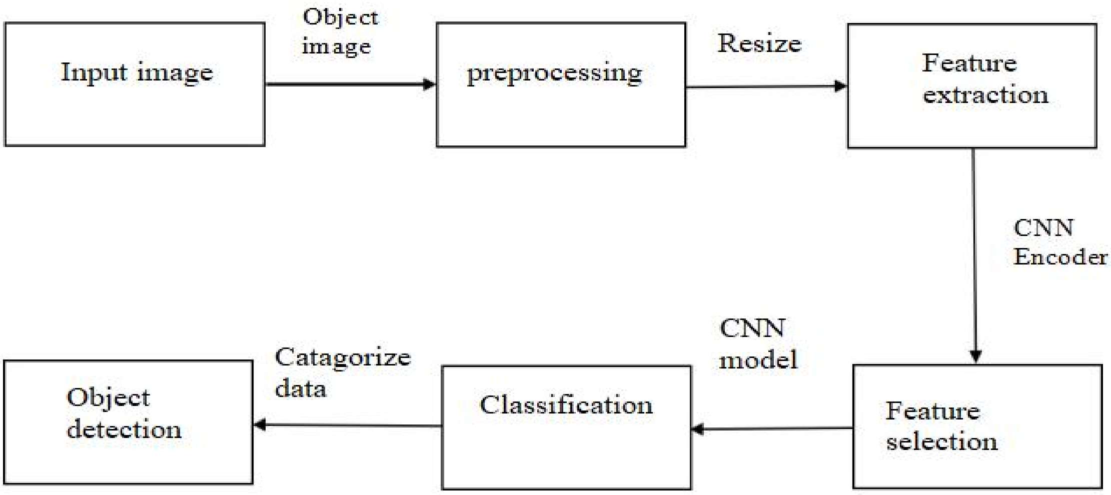


Figure 2.1: Architecture of the proposed system.

Figure 2.1 shows the architecture of the proposed system. Images of object and are acquired initially. So the image is preprocessed by applying specific preprocessing techniques such as histogram equalization and Median filter to remove noise and enhance the image. Next, the preprocessed image is segmented for choosing the right portion where the object is detected. Then the selected features are extracted using algorithm and stored in the database for classification. The classification is based on the object and it is detected by using CNN. The method follows as shown in above figure.

The process will follow the following steps:

1. RGB to grey scale
2. Noise Removal
3. Thresholding
4. Image Sharpening
5. Feature Extraction and Classification

RGB to Grey scale

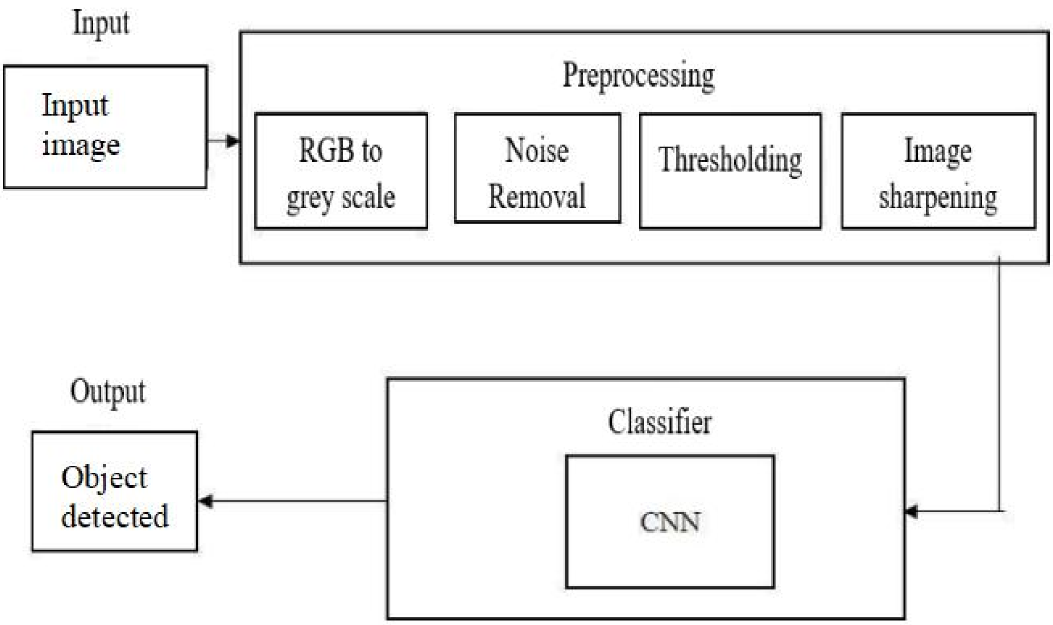


Figure 2.2: Architectural Diagram of the Proposed System using CNN.

Figure 2.2 refers the architecture diagram of the proposed system in CNN. In the first step of proposed approach, store a single color pixel of an RGB color image we will need 8*3 = 24 bits (8 bit for each color component).Only 8 bit is required to store a single pixel of the image. So we will need 33 % less memory to store grayscale image than to store an RGB image. Grayscale images are much easier to work within a variety of task like In many morphological operation and image segmentation problem, it is easier to work with single layered image (Grayscale image) than a three- layered image (RGB color image)

Data Flow Diagram for pre-processing module.

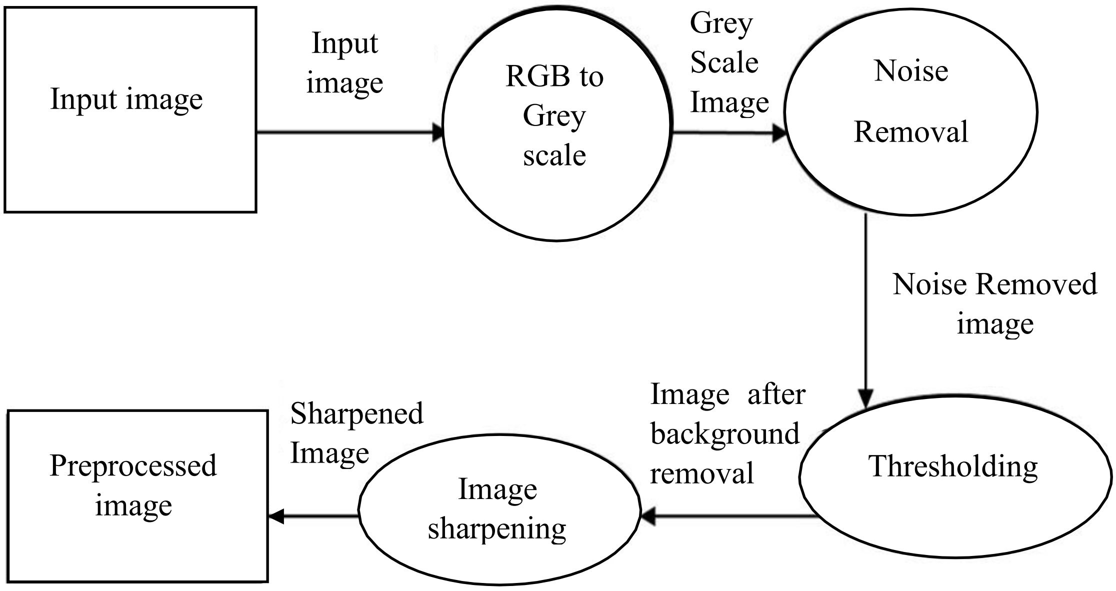


Figure 2.3: Data Flow Diagram for pre-processing module.

Figure 2.3 shows the Data flow diagram for pre-processing module. Pre-processing is requiredon every image to enhance the functionality of image processing. Captured images are in the RGB format. The pixel values and the dimensionality of the captured images is very high. As images are matrices and mathematical operations are performed on images are the mathematical operations on matrices. So, we convert the RGB image into Gray image. Then we carry out Noise Removal followed by Thresholding, the last step is Image Sharpening after which we obtain the pre-processed Image.

Data Flow Diagram of Classification using CNN

The figure 2.4 shows data flow diagram of classification using CNN. In deep learning,a convolutional neural network (CNN, or ConvNet) is a class of deep neural network most commonly applied to analyzing visual imagery. They are also known as shift invariant or space invariant artificial neural networks (SIANN), based on their shared- weights architecture and translation in variance characteristics. As images are matrices and mathematical operations are performed on images are the mathematical operations on matrices. So, we convert the RGB image into Gray image. Grayscale images are much easier to work within a variety of task like In many morphological operation and image segmentation problem.

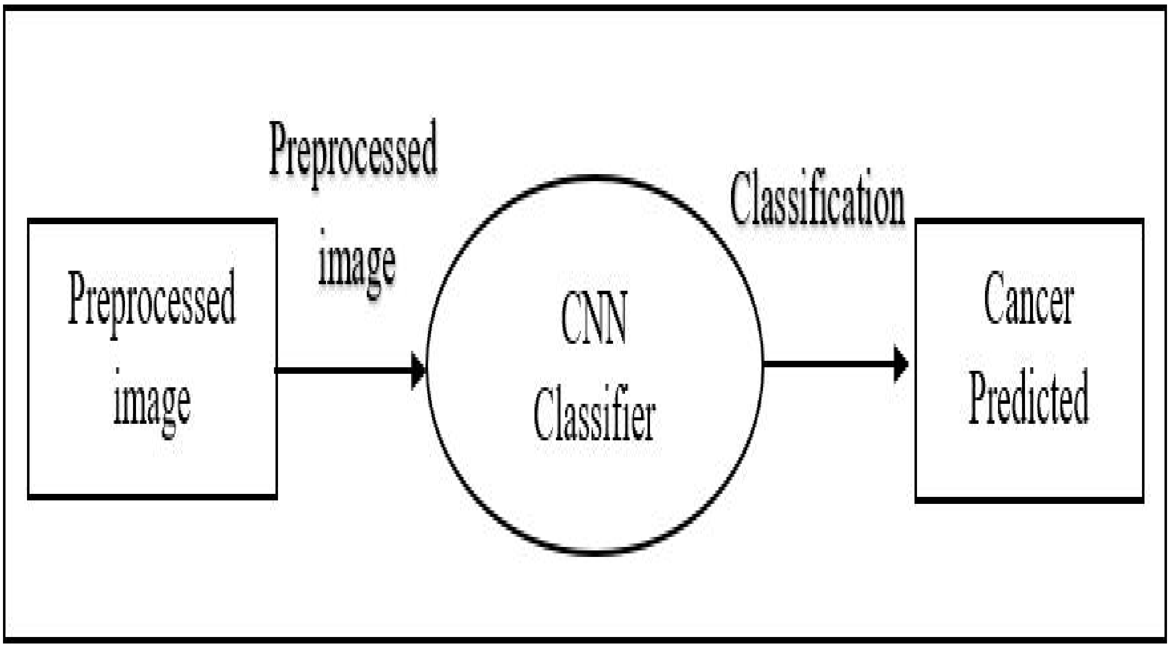


Figure 2.4: Data Flow Diagram of Classification using CNN.

