



## **HIGH LEVEL DESIGN DOCUMENT**

### **Traffic Sign Detection and Recognition**

**UE18CS390A – Capstone Project Phase – 1**

*Submitted by:*

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## **HIGH LEVEL DESIGN DOCUMENT**

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## **1. Introduction**

This high level design document provides complete design and implementation specifications of the project “Traffic Sign Recognition System”, which is currently developed by our team.

The main objective of the project is to provide a solution for the autonomous car which involves traffic sign detection and recognition during the journey of the vehicle on the road. In the following section we will be introducing the overall description and features of the project which includes class diagrams, high level design, performance measures, etc.

We have used an iterative and incremental model for the development of this project.

## **2. Current System**

The current system under development is an application interface which takes video data as an input and given the detected traffic sign(if any) as an output. The tkinter framework of python is used for the GUI and the cv2 library is used for working with the video data.

## **3. Design Considerations**

### **3.1. Design Goals**

- The user should upload the video which contains a traffic sign using the GUI developed.
- The system developed should be able to detect traffic signs from a video.
- The detected traffic sign should be recognised and the name of the traffic sign should be displayed to the user.

### **3.2. Architecture Choices**

The design approach followed for the project development is Iterative and incremental.

#### Pros

- Initial product delivery is faster
- Develop prioritized requirements first
- Parallel development can be planned
- New features can be added in each iteration

#### Cons

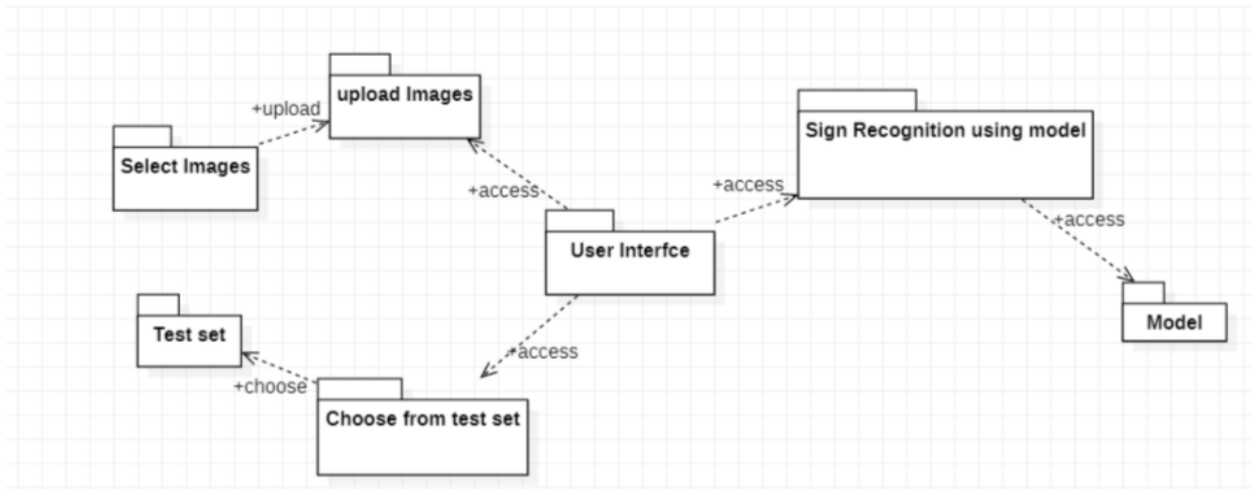
- Requires early definition of a complete and fully functional system to allow the definition of increments.
- Most of the requirements are known up-front but are expected to evolve over time.

### **3.3. Constraints, Assumptions and Dependencies**

1. Constraints:
  - a. Project mainly concentrates on Indian Traffic Signs.
  - b. The Images need to be of a reasonable quality.
2. Dependencies:
  - a. The performance of the model is dependent on the OS of the external system.
  - b. The image quality is dependent on the image capturing device(camera or recorder).
  - c. The tradeoff between the speed and the accuracy of the system.
3. Assumptions:
  - a. The Images are assumed to be of a reasonable quality.
  - b. The size of the images are assumed to be less than 5mb.
  - c. The system is assumed to accept any format of the images(jpg , jpeg, png).

