## ACKNOWLEDGEMENT

The completion of project brings with and sense of satisfaction, but it is never completed without thanking the persons who are all responsible for its successful completion. First and foremost, I wish to express our deep sincere feelings of gratitude to my Institution, **Sai Vidya Institute of Technology**, for providing mean opportunity to do our education.

I would like to thank the **Management** and **Prof. M R Holla,** Director, Sai Vidya Institute of Technology for providing the facilities.

I extend my deep sense of sincere gratitude to **Dr. H S Ramesh Babu**, Principal, Sai Vidya Institute of Technology, Bengaluru, for having permitted to carry out the project work on "**Sign Language Recognition**" successfully.

I am thankful to **Prof. A M Padma Reddy**, Additional Director and Professor, Department of Computer Science and Engineering, Sai Vidya Institute of Technology, for his constant support and motivation.

I express my heartfelt sincere gratitude to **Prof. Sreelatha P K,** HOD, Department of Computer Science and Engineering, Sai Vidya Institute of Technology, Bengaluru, for his valuable suggestions and support.

I express my sincere gratitude to **Prof. Sunil G L**, Assistant Professor, Project Guide, Department of CSE, Sai Vidya Institute of Technology, Bengaluru, for his constant support in completing the project.

Finally, I would like to thank all the Teaching, Technical faculty and supporting staff members of Department of Computer Science and Engineering, Sai Vidya Institute of Technology, Bengaluru, for their support.

Satwik Ram K 1VA17CS047 N Payan Kumar 1VA17CS028

## **ABSTRACT**

Sign Language is mainly used by deaf (hard hearing) and dumb people to exchange information between their own community and with other people. It is a language where people use their hand gestures to communicate as they can't speak or hear. Sign Language Recognition (SLR) deals with recognizing the hand gestures acquisition and continues till text or speech is generated for corresponding hand gestures. Here hand gestures for sign language can be classified as static and dynamic. However, static hand gesture recognition is simpler than dynamic hand gesture recognition, but both recognition is important to the human community. We can use Deep Learning Computer Vision to recognize the hand gestures by building Deep Neural Network architectures (Convolution Neural Network Architectures) where the model will learn to recognize the hand gestures images over an epoch. Once the model Successfully recognizes the gesture the corresponding English text is generated and then text can be converted to speech. This model will be more efficient and hence communicate for the deaf (hard hearing) and dump people will be easier. In this paper, we will discuss how Sign Language Recognition is done using Deep Learning.

## **Table of Contents**

ABSTRACT	ACKNOWLEDGEMENTI
TABLE OF CONTENTS       III         LIST OF FIGURES       VI         CHAPTER 1       INTRODUCTION       1         1.1 Problem Statement       1         1.2 Solution for the Problem       1         1.3 Existing Technique       2         1.4 Proposed Technique       2         1.5 Objective       3         1.6 Motivation       3         CHAPTER 2         LITERATURE SURVEY       6         2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3       8         CHAPTER 3       8         CHAPTER 3       8         CHAPTER 3       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	
LIST OF TABLES       VIII         CHAPTER 1         1.1 Problem Statement       1         1.2 Solution for the Problem       1         1.3 Existing Technique       2         1.4 Proposed Technique       2         1.5 Objective       3         1.6 Motivation       3         CHAPTER 2         LITERATURE SURVEY       6         2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       9         3.4 Non-Functional Requirements       10         3.4 Non-Functional Requirements       10	TABLE OF CONTENTSIII
CHAPTER 1         INTRODUCTION	LIST OF FIGURESVI
INTRODUCTION	
INTRODUCTION	
1.1 Problem Statement       1         1.2 Solution for the Problem       1         1.3 Existing Technique       2         1.4 Proposed Technique       2         1.5 Objective       3         1.6 Motivation       3         CHAPTER 2         LITERATURE SURVEY       6         2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	CHAPTER 1
1.2 Solution for the Problem       1         1.3 Existing Technique       2         1.4 Proposed Technique       2         1.5 Objective       3         1.6 Motivation       3         CHAPTER 2         LITERATURE SURVEY       6         2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	INTRODUCTION1
1.3 Existing Technique	1.1 Problem Statement
1.4 Proposed Technique       2         1.5 Objective       3         1.6 Motivation       3         CHAPTER 2         LITERATURE SURVEY       6         2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	1.2 Solution for the Problem1
1.5 Objective       3         1.6 Motivation       3         CHAPTER 2         LITERATURE SURVEY       6         2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	1.3 Existing Technique
1.6 Motivation       3         CHAPTER 2       6         2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3       8         CHAPTER 3       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	
CHAPTER 2         LITERATURE SURVEY       6         2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	1.5 Objective
LITERATURE SURVEY       6         2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	1.6 Motivation
LITERATURE SURVEY       6         2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	
2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	CHAPTER 2
2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	
2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	LITERATURE SURVEY6
2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	
2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10	2.1 Deep Learning6
2.6 American SLR	2.1 Deep Learning62.2 Computer Vision6
CHAPTER 3  REQUIREMENT SPECIFICATION 9  3.1 Software Requirements 9  3.2 Hardware Requirements 9  3.3 Functional Requirements 10  3.4 Non-Functional Requirements 10	2.1 Deep Learning62.2 Computer Vision62.3 Applications7
REQUIREMENT SPECIFICATION93.1 Software Requirements93.2 Hardware Requirements93.3 Functional Requirements103.4 Non-Functional Requirements10	2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7
REQUIREMENT SPECIFICATION93.1 Software Requirements93.2 Hardware Requirements93.3 Functional Requirements103.4 Non-Functional Requirements10	2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8
3.1 Software Requirements93.2 Hardware Requirements93.3 Functional Requirements103.4 Non-Functional Requirements10	2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8
3.2 Hardware Requirements 9 3.3 Functional Requirements 10 3.4 Non-Functional Requirements 10	2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8
3.3 Functional Requirements	2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8
3.4 Non-Functional Requirements	2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9
	2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9
CHAPTER 4	2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10
	2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10
SYSTEM DESIGN11	2.1 Deep Learning       6         2.2 Computer Vision       6         2.3 Applications       7         2.4 SLR Using MATLAB       7         2.5 Real Time SLR using CNN       8         2.6 American SLR       8         CHAPTER 3         REQUIREMENT SPECIFICATION       9         3.1 Software Requirements       9         3.2 Hardware Requirements       9         3.3 Functional Requirements       10         3.4 Non-Functional Requirements       10

4.1 Basic Block Diagram
4.2 Deployment Diagram
4.3 Protocol Architecture
4.4 Flow Chart
4.5 State Transition Diagram
4.6 Sequence Diagram
4.7 Activity Diagram
4.8 Data Flow Diagram
CHAPTER 5
IMPLEMENTATION14
5.1 Dataset
5.2 Data Pre-Processing
5.3 CNN
5.4 CNN Architectures 18
5.5 Proposed Model
5.6 System Testing
CHAPTER 6
RESULTS
6.1 Snapshots
CHAPTER 7
CONCLUSION
7.1 Conclusion
REFERENCES37

List	of	Fig	gur	es
------	----	-----	-----	----

Figure 1.1	Figure Name	2
Figure 2.1	Figure Name	6
Figure 2.2	Figure Name	7

## **List of Tables**

Table 1.1	Table Name	10
Table 2.1	Table Name	15
Table 2.2	Table Name	16
Table 3.1	Table Name	25