2.4 Board work

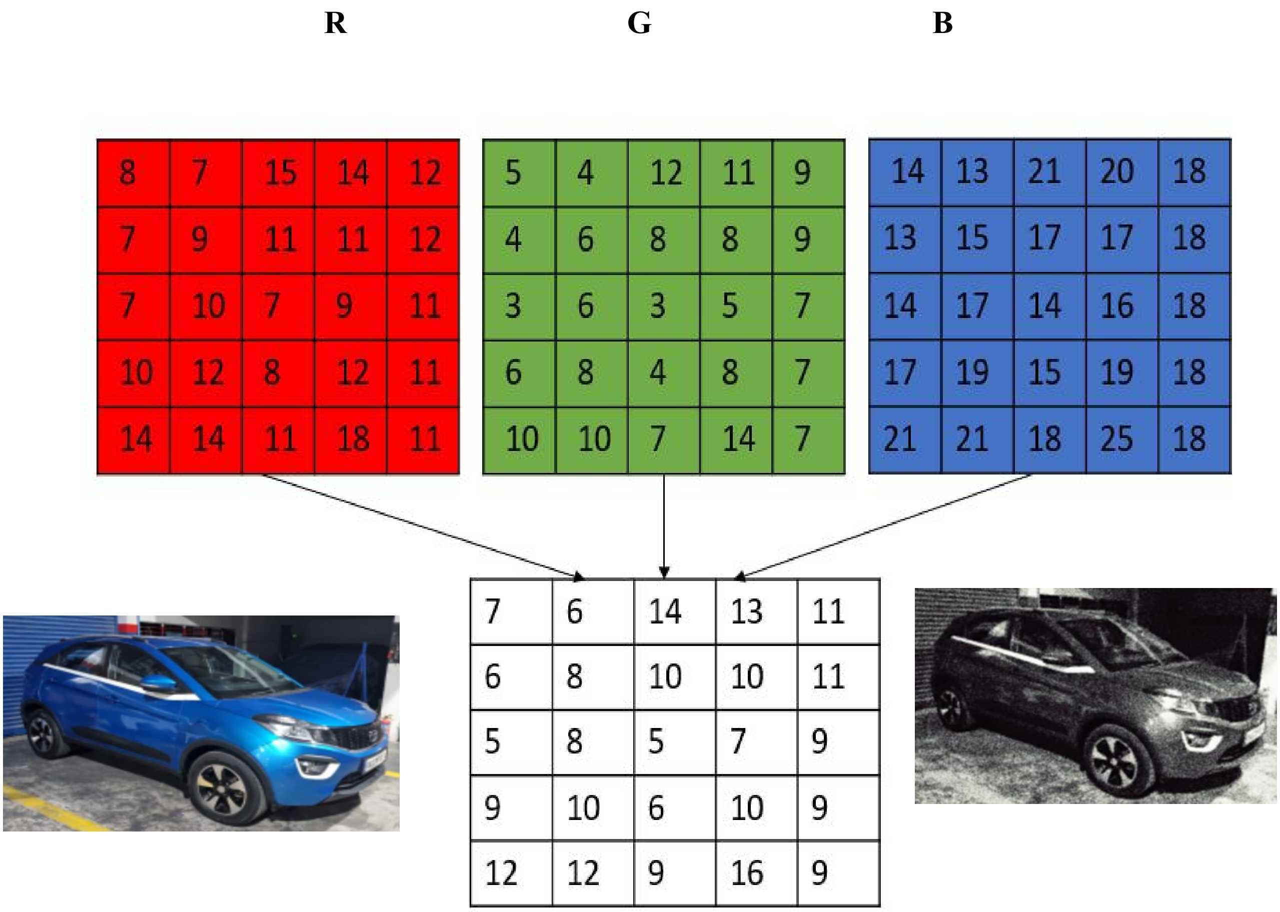
Conversion from RGB to Greyscale

Figure 3.5 shows the conversion from RGB to gray scale. The first step in pre-processing is converting the image from RGB to Grayscale. Itcan be obtained by applying the below formulato the RGB image. The figure 4.4 depicts the Conversion from RGB to grayscale. It helps in simplifying algorithms and as well eliminates the complexities related to computationalrequirements. It makes room for easier learning for those who are new to image processing. This is because grayscale compressors an image to its barest minimum pixel. It enhances easyvisualization.

An RGB image has three color channels: Red channel, Green channel and Blue channel. However, a grayscale image has just one channel. Only 8 bit is required to store a single pixel of the image. So we will need 33 % less memoryto store grayscale image than to store an RGB image.

Grayscale images are much easier to work within a variety of task like In many morphological operation and image segmentation problem, it is easier to work with single layered image (Grayscale image) than a three-layered image (RGB color image). It enhances easy visualization. An RGB image has three color channels: Red channel, Green channel and Blue channel. However, a grayscale image has just one channel. It is also easier to distinguish features of an image when we deal with a single layered image.

The formula : 0.2989*R+0.5870*G+0.1140*B



R

8	7	15	14	12
7	9	11	11	12
7	10	7	9	11
10	12	8	12	11
14	14	11	18	11

G

5	4	12	11	9
4	6	8	8	9
3	6	3	5	7
6	8	4	8	7
10	10	7	14	7

B

14	13	21	20	18
13	15	17	17	18
14	17	14	16	18
17	19	15	19	18
21	21	18	25	18

7	6	14	13	11
6	8	10	10	11
5	8	5	7	9
9	10	6	10	9
12	12	9	16	9

Figure 2.5: Conversion from RGB to grayscale.

Advantages of converting RGB color space to gray

- To store a single color pixel of an RGB color image we will need 8*3 = 24 bits (8 bit for each color component).
- Only 8 bit is required to store a single pixel of the image. So we will need 33 % less memoryto store grayscale image than to store an RGB image.
- Grayscale images are much easier to work within a variety of task like In many morphological operation and image segmentation problem, it is easier to work with single layered image (Grayscale image) than a three-layered image (RGB color image).
- It enhances easy visualization. An RGB image has three color channels: Red channel, Greenchannel and Blue channel. However, a grayscale image has just one channel.
- It is also easier to distinguish features of an image when we deal with a single layered image.

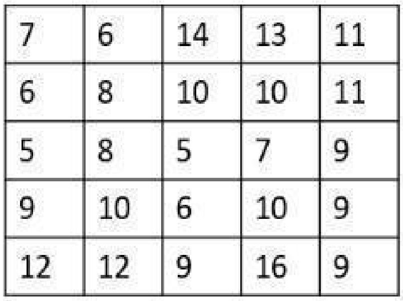
Noise Removal

Noise removal algorithm is the process of removing or reducing the noise from the image. The noise removal algorithms reduce or remove the visibility of noise by smoothing theentire image leaving areas near contrast boundaries. Noise removal is the second step in imagepre-processing. Here the grayscale image which was obtained in the previous step is given as input. Here we are making use of Median Filter which is a Noise Removal Technique.

Median Filtering

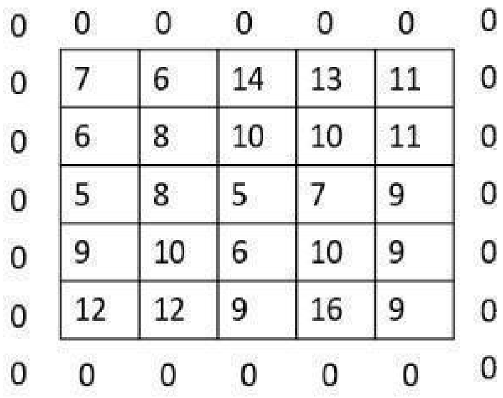
The median filter is a non-linear digital filtering technique, often used to remove noisefrom an image or signal. Here 0's are appended at the edges and corners to the matrix which isthe representation of the grey scale image. Then for every3*3 matrix, arrange elements in ascending order, then find median/middle element of those 9 elements, and write that median value to that particular pixel position. The figure 3.6 depicts Noise filtering using Median Filter.

Original matrix:

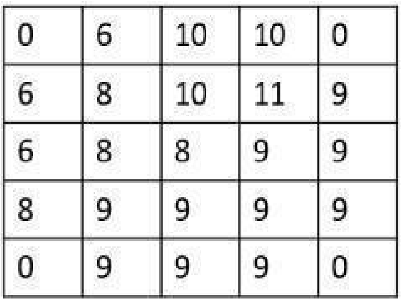


7	6	14	13	11
6	8	10	10	11
5	8	5	7	9
9	10	6	10	9
12	12	9	16	9

Append 0's at edges and corners:



0	0	0	0	0	0	0
0	7	6	14	13	11	0
0	6	8	10	10	11	0
0	5	8	5	7	9	0
0	9	10	6	10	9	0
0	12	12	9	16	9	0
0	0	0	0	0	0	0



0	6	10	10	0
6	8	10	11	9
6	8	8	9	9
8	9	9	9	9
0	9	9	9	0

Figure 2.6 : Noise filtering using Median Filter.

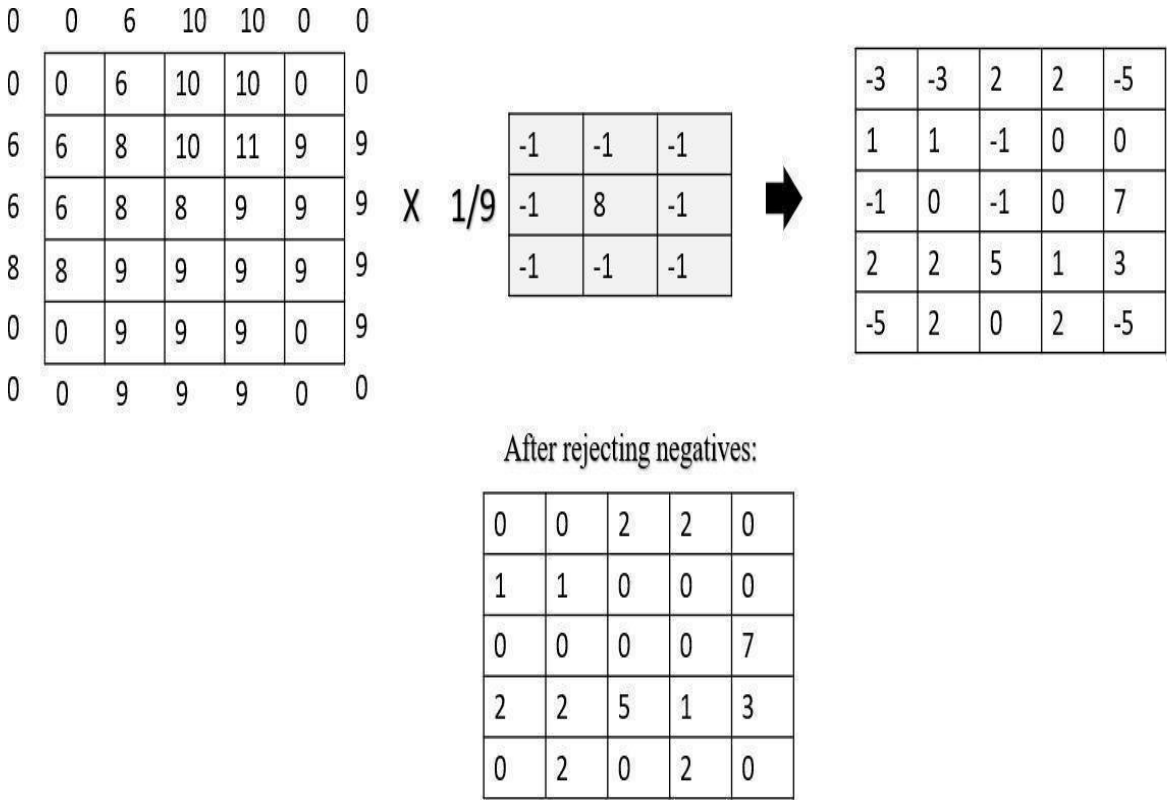
Image Sharpening

Image sharpening refers to any enhancement technique that highlights edges and fine details in an image, Increasing yields a more sharpened image.

High-Pass Filtering

The figure 4.6 depicts the method of image sharpening using high-pass filtering. A high- pass filter can be used to make an image appear sharper. These filters emphasize fine details inthe image. Here the output from the thresholding is given as input. Here, we are making use ofa filter, First we append the nearest values to pixels at the boundary pixels. The figure 2.7 depicts Image Sharpening using High-Pass Filter.