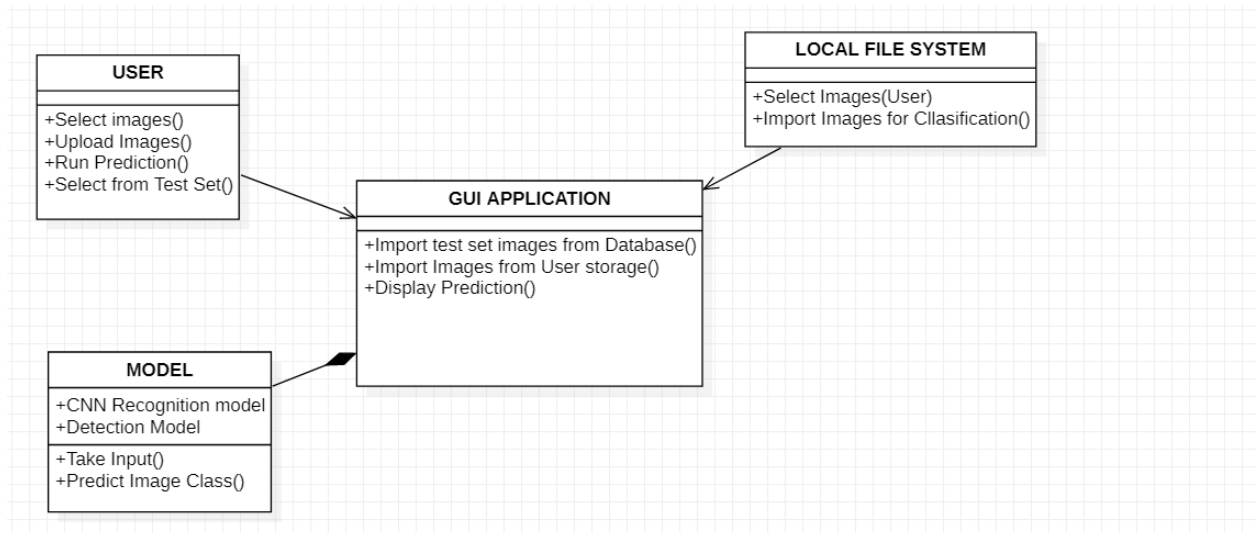
### 4. High Level System Design

The user will have the ability to upload images/video using the GUI upon which the model will be used to detect and recognise the traffic sign and display the name the image/video contains.



