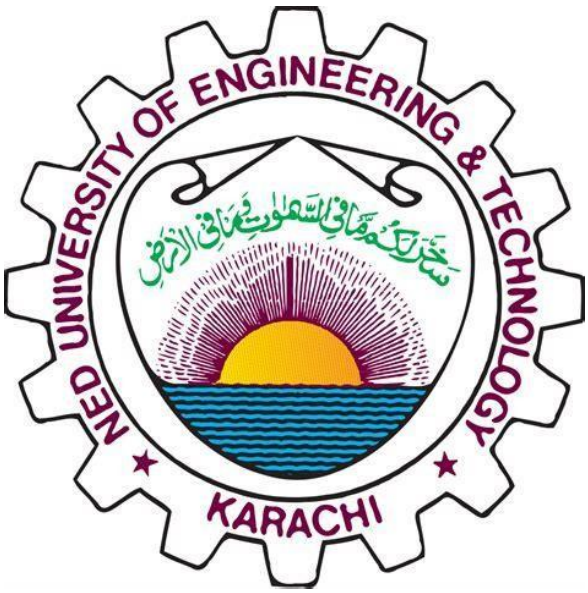


ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS (CT-361)

PROJECT REPORT

MEMBERS:

SHAHZAD(CT-22023)

M.FAROOQ (CT-22043)

M.ANAS (CT-22035)

AFFAN ALVI (CT-22040)

DEPT: CSIT (A)

BATCH: 2022-26

DEPARTMENT OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY
BACHELORS OF SCIENCE IN COMPUTER SCIENCE

Complex Computing Problem Assessment Rubrics

Course Code: CT-361		**Course Title: Artificial Intelligence & Expert System**	
Criteria and Scales			
Excellent (3)	**Good (2)**	**Average (1)**	**Poor (0)**
Criterion 1: Understanding the Problem: How well the problem statement is understood by the student			
Understand the problem clearly and identify the underlying issues and functionalities.	Adequately understands the problem and identifies the underlying issues and functionalities.	Inadequately defines the problem and identifies the underlying issues and functionalities.	Fails to define the problem adequately and does not identify the underlying issues and functionalities.
Criterion 2: Research: The amount of research that is used in solving the problem			
Contains all the information needed for solving the problem	Good research leads to a successful solution	Mediocre research which may or may not lead to an adequate solution	No apparent research
Criterion 3: Code: How complete the code is along with the assumptions and selected functionalities			
Complete the code according to the selected functionalities of the given case with clear assumptions	Incomplete code according to the selected functionalities of the given case with clear assumptions	Incomplete code according to the selected functionalities of the given case with unclear assumptions	Wrong code and naming conventions
Criterion 4: Report: How thorough and well-organized is the solution			
All the necessary information is organized for easy use insolving the problem	Good information organized well could lead to a good solution	Mediocre information which may or may not lead to a solution	No report provided

Total Marks: _____

Teacher's Signature:_____

Sign Language Recognition System Using AI

1. INTRODUCTION

Communication is a fundamental aspect of human life. However, individuals with hearing or speech impairments often rely on sign language to convey their thoughts. Unfortunately, not everyone is proficient in understanding sign language, which leads to communication barriers. With advancements in Artificial Intelligence (AI) and computer vision, it's now possible to build systems that automatically recognize and translate sign language gestures into text or speech. This report discusses the design, components, and functioning of a Sign Language Recognition System (SLRS) powered by AI.

2. OBJECTIVE

The primary objective of this system is to bridge the communication gap between sign language users and non-signers by providing a real-time recognition and translation platform. This enhances accessibility and inclusion for the deaf and hard-of-hearing community.

3. BACKGROUND

Traditional sign language interpretation relies heavily on human interpreters, which may not always be feasible or affordable. Recent breakthroughs in machine learning (ML), deep learning (DL), and image processing have made it possible to automate this task. These systems typically involve:

- Capturing the gesture using cameras or sensors,
- Processing the image or video feed,
- Recognizing the gesture using AI models,
- Translating it into human-readable or audible output.