Boundary extension at edgesand corner: The filtered matrix:



0	0	6	10	10	0	0
0	0	6	10	10	0	0
6	6	8	10	11	9	9
6	6	8	8	9	9	9
8	8	9	9	9	9	9
0	0	9	9	9	0	9
0	0	9	9	9	0	0

X 1/9

-1	-1	-1
-1	8	-1
-1	-1	-1

-3	-3	2	2	-5
1	1	-1	0	0
-1	0	-1	0	7
2	2	5	1	3
-5	2	0	2	-5

After rejecting negatives:

0	0	2	2	0
1	1	0	0	0
0	0	0	0	7
2	2	5	1	3
0	2	0	2	0

Figure 2.7 : Image Sharpening using High-Pass Filter.

We multiply the elements of the 3*3 input matrix with the filter matrix, this can be representsas A(1,1)*B(1,1), in this way all the elements in the 3*3 are multiplied and their sum id dividedby 9, which gives the value for the particular pixel position. In the same way the values of all the pixel positions are calculated. The negative values are considered as zero, as there can be no such thing as negative illumination.

Flowchart for classification

In the last module of classification, we use - CNN (Convolutional Neural Networks to classify the image of the leaf as healthy or into the different disease type classes. In CNN, we take the output from the high-pass filter as input, leaving out feature extraction, as CNN is a classifier which simply has a feature extracting process of its own, using convolution, rectification and pooling as the 3 sub-modules.

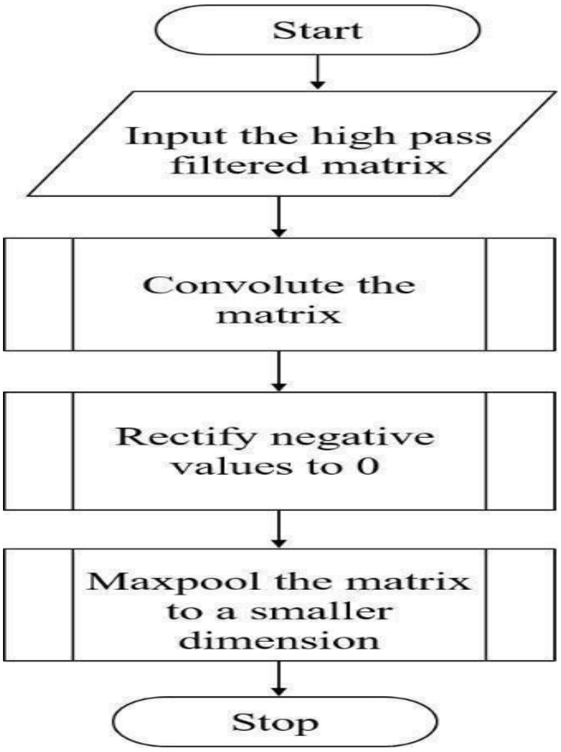

Start
Input the high pass filtered matrix
Convolute the matrix
Rectify negative values to 0
Maxpool the matrix to a smaller dimension
Stop

Figure 2.8: Flowchart for classification using CNN.

The figure 2.8 shows typical CNN architecture. The CNN is composed of several kinds of layers:

Convolutional layer- creates a feature map to predict the class probabilities for each featureby applying a filter that scans the whole image, few pixels at a time.

Pooling layer (down sampling)- scales down the amount of information the convolutional layer generated for each feature and maintains the most essential information (the process of the convolutional and pooling layers usually repeats several times).

Fully connected layer- "flattens" the outputs generated by previous layers to turn them intoa single vector that can be used as an input for the next layer. Applies weights over the input generated by the feature analysis to predict an accurate label.

Output layer- generates the final probabilities to determine a class for the image.

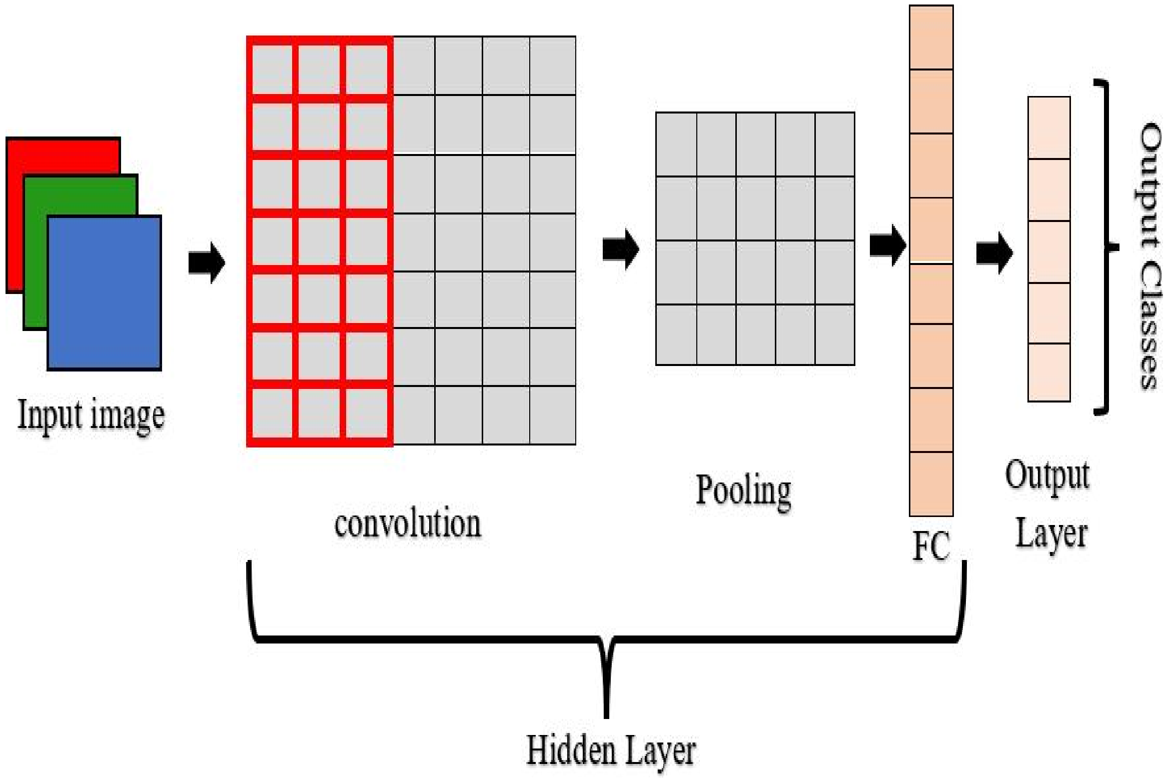
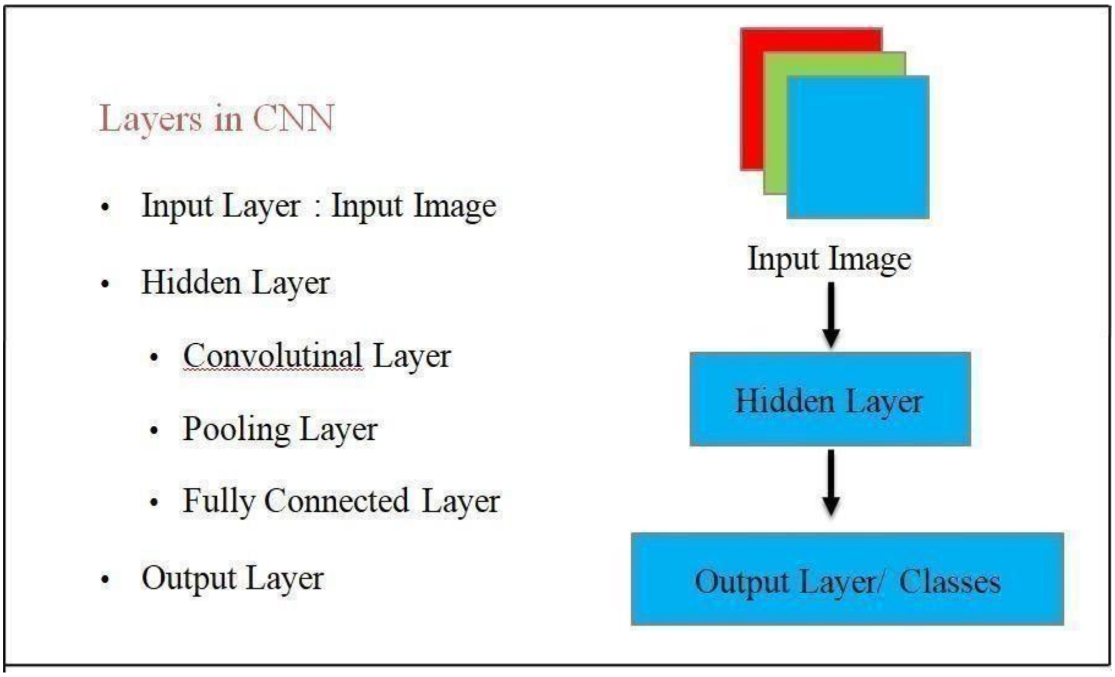


Figure 2.9: Typical CNN Architecture.



Layers in CNN

- Input Layer : Input Image
- Hidden Layer
  - Convolutinal Layer
  - Pooling Layer
  - Fully Connected Layer
- Output Layer

Input Image

Hidden Layer

Output Layer/ Classes

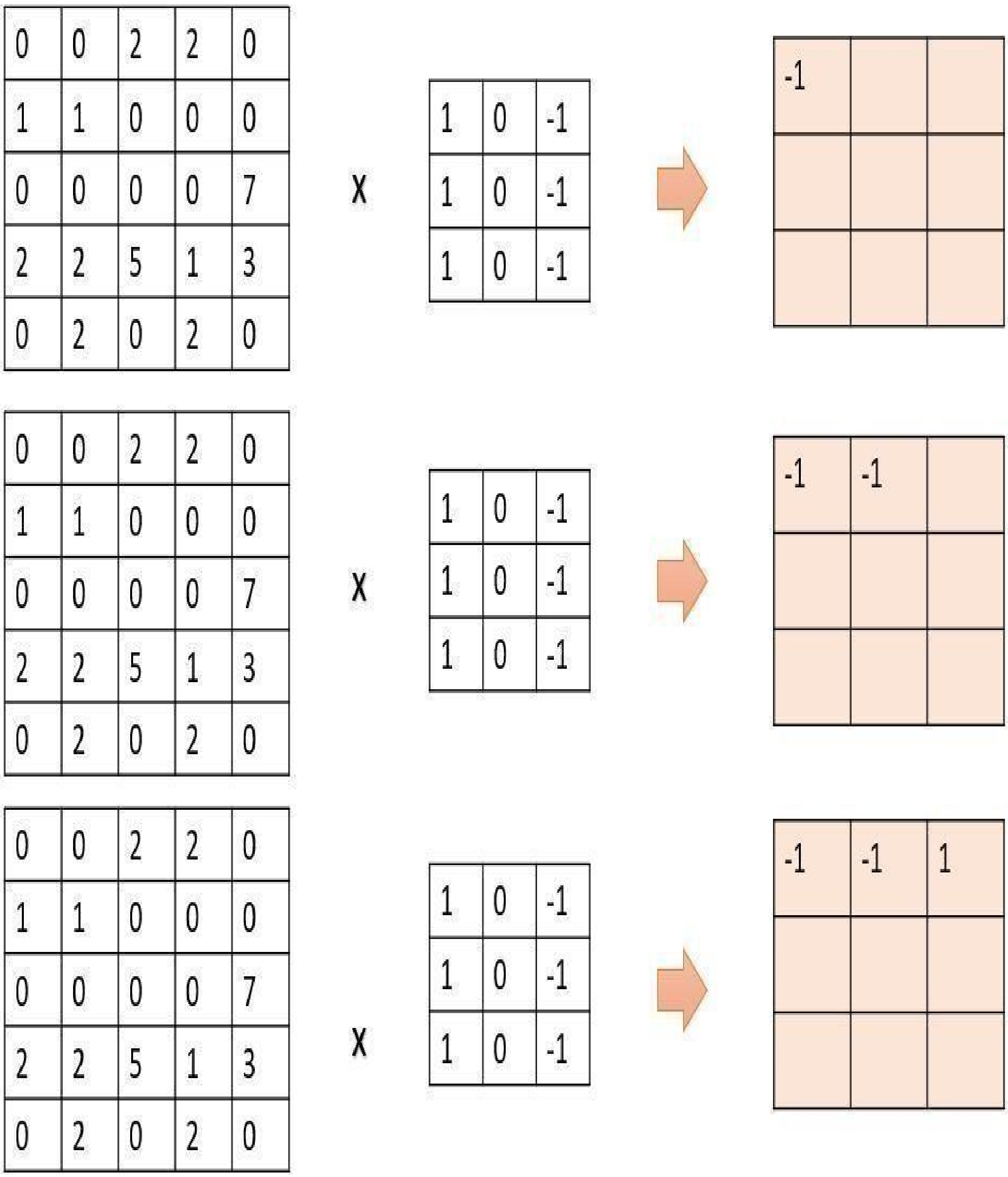
Figure 2.10: Layers in CNN.