### 5. Design Description

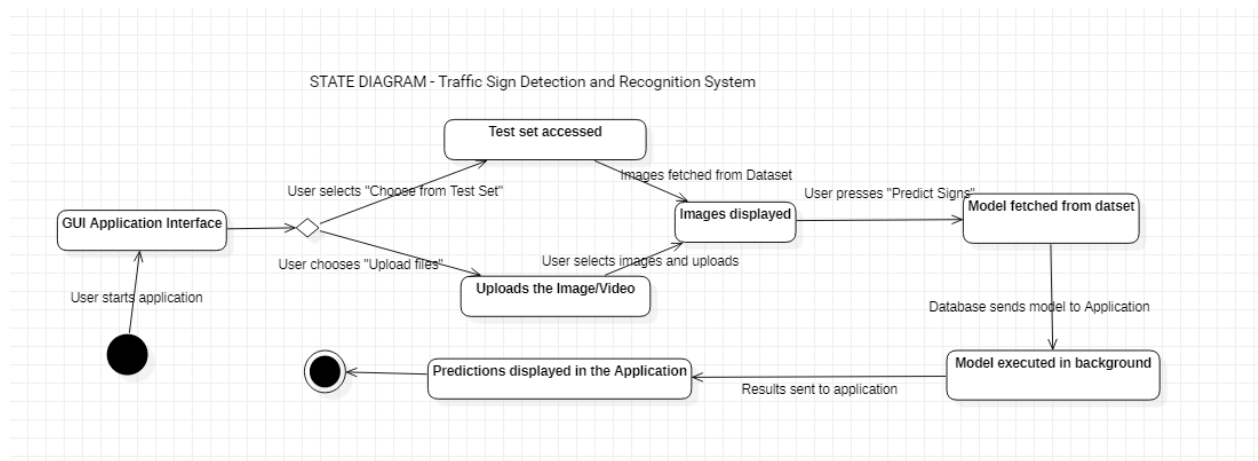
#### 5.1. Master Class Diagram



### 5.2. Reusability Considerations

- The traffic sign detection and recognition system will be built which can be modified to suit similar image recognition systems.
- A python GUI will be built which can be used for similar image detection and recognition systems.