4. SYSTEM ARCHITECTURE

4.1 Input Module

- Hardware: Webcam, smartphone camera, or depth sensors (e.g., Kinect, Leap Motion)
- Data Capture: Real-time video or static images of hand gestures

4.2 Preprocessing

- Image normalization
- Background subtraction
- Noise reduction
- Region of interest (ROI) extraction
- Hand segmentation

4.3 Feature Extraction

- Keypoint detection using libraries like MediaPipe, OpenPose, or YOLO
- Extraction of features like:
  - Hand orientation
  - Finger positioning
  - Gesture motion trajectory

4.4 Model Training & Classification

- Machine Learning Algorithms:
  - SVM, KNN, Decision Trees (used for static gestures)
- Deep Learning Approaches:
  - CNNs for image-based gesture recognition
  - RNNs or LSTMs for dynamic gesture sequences
  - Transformer-based models for sequence-to-sequence tasks

4.5 Output Module

- Text Display of recognized gestures
- Text-to-Speech (TTS) synthesis for voice output
- Multilingual support for localization

5. Technologies Used

Component	Technology
Programming Languages	Python, TensorFlow, PyTorch
Libraries	OpenCV, MediaPipe, Scikit-learn, Keras
Hardware	Camera, GPU/TPU, Sensor modules

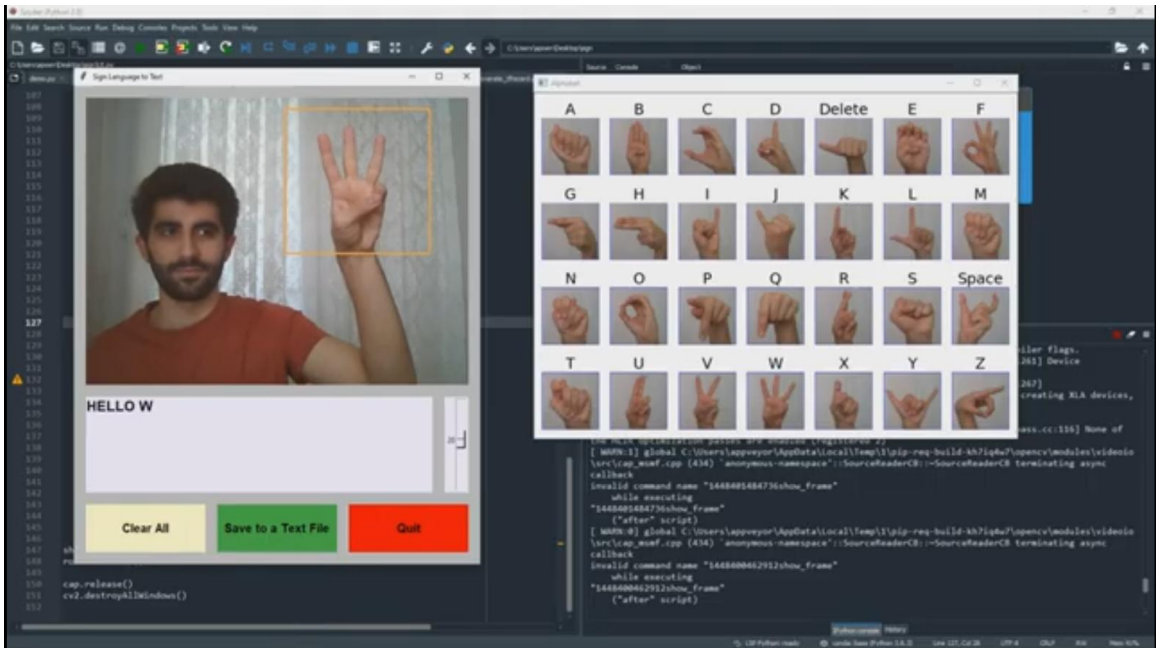
Frameworks	Flask/Django (for web interface), React Native (for mobile)

6. Challenges

- Gesture Variability: Different users may perform the same gesture differently.
- Occlusion and Lighting: Poor lighting and overlapping objects affect accuracy.
- Real-time Performance: High latency reduces usability.
- Dynamic Gestures: Continuous signs (used in real sign language) are harder to detect than static gestures.

7. Datasets

Some common datasets used to train and validate models:
- ASL Alphabet Dataset
- RWTH-BOSTON-104 (German Sign Language)
- Chalearn LAP Isolated Gesture Dataset
- LSA64 (Argentinian Sign Language)



8. APPLICATIONS

- Education Tools for teaching sign language
- Assistive Technology for communication
- Customer Support interfaces for hearing-impaired users
- Public Service Kiosks with automatic sign translation
- Emergency Services for inclusive communication

9. FUTURE SCOPE

- Integration with Augmented Reality (AR) or Virtual Reality (VR)
- Full sentence-level sign recognition
- Improved gesture context understanding
- Wearable AI devices