The figure 3.9 shows the layers in CNN. The layers are as follows,

Convolutional Layer

Convolutional Layer is the first step in CNN, here 3*3 part of the given matrix which was obtained from High-pass filter is given as input. That 3*3 matrix is multiplied with the filter matrix for the corresponding position and their sum is written in the particular position. This is shown in the below figure. This output is given to pooling layer where the matrix is further reduced. Figure 4.11 shows the Convolutional Layer.

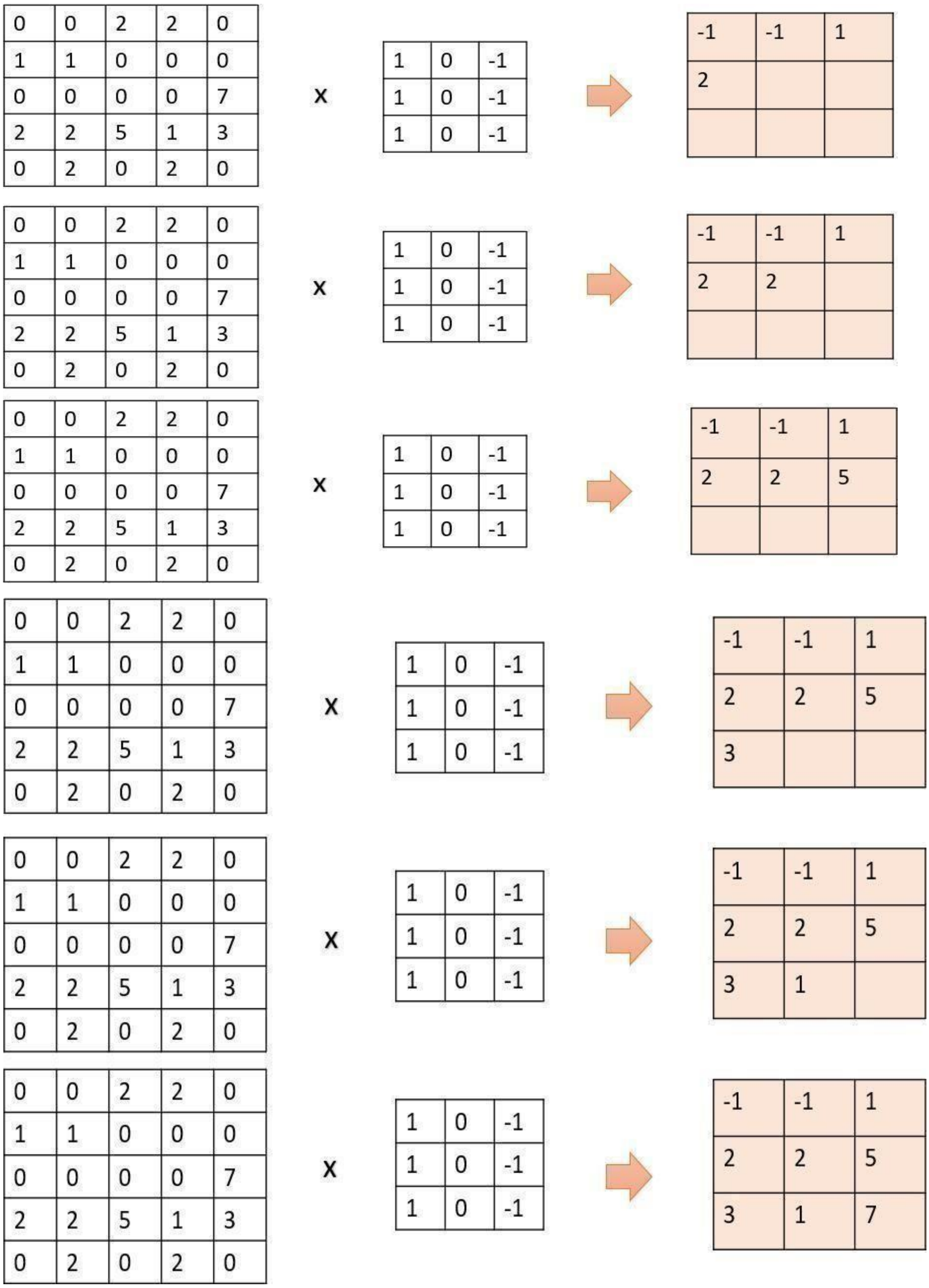
Convolution layer includes:



$$\begin{bmatrix}0&0&2&2&0\\1&1&0&0&0\\0&0&0&0&7\\2&2&5&1&3\\0&2&0&2&0\end{bmatrix} X \begin{bmatrix}1&0&-1\\1&0&-1\\1&0&-1\end{bmatrix} \rightarrow \begin{bmatrix}-1&&\\&&\\&&\end{bmatrix}$$

$$\begin{bmatrix}0&0&2&2&0\\1&1&0&0&0\\0&0&0&0&7\\2&2&5&1&3\\0&2&0&2&0\end{bmatrix} X \begin{bmatrix}1&0&-1\\1&0&-1\\1&0&-1\end{bmatrix} \rightarrow \begin{bmatrix}-1&-1&\\&&\\&&\end{bmatrix}$$

$$\begin{bmatrix}0&0&2&2&0\\1&1&0&0&0\\0&0&0&0&7\\2&2&5&1&3\\0&2&0&2&0\end{bmatrix} X \begin{bmatrix}1&0&-1\\1&0&-1\\1&0&-1\end{bmatrix} \rightarrow \begin{bmatrix}-1&-1&1\\&&\\&&\end{bmatrix}$$



$$\begin{array}{|c|c|c|c|c|}\hline 0&0&2&2&0\\\hline 1&1&0&0&0\\\hline 0&0&0&0&7\\\hline 2&2&5&1&3\\\hline 0&2&0&2&0\\\hline\end{array} \times \begin{array}{|c|c|c|}\hline 1&0&-1\\\hline 1&0&-1\\\hline 1&0&-1\\\hline\end{array} \Rightarrow \begin{array}{|c|c|c|}\hline -1&-1&1\\\hline 2&&\\\hline &&\\\hline\end{array}$$

$$\begin{array}{|c|c|c|c|c|}\hline 0&0&2&2&0\\\hline 1&1&0&0&0\\\hline 0&0&0&0&7\\\hline 2&2&5&1&3\\\hline 0&2&0&2&0\\\hline\end{array} \times \begin{array}{|c|c|c|}\hline 1&0&-1\\\hline 1&0&-1\\\hline 1&0&-1\\\hline\end{array} \Rightarrow \begin{array}{|c|c|c|}\hline -1&-1&1\\\hline 2&2&\\\hline &&\\\hline\end{array}$$

$$\begin{array}{|c|c|c|c|c|}\hline 0&0&2&2&0\\\hline 1&1&0&0&0\\\hline 0&0&0&0&7\\\hline 2&2&5&1&3\\\hline 0&2&0&2&0\\\hline\end{array} \times \begin{array}{|c|c|c|}\hline 1&0&-1\\\hline 1&0&-1\\\hline 1&0&-1\\\hline\end{array} \Rightarrow \begin{array}{|c|c|c|}\hline -1&-1&1\\\hline 2&2&5\\\hline &&\\\hline\end{array}$$

$$\begin{array}{|c|c|c|c|c|}\hline 0&0&2&2&0\\\hline 1&1&0&0&0\\\hline 0&0&0&0&7\\\hline 2&2&5&1&3\\\hline 0&2&0&2&0\\\hline\end{array} \times \begin{array}{|c|c|c|}\hline 1&0&-1\\\hline 1&0&-1\\\hline 1&0&-1\\\hline\end{array} \Rightarrow \begin{array}{|c|c|c|}\hline -1&-1&1\\\hline 2&2&5\\\hline 3&&\\\hline\end{array}$$

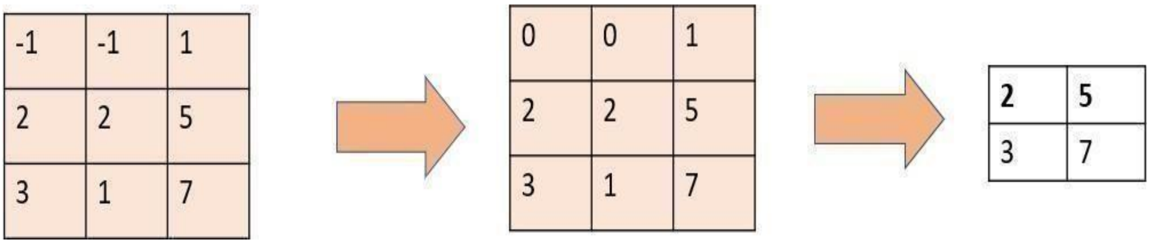
$$\begin{array}{|c|c|c|c|c|}\hline 0&0&2&2&0\\\hline 1&1&0&0&0\\\hline 0&0&0&0&7\\\hline 2&2&5&1&3\\\hline 0&2&0&2&0\\\hline\end{array} \times \begin{array}{|c|c|c|}\hline 1&0&-1\\\hline 1&0&-1\\\hline 1&0&-1\\\hline\end{array} \Rightarrow \begin{array}{|c|c|c|}\hline -1&-1&1\\\hline 2&2&5\\\hline 3&1&\\\hline\end{array}$$

$$\begin{array}{|c|c|c|c|c|}\hline 0&0&2&2&0\\\hline 1&1&0&0&0\\\hline 0&0&0&0&7\\\hline 2&2&5&1&3\\\hline 0&2&0&2&0\\\hline\end{array} \times \begin{array}{|c|c|c|}\hline 1&0&-1\\\hline 1&0&-1\\\hline 1&0&-1\\\hline\end{array} \Rightarrow \begin{array}{|c|c|c|}\hline -1&-1&1\\\hline 2&2&5\\\hline 3&1&7\\\hline\end{array}$$

Figure 2.11: Convolutional Layer.

The figure 2.11 shows convolution layer. The Convolution is followed by the rectification of negative values to 0s, before pooling. Here, it is not demonstratable, as all values are positive.In fact, multiple iterations of both are needed before pooling.

Pooling Layer



$$\begin{bmatrix} -1 & -1 & 1 \\ 2 & 2 & 5 \\ 3 & 1 & 7 \end{bmatrix} \rightarrow \begin{bmatrix} 0 & 0 & 1 \\ 2 & 2 & 5 \\ 3 & 1 & 7 \end{bmatrix} \rightarrow \begin{bmatrix} 2 & 5 \\ 3 & 7 \end{bmatrix}$$

Figure 2.12: Pooling Layer.

The figure 2.12 shows the pooling layer. In Pooling layer 3*3 matrix is reduced to 2*2 matrix, this is done by selecting the maximum of the particular 2*2 matrix for the particular position. Figure 2.12 shows the Pooling Layer.