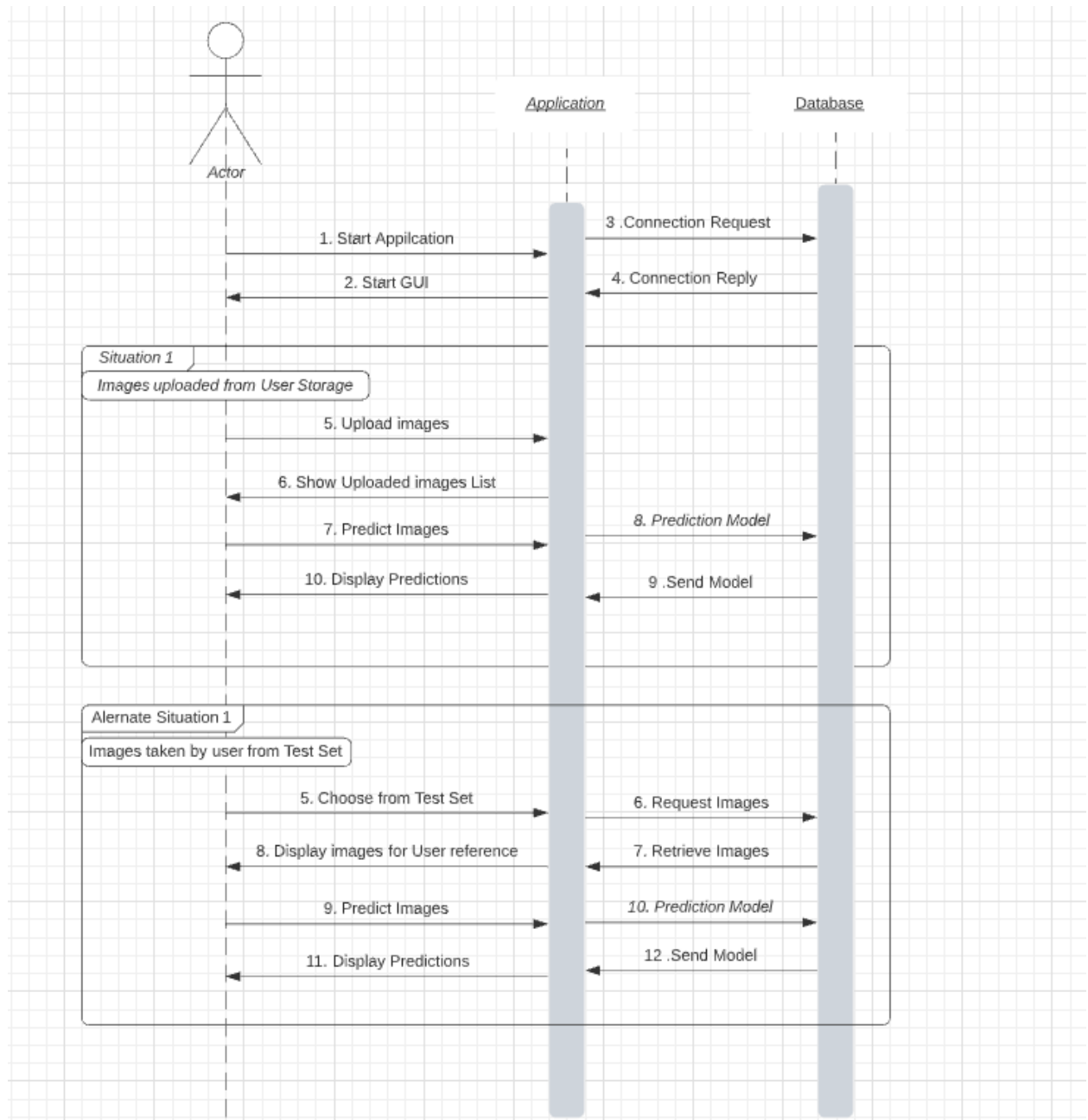
### 6. State Diagram



#	Entity	Name	Definition	Type
<b>ENTITIES</b>				
1.	GUI Application	Tkinter App	The user interface for uploading image/video	NA
2.	Python Program	Detection and Recognition Program	The Python Program for detecting and recognising the traffic signs	NA
#	Attribute	Name	Definition	Type (size)
<b>DATA ELEMENTS</b>				
1.	Images/Video	Images/Video	The images or video to be uploaded for	Less than 5 mb.

			traffic detection and recognition	sign and	
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### 7. User Interface Diagrams