Fully connected layer and Output Layer

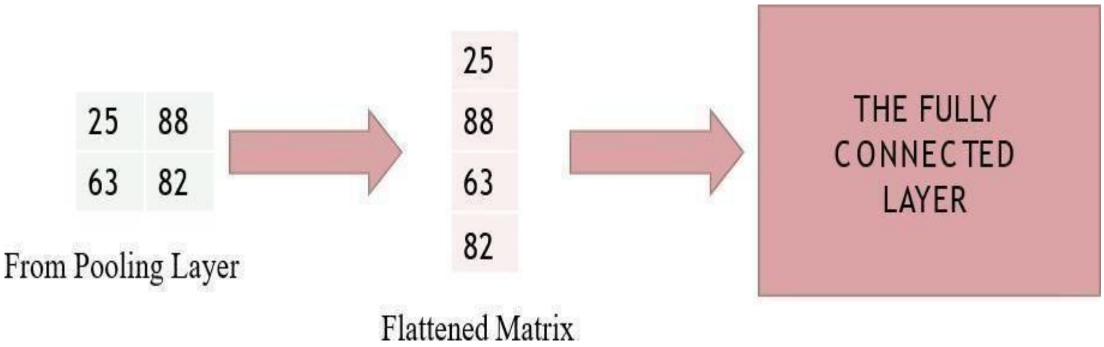


Figure 2.13: Fully Connected Layer.

The figure 2.13 shows the fully connected layer. The Fully Connected Layer is simply, feed forward neural networks. Fully Connected Layers form the last few layers in the network. The input to the fully connected layer is the output from the final Pooling or Convolutional Layer, which is flattened and then fed into the fully connected layer.

2.5 Summary

In third chapter, system design of the proposed method is discussed. Here mainly 2.1 presents system requirements specification. Section 2.2 presents the design considerations for the project. Section 2.3 discusses the system architecture of proposed system. The next Section 2.4 describes the boardwork.

CHAPTER 3

IMPLEMENTATION

Implementation is the process of converting a new system design into an operational one. It is the key stage in achieving a successful new system. It must therefore be carefully planned and controlled. The implementation of a system is done after the development effort is completed.

3.1 Implementation Requirements

To implement Smart street light using Convolutional Neural Network,

Software used are,

- ➢ Language used to code the project is Python.
- ➢ Operating System-Windows 10.

Visual Studio Code

Visual Studio Code is a freeware source-code editor made by Microsoft for Windows, Linux and mac OS. Features include support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded Git. Users can change the theme, keyboard shortcuts, preferences, and install extensions that add additional functionality.

3.2 Programming Language Used

Programming language used to design the proposed method is Python. Python is a high-level programming language with dynamic semantics. It is an interpreted language i.e. interpreter executes the code line by line at a time, thus makes debugging easy Python ImagingLibrary(PIL) is one of the popular libraries used for image processing. PIL can be used to display image, create thumbnails, resize, rotation, convert between file formats, contrast enhancement, filter and apply other digital image processing techniques etc. Python is often used as a support language for software developers, for build control and management, testing, and in many other ways. Python is designed by Guido van Rossum.It is very easy for user to learn this language because of its simpler coding. It provides an easy environment to furnish computation, programming visualization. Python supports modules and packages, which encourages program modularity and code reuse.

Key Features of Python

- Python is an interpreted language i.e. interpreter executes the code line by line at a time,thus makes debugging easy.
- To design and solve problems it offers an interactive atmosphere.
- Python has a large and broad library and provides rich set of module and functions forRapid application development.
- Built in graphics for conception of data and tools is also supported.
- It can be easily integrated with languages like C, C++, JAVA etc.
- Python can be extensible, portable, interpreted.

TKinter GUI

Python offers multiple options for developing GUI (Graphical User Interface).Out of all the GUI methods, tkinter is the most commonly used method. It is a standard Python interface to the Tk GUI toolkit shipped with Python.

Open CV-Python Tool

Open CV-Python is a library of Python bindings designed to solve computer vision problems. Visual information is the most important type of information perceived.

Flask

Flask offers suggestions, but doesn't enforce any dependencies or project layout. It is up to the developer to choose the tools and libraries they want to use. There are many extensionsprovided by the community that make adding new functionality easy.

Google Colab

Colaboratory, or "Colab" for short, is a product from Google Research. Colab allows anybody to write and execute arbitrary python code through the browser, and is especially wellsuited to machine learning, data analysis and education.

Packages

Packages are the name spaces which consists of multiple packages and module themselves. Each package in Python is a directory which must contain a special file called_init_py.

1. Csv

In this work, to import or export spread sheets and databases for its use in the Python interpreter, the CSV module, or Comma Separated Values format is used. These CSV files areused to store a large number of variables or data and the CSV module is a built-in function thatallows Python to parse these types of files.

The text inside a CSV file is organized in the formof rows, and each row consists of the columns, all separated by commas, indicates the separatecells in CSV file. There is no standard for the CSV modules hence, these modules makes use of "dialects" to support parsing using different parameters. The text inside a CSV file is organized in the form of rows.

The CSV module includes all the necessary built-in functions, csv.reader and csv.writer are themost commonly used built-in functions in Python. These functions are given below.

csv.reader (csvfile, dialect='excel', **fmtparams)

It will return a reader object which will iterate over lines in the given csvfile. csvfile can be any object which supports the iterator protocol and returns a string each time its next() method is called – file objects and list objects are both suitable. If csv file is a file object, it must be opened with the 'b' flag on platforms where that makes a difference. An optional dialectparameter can be given which is used to define a set of parameters specific to a particular CSVdialect.

It may be an instance of a subclass of the Dialect class or one of the strings returned bythe list_dialects() function. The other optional fmtparams keyword arguments can be given to override individual formatting parameters in the current dialect. Each row read from the csv file is returned as a list of strings. No automatic data type conversion is performed.

csv.writer (csvfile, dialect='excel', **fmtparams)

It returns a writer object responsible for converting the user's data into delimited strings onthe given file-like object. csvfile can be any object with a write() method. If csvfile is a fileobject, it must be opened with the 'b' flag on platforms where that makes a difference. Anoptional dialect parameter can be given which is used to define a set of dialect. It may be an instance of a subclass of the Dialect class or one of the strings returned by thelist_dialects() function

2. Tensorflow

Tensorflow is a free and open source software library for dataflow and differentiable programming across a range of tasks. It is a symbolic math library, and is also used for machine learning applications such as neural network, it is used for both research and production at Google.

Tensorflow was developed by the Google Brain team for internal Google use. It was released under the Apache License 2.0 on November 9, 2015. Tensorflow is Google Brain's second-generation system. Version 1.0.0 was released on February 11, 2017. While the reference implementation runs in single devices, Tensorflow can run on multiple CPUs and GPUs. Tensorflow is available on 64- bit Linux, macOS, Windows and mobile computing platforms including Android and ios.

3. Keras

Keras is an open source neural- network library written in Python. It is capable of Running on top of Tensorflow, Microsoft Cognitive Toolkit, R, Theano or PlaidML. It is designed to enable fast experimentation with deep neural networks. It focuses in being user- friendly, modular, and extensible CUDA.

Keras contains numerous implementations of commonly used neural- network building blocks such as layers, objectives, activation function, optimizers, and a host of tools to make working with image and text data easier to simplify thecode necessary for writing deep neural network code. The code is hosted on GitHub, and commonly support forums include the GitHub issues page, and a Slack channel. In addition toStandard neural networks.

Keras has support for convolutional and recurrent neural networks. It supports other common utility layers like dropout, batch normalization and pooling. Keras allows users to productize deep models on smart phones, on the web or on the java virtual machine. Colab allows you to use and shareJupiter notebooks with others without having to download, install, or run anything. Code is Executed in a virtual machine private to your account. Virtual machines are deleted when idlefor a while, and have a maximum lifetime enforced by the Colab service**.** Virtual machines are deleted when idlefor a while, and have a maximum lifetime enforced by the Colab service. Resources in Colab are prioritized for users who have recently used less resources. It also allows use of distributed training of deep learning models on clusters of Graphics processing units (GPU) and tensor processing units (TPU) principally in conjunctionwith CUDA.

4. NumPy

NumPy is a python library used for working with arrays. It also has functions for working in domain of linear algebra, Fourier transform, and matrices. NumPy was created in 2005 by Travis Oliphant.

It is an open source project and you can use it freely. NumPy standsfor Numerical Python. In Python we have lists that serve the purpose of arrays, but they are slow to process. NumPy aims to provide an array object that is up to 50x faster than traditional Python lists.

The array object in NumPy is called n array, it provides a lot of supporting functions that make working with n array very easy. Arrays are very frequently used in data science, where speed and resources are very important. NumPy arrays are stored at one continuous place in memory unlike lists, so processes can access and manipulate them very efficiently. This behaviour is called locality of reference in computer science. This is the mainreason why NumPy is faster than lists. Also, it is optimized to work with latest CPU architectures

5. Matplotlib

Matplotlib is a comprehensive library for creating static, animation and interactive visualizations. Matplotlib produces publication quality figures in a hard-copy format. pyplot isa collection of command style functions that make matplotlib work like MATLAB.

3.3 Pseudocodes for Preprocessing Techniques

1. Pseudocode for Picture Uploading

Pseudocode 1 explains the code for picture uploading. The code concerning machines being able to understand images and videos, is one of the hottest topics in the tech industry, Robotics, self-driving cars, and facial recognition all rely on computer vision to work. At the core of computer vision is image recognition, the task of recognizing what an image represents. Input image is obtained from the datasets which represents a healthy or diseased cell.

The pseudocode is as follows,

```
Step 1: Click on upload
Step 2: Read the cell image from datasets imageA=cv2.imread(args["first"])
Step 3: Display the name of the image on the web page
Step 4: Shows the name of the image in the dialog box.
```

2. Pseudocode for Converting RGB image to Gray

The pseudocode 2 explains the conversion of RGB image to grey. In this section the RGB image is converted to grey image because it is easy to perform the operations such as,

- Median filtering
- Thresholding
- High pass filtering.

The pseudocode is as follows,

```
Step 1: Converting RGB to Gray
Step 2: Show the window to display the image
Step 3: Display the image in the window
Step 4: Multiply each plane with a threshold value
Step 5: after completing above step follow the step 6 for accurate results.
Step 6: Grey_pixel = (R_plan * R_thresh) + (G_plan * G_thresh) + (B_plan * B_thresh);
```

3. Pseudocode for Converting RGB image to Gray

The pseudocode 3 explains the conversion of RGB image to grey. In this section the RGB image is converted to grey image because it is easy to perform the operations such as,

- Median filtering
- Thresholding
- High pass filtering.

The pseudocode is as follows,

```
Step 1: Converting RGB to Gray
Step 2: Show the window to display the image
Step 3: Display the image in the window
Step 4: Multiply each plane with a threshold value
Step 5: Complete the whole procedure
Step 6: Grey_pixel = (R_plan * R_thresh) + (G_plan * G_thresh) + (B_plan * B_thresh);
```

4. Pseudocode for Thresholding

```
Step 1: for i:=1 to480*640pixels
Step 2: if new_im(i)<T
Step 3: Change to black, and consider as obstacle setnew_im(i)=0
Step 4: Change to white, and consider as free space else set new_im(i)=1
```

The pseudocode 4 is a code for thresholding. Image thresholding is a simple, yet effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images.

5. Pseudocode for Highpass Filtering

```
Step1: Displays the high contrast version of original image.
Step2: Make a copy of the original image.
        Initialize color[ ][ ] retval    copy(original)
Step3: Blur the copy of original image.
        set color[ ][ ]    blurred gaussian  Blur(original)
Step4: Subtract the blur image from original image.
        Color[ ][ ]  highpass difference(original,blurred)
Step5: Add the unsharp mask to original image to get sharpened image.
Step6: Run a loop for the entire rows and columns
        For row=0 to original.length repeat until for col=0
        to original[row].length repeat until initialize color
        original[row][col]
        Initialize contrast Color high Contrast[row][col]
        set color difference←contrastColor - origColor
        end for
        end for
```

The pseudocode 5 is for high pass filtering. The high-pass filter can be used to make an image appear sharper. These filters emphasize fine details in the image- which is exactly the opposite of low pass filters. Highpass filtering works in exactly the same way as a low pass filter except that it uses a different convolution kernel. Unfortunately, while low-pass filtering smooths out noise, high-pass only does the opposite by amplifying noise. However, if the original image is not too noisy-this is avoided to an extent.

Summary

This chapter describes the implementation of the Smart and adaptive street lighting with safety system using various CNN architectures. Implementation requirement is deliberated in Section 3.1, Section 3.2 briefs about the programming language selected. Section 3.3 describes the pseudocode for pre processing techniques.

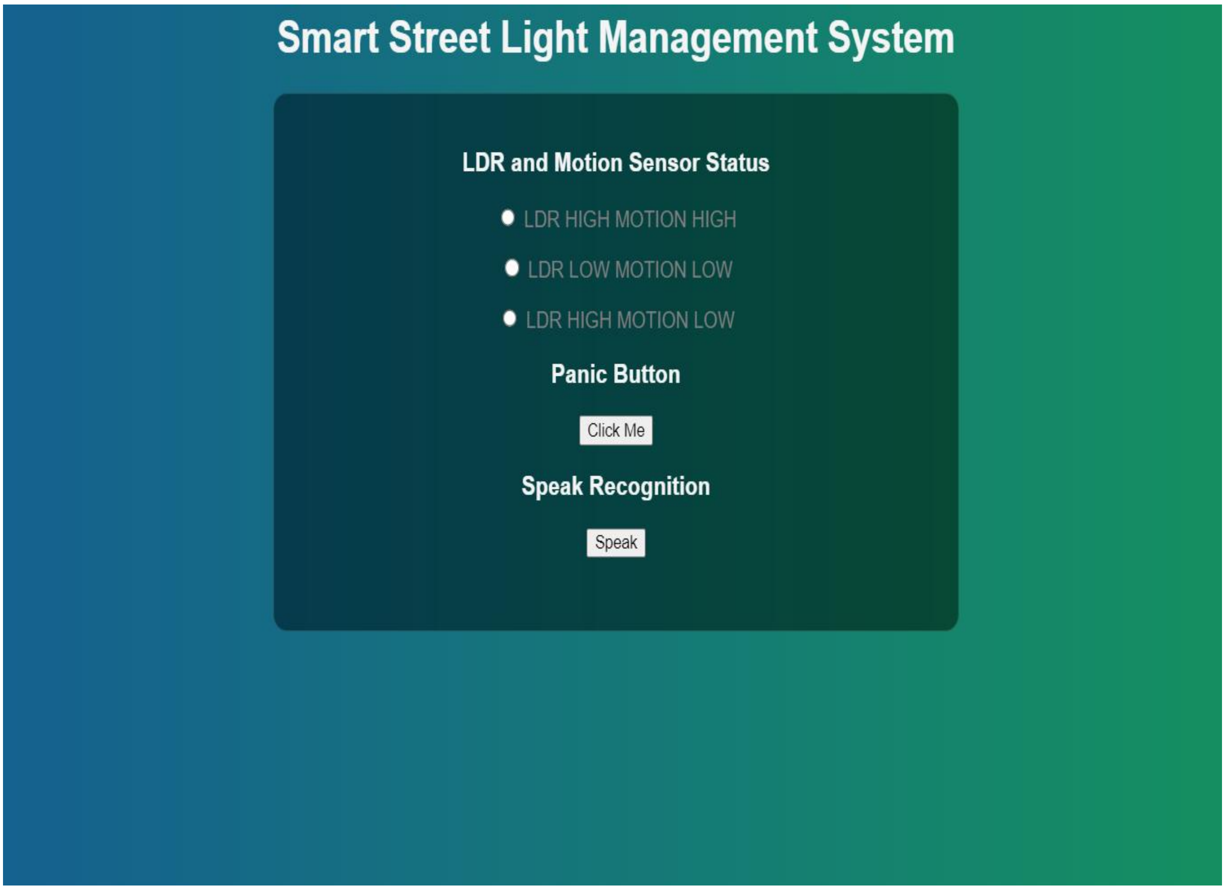
CHAPTER 4

RESULTS AND ANALYSIS

Programming language used to design the proposed method is Python. By using relevant images of objects, classified using CNN architectures, we get to know the objects that is present or not, with a small description as the output, results obtained in each step are demonstrated in following snapshots.

Screenshot showing, Motion detection for balancing intensity of street light.

4.1 Snapshot showing Homepage



Smart Street Light Management System

LDR and Motion Sensor Status

- ○ LDR HIGH MOTION HIGH
- ○ LDR LOW MOTION LOW
- ○ LDR HIGH MOTION LOW

Panic Button

Speak Recognition

Snapshot 4.1: Home Page of Smart street light with safety system.

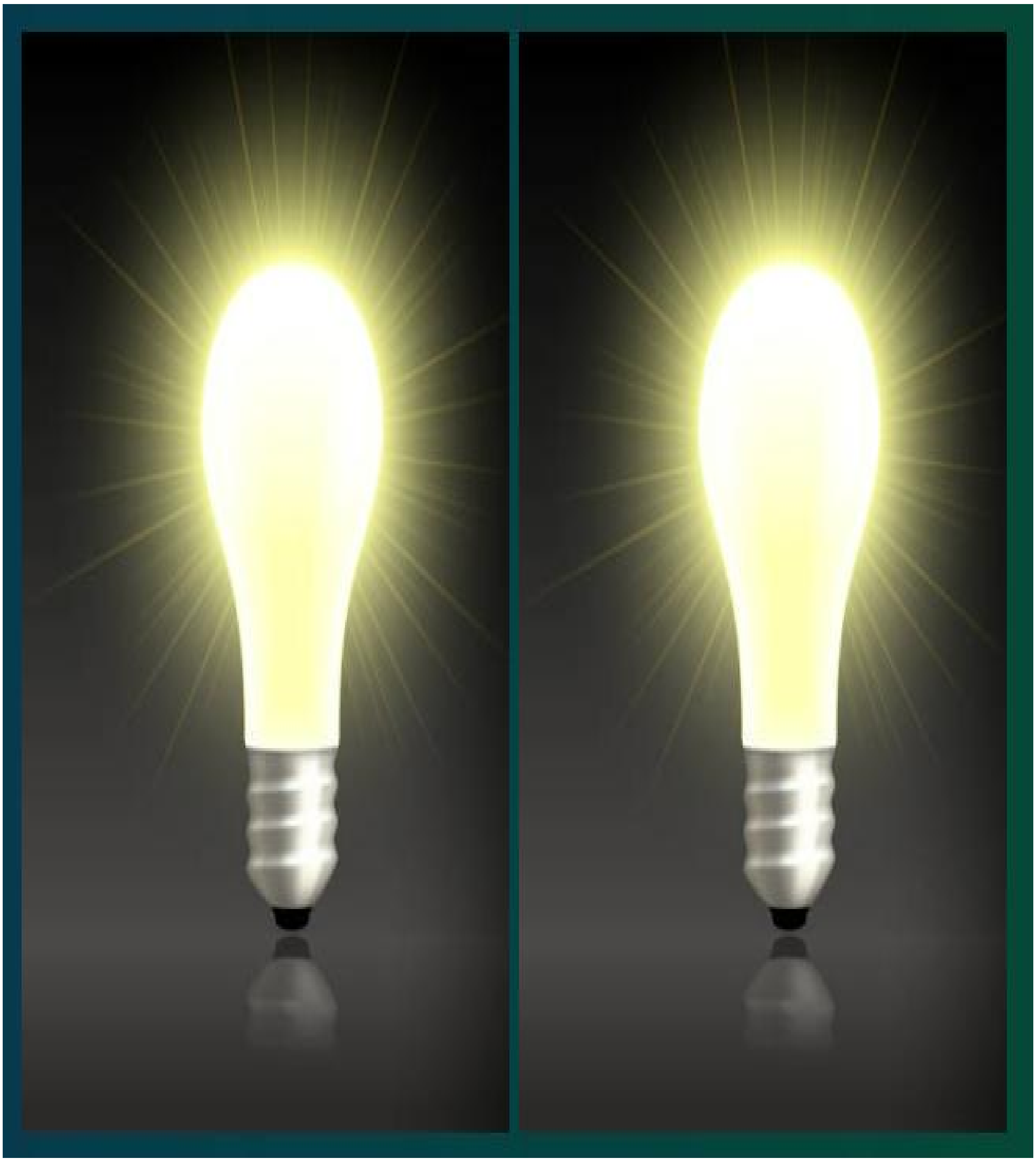
The snapshot 4.1 shows the home page of Smart street light with safety system. The home page for the smart strrt light performance is shown above, where the particular image for the object is selected. Then, the further techniques such as original image to the gray Scale conversion followed by the and future extraction are done.

4.2 Screenshot displaying the street light on when both LDR and motion of object is high.

4.2: displaying the analysis of image selected from the dataset.

The snapshot 4.2 displaying the detection of object selected from the dataset. The detection of object selecting a particular image is shown, where the original image is converted into grayscale image where in the wanted data from the image can be obtained and that data is sent for the segmentation to extract the specific image features required for detection. As a result of this, one or more one or more objects can be detected or none of the objects maybe detected or only one can be detected. By this the intensity of street light changes.

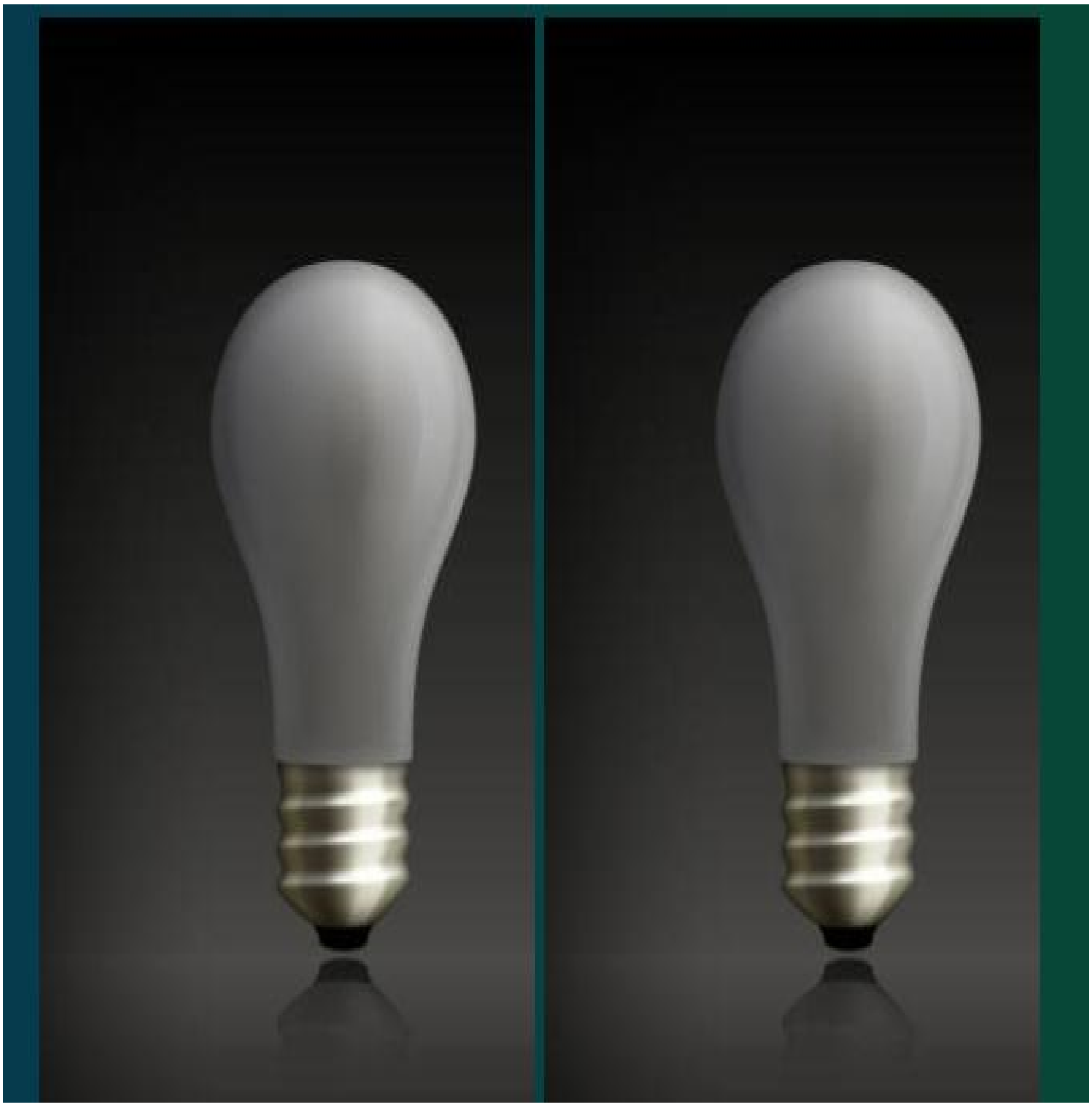
4.3 LDR high and motion high.