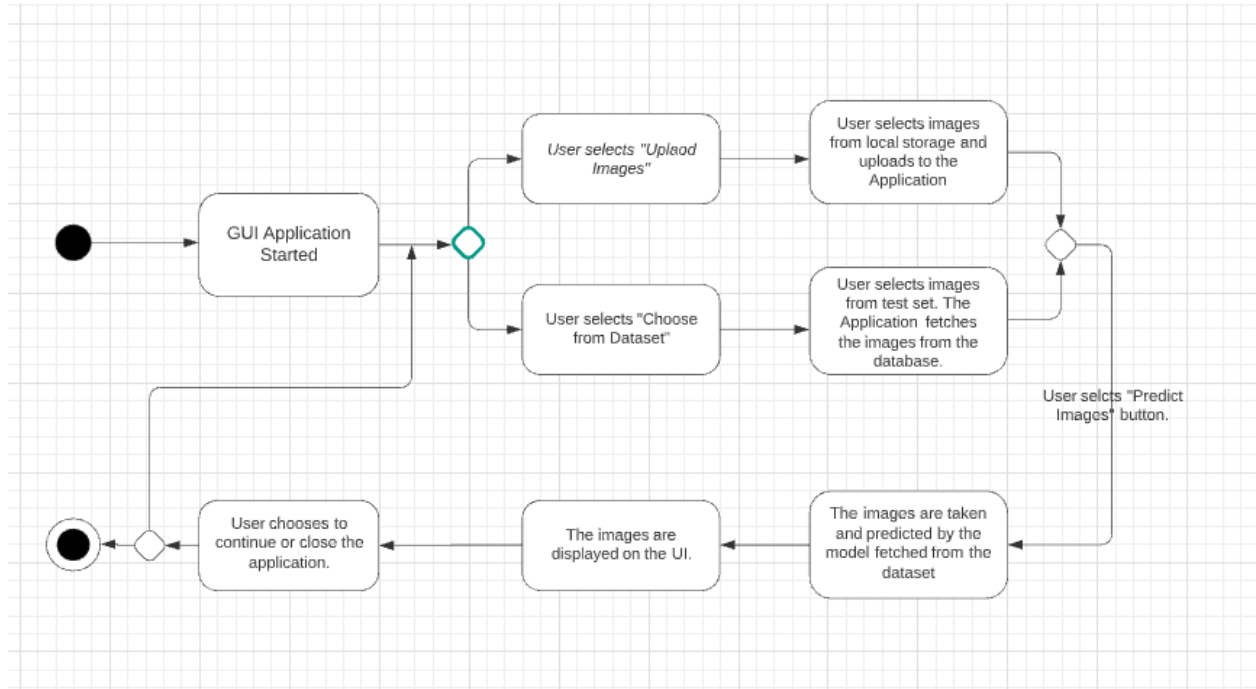




### 8. Report Layouts

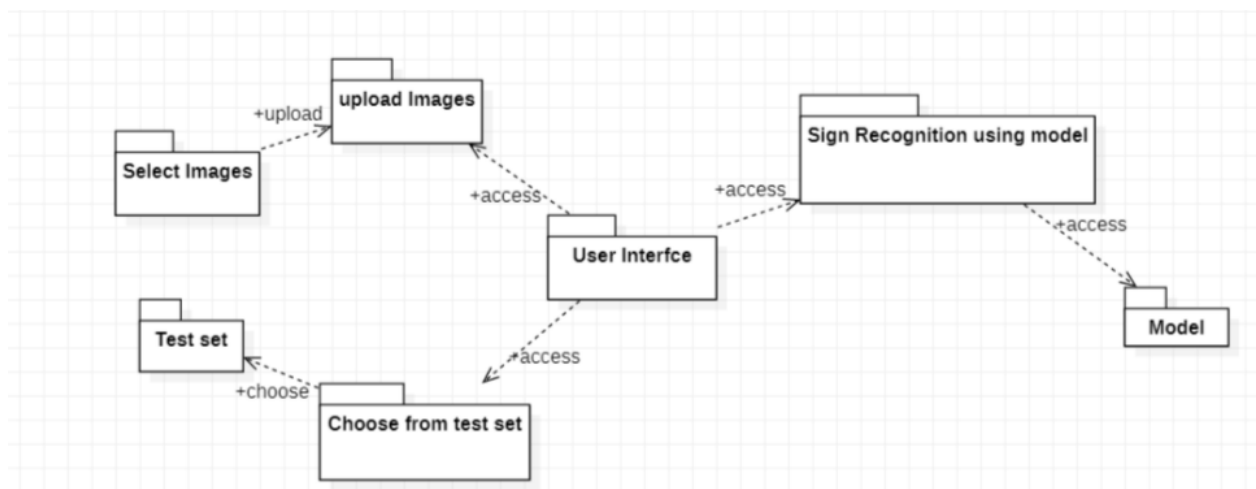
The report has been prepared in full detail containing all the required specifications and explanation.

### 9. External Interfaces

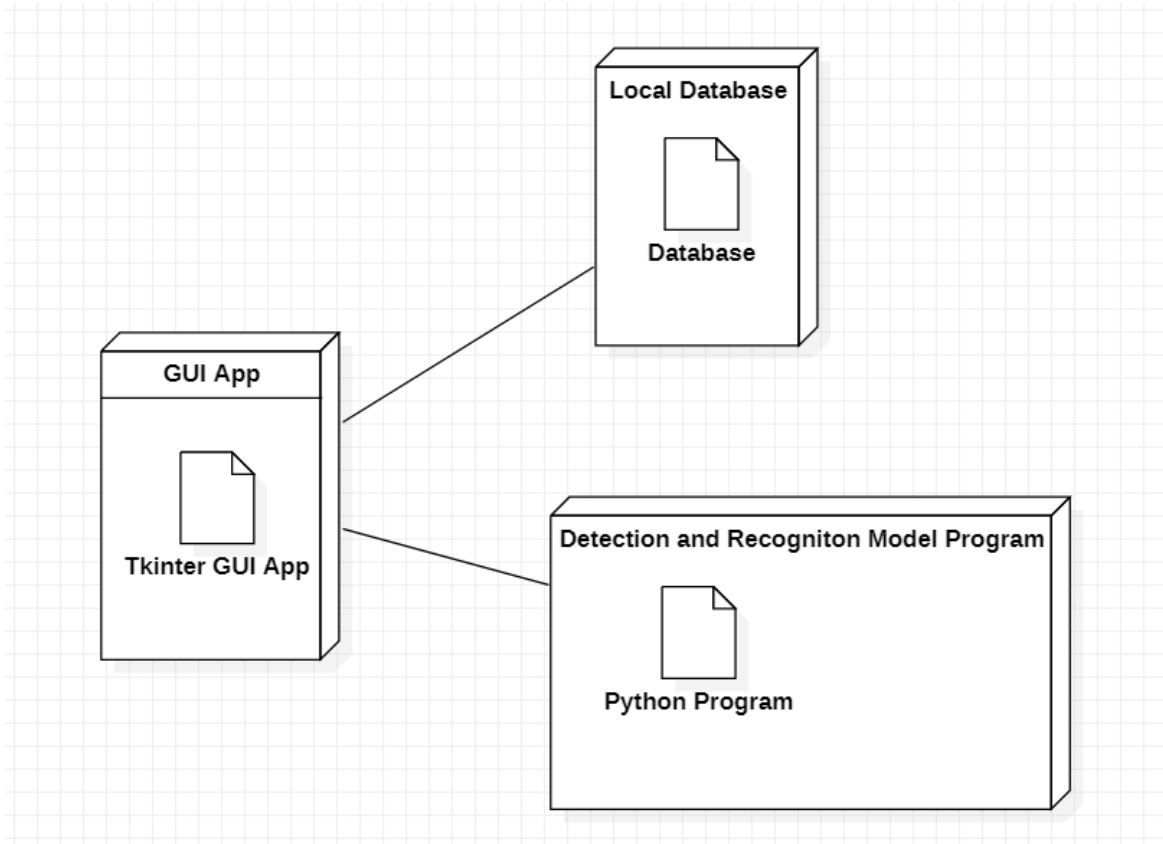


### 10. Packaging and Deployment Diagram

Package Diagram:



Deployment Diagram:



## 11. Help

The system is very simple and easy to use, so the instructions to run the model will be displayed in the GUI developed itself.

## 12. Design Details

### 12.1 Novelty

The novelty of the project lies in the methodology and the dataset. The methodology includes the use of CNN as opposed to traditional methods such as SVM, KNN. The dataset used for the project is the indian traffic sign dataset which was collected by the team manually.

### 12.2 Innovativeness

The innovativeness of the project lies in the ability of the system to autonomously detect and recognize a traffic sign.

### **12.3 Performance**

- The system performance highly depends on the speed and the framework response.
- The project uses CNN which gives the advantage of speed and accuracy over traditional models.
- The system and app framework used for the project are open-source which moderately affects the performance.
- The system should possess less calculation time and response time of determining which traffic sign does the given image correspond to.
- System should work in real time with a max delay of 7 to 8 seconds.

### **12.4 Security**

- The security of the system is a secondary concern as the images of the TSDR domain are open-source.
- The data security is provided by the web hosting site.
- The user data i.e images provided by the user are directly stored in the system storage and only accessible by the user.

### **12.5 Reliability**

The reliability of the application is high and user dependent as it runs locally on the client system.

### **12.6 Maintainability**

- The system is run locally on the client side. So maintenance is a concern of the client.
- The system can be assumed to be updated automatically for later versions.

### **12.7 Portability**

The system is run on the client operating system and portability of the system is not applicable for this project as it is run locally and on a single host.

### 12.8 Reusability

The application is reusable for any further improvements of the projects and the framework can be modified for any developments of any other project of the same domain.

### Appendix A: Definitions, Acronyms and Abbreviations

TSDR	Traffic Sign Detection and Recognition
CNN	Convolutional Neural Networks
SVM	Support Vector Machine(classifier)
KNN	K-nearest neighbours (classifier)
OS	Operating System

### Appendix B: References

<https://creately.com/blog/diagrams/uml-diagram-types-examples/>

### Appendix C: Record of Change History

#	Date	Document Version No.	Change Description	Reason for Change
1.	14-04-2021	1	capstone phase-1	new GUI idea
2.	18-05-2021	2	capstone phase-2	new system under development

### Appendix D: Traceability Matrix

[Demonstrate the forward and backward traceability of the system to the functional and non-functional requirements documented in the Requirements Document.]

Project Requirement Specification Reference Section No. and Name.	DESIGN / HLD Reference Section No. and Name.
1.1 Project Scope	1 Introduction
2.3 General Constraints, Assumptions and Dependencies	3.3 Constraints, Assumptions and Dependencies



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