Snapshot 4.3: Screenshot of the page when LDR high and motion high.

The snapshot 4.3 displays the screen shot showing the page when both LDR(Light Detecting Resistor) and motion of an objects are high. Both the bulbs in the smart street light are on. This shows that the intensity on sunlight is low so that one bulb is on and mothion of vehicals are also more so the second bulb is also in on condition.

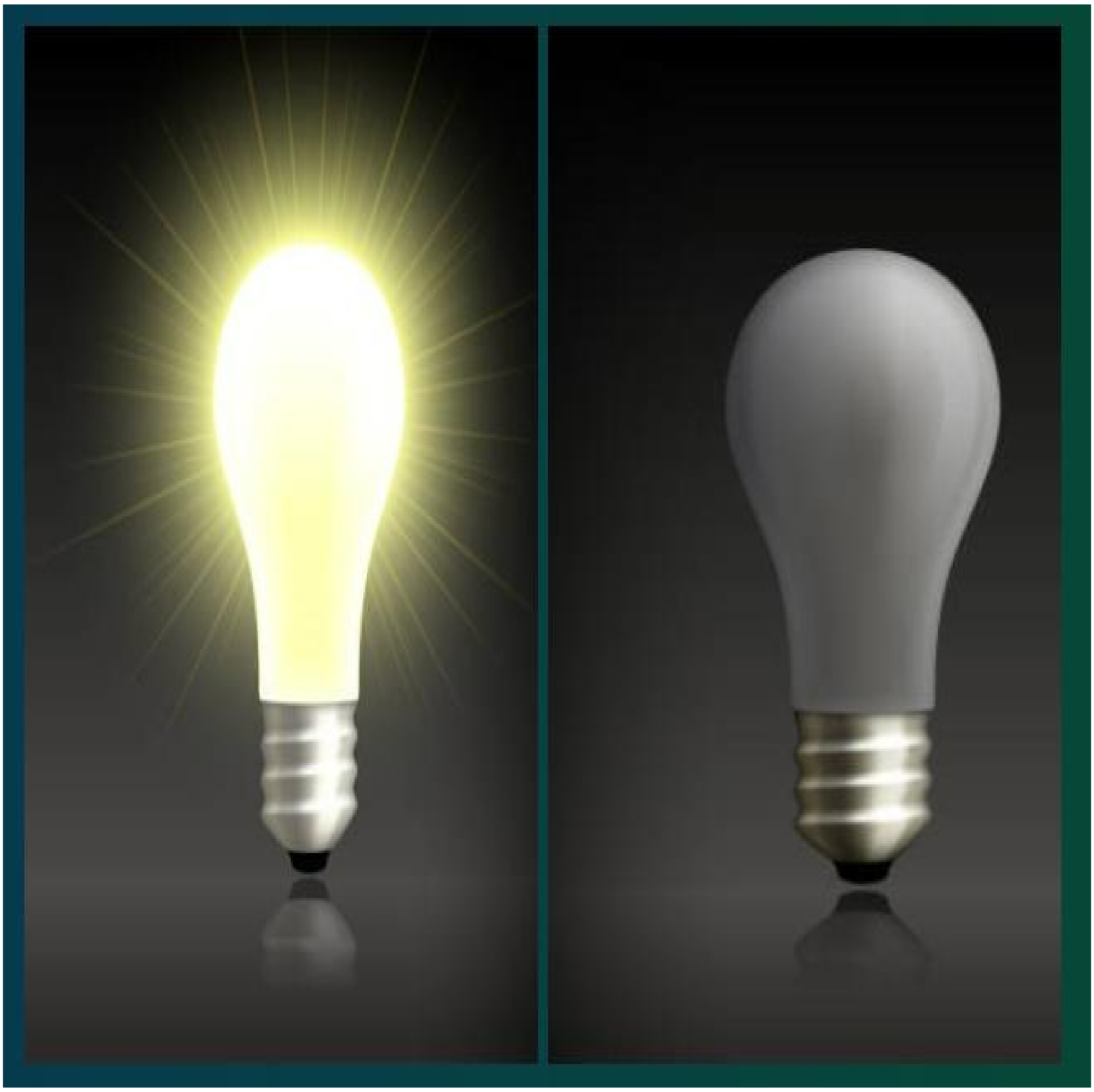
4.4 LDR low and motion low.



Snapshot 4.4: Screenshot of the page when LDR low and motion low.

The snapshot 4.4 shows the screen shot of the page when LDR low and motin low. It is a case when the intensity of sunlight is high and the objects or the movement of the vehicals are low which is in the case of late night both the bulbs in the street light is off to conserve energy. When both the lights are turned off it is the case that there are no vehical movements on the road.

4.5 LDR High and motion low.

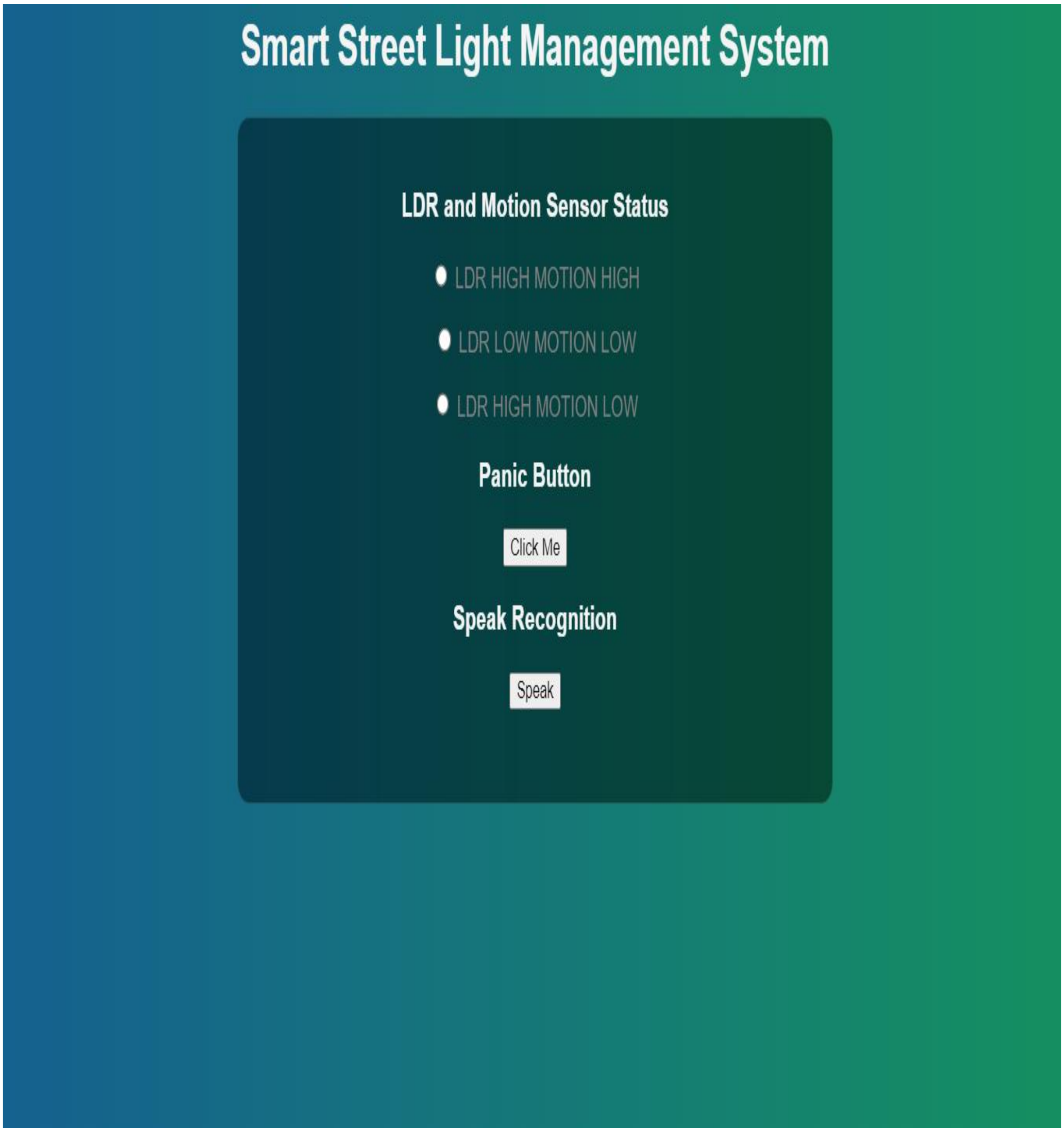


Snapshot 4.5: Screenshot of the page when LDR high and motion low.

The screenshot 4.5 shows the page when LDR low and motion low. Here the intensity of the sun light is less so that one bulb in the smart street light is on and the movement of the objects are less which means the movement of vehicals are less so that one bulb is turned off in the street light. By this kind of action it will be helpful for the conservation of energy.

In the case such that LDR is low and motion is high both the lights are off because anyway there is a sunlight.

4.6 Detection and capturing of abnormal activities on street through panic button.



Smart Street Light Management System

LDR and Motion Sensor Status

- LDR HIGH MOTION HIGH
- LDR LOW MOTION LOW
- LDR HIGH MOTION LOW

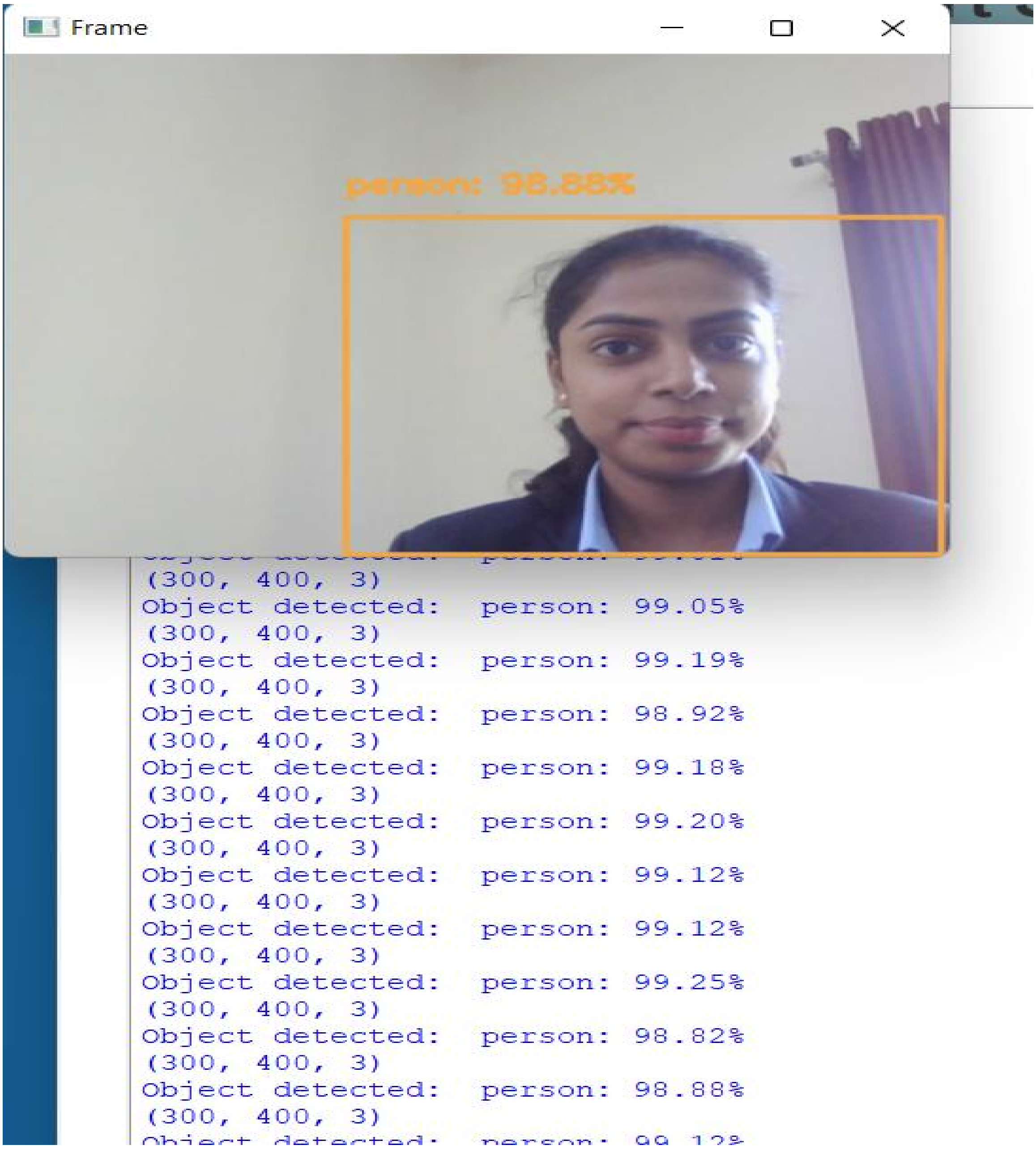
Panic Button

Speak Recognition

Snapshot 4.6: Screenshot of the page showing panic button.

The screenshot 4.6 shows the home page containing panic button. In street lights the panic buttons are placed in the reachable hights so that any person can click the button to start recording. After quiting the mail will be sent to near by police stations through email so that it will be helpful for the public to capture any abnormal activities or any accidents that may happen immidiate actions can be taken on that. By clicking on speak button in speck recognition any one can record their voice too. This will be forwarded directly to stations.

4.7 Video recording and email forwarded to station

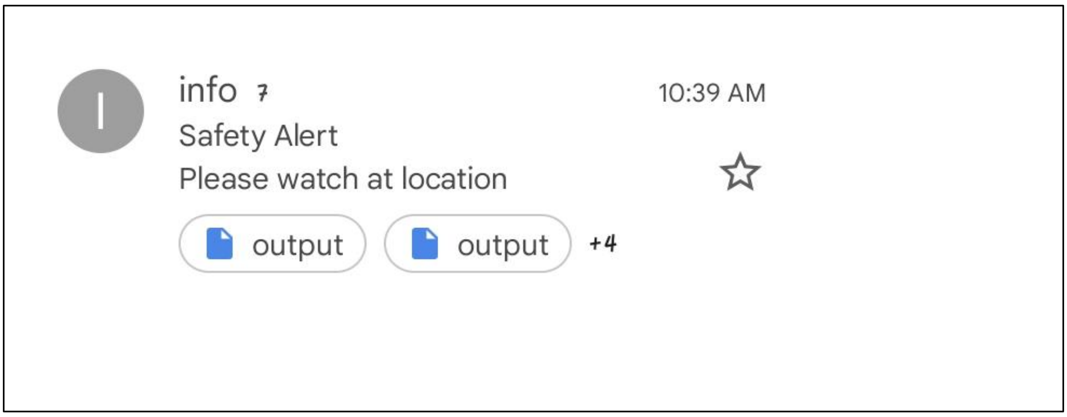


```
(300, 400, 3)
Object detected:  person: 99.05%
(300, 400, 3)
Object detected:  person: 99.19%
(300, 400, 3)
Object detected:  person: 98.92%
(300, 400, 3)
Object detected:  person: 99.18%
(300, 400, 3)
Object detected:  person: 99.20%
(300, 400, 3)
Object detected:  person: 99.12%
(300, 400, 3)
Object detected:  person: 99.12%
(300, 400, 3)
Object detected:  person: 99.25%
(300, 400, 3)
Object detected:  person: 98.82%
(300, 400, 3)
Object detected:  person: 98.88%
(300, 400, 3)
Object detected:  person: 99.12%
```

Snapshot 4.7: Snapshot showing the video recording and email forwarded to station

The snapshot 4.7 showing how the video is beeing recorded. It also shows that which type of object is beeing detected and also how far is the object from the streetlight. We can also record the voice in the same way by clicking speak button. After video is been recorded or the voice is recorded we have to quit the video by clicking 'q'. After the quit the video footages or the voice recordings will be forwarded to the emails of near by police stations as shown in the snapshot

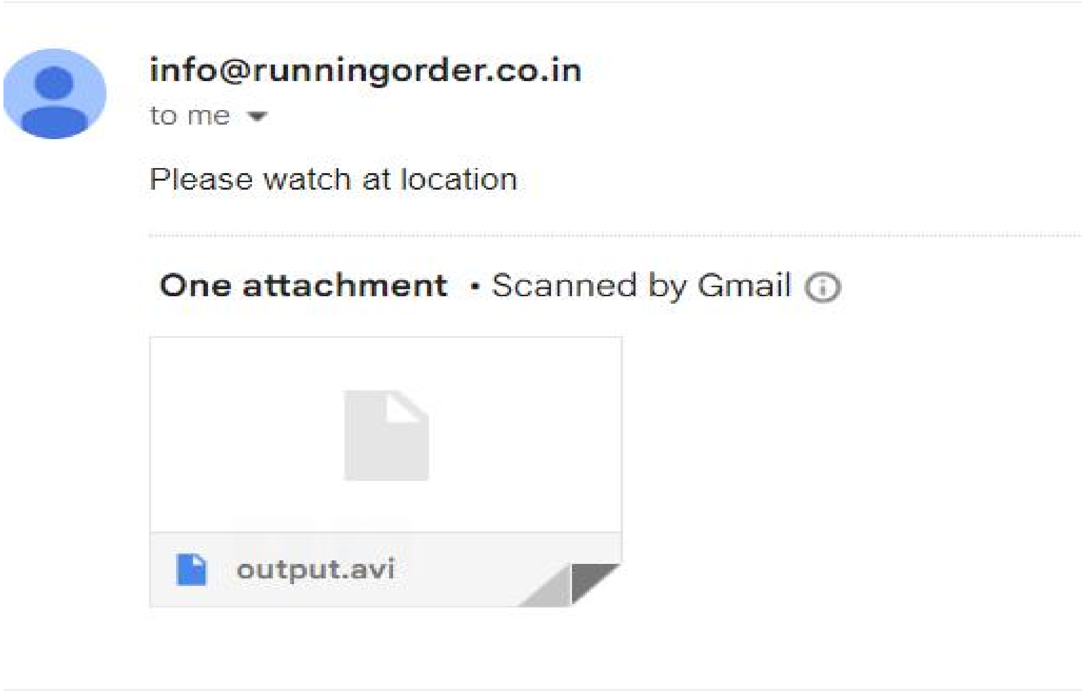
4.8 Email sent to nearby stations



info 7 10:39 AM

Safety Alert

Please watch at location



info@runningorder.co.in

to me

Please watch at location

One attachment • Scanned by Gmail

Snapshot 4.8: Snapshot showing email with video footage or voice notes in stations

The snapshot 4.8 showing the email sent to nearby satations with live video footages or the voice recording sent by a person. It shows that there is a safety alert please watch the location. The mail contains the video footage or the voice recording along with the location it will helps in taking immidiate actions on the abnormal activities or the accidents. This shows that the safety measures that can be taken on public by introducing smart street lights in the cities.

4.9 Summary

This chapter is about results and analysis. The section 4.1 shows Snapshot showing Homepage. The section 4.2 showsScreenshot displaying the street light on when both LDR and motion of object is high. The section 4.3 shows when the LDR high and motion high. The section 4.4 shows LDR low and motion low. The section 4.5 shows LDR High and motion low. The section 4.6 shows Detection and capturing of abnormal activities on street through panic button. The section 4.7 shows Video recording and email forwarded to station. The section 4.8 shows Email sent to nearby stations

CHAPTER 5

CONCLUSION AND FUTURE ENHANCEMENTS

5.1 Conclusion

I would like to conclude that expert-level diagnosis may be achieved with limited training data using a relatively simple, computationally efficient, and explainable technique. When appropriately integrated, as done here, with domain knowledge and other more generic techniques, particular of the modules learned from the recommended methodological involvement could potentially aid supplementary medical appearance fractional and concealing appeals.

To summarize skillful colposcopist enhactment, I built a set of characteristic uprootingand elementary contraption algorithms that were acquired with a colposcope for self- operatingrecognition of objects. I believe that by using the algorithms, I will be ableto improve overall sensitivity and specificity.

In Smart and adaptive street light and safety system the system cuts down the cost of conventional system by 50-60 percent which improves the economy of the country and saves a huge amount of investment as it can be utilized in useful ideas. The system ensures the security to the people and it provides a great security. The system can prevent women harassment, thefts and other threats. The system is Cost efficient, Reliable, Wireless communication, Prevents manual ON and OFF of street lights, Prevents energy wastage, Ecofriendly and the safest way to save energy .

This system have other benefits like, dynamic lighting control based on movement detection, digital signage that can update as needed, such as detecting abnormal activities like accidents etc. Sensors that senses the voice will help recording any abnormal activities on road. Monitor and track live footages of activities on road.Street lighting controls reduces energy consumption and carbon dioxide emission. Street lighting control lowers repair and maintainance cost with the monitoring software reduces carbon emmision and pollution. By using this system it will increases lamp life and shorter response times to outages.

5.2 Future Enhancements

As a future enhancement to the system, These smart lights will help cities reduce electricity costs, lower CO2 emissions, and improve maintenance. With auto-dimming, scheduling, and a host of other capabilities, cities could see a 50-75% reduction in energy costs via smart street lighting. But energy efficiency is just the beginning.

As a future enhancement to the system, Analysts predict that as much as 89% of the planet's 363 million streetlights will have adopted LED technology by 2027. It makes financial sense. The switch to LED represents an effective reduction in costs, maintenance, and environmental degradation.

As a future enhancement to the system,The technology can control remotely the output of individual streetlights, detect faults, monitor energy performance and when coupled with sensors, even facilitate real time alerts for city-wide problems like traffic flow, parking spaces, electrical outages, and possible accidents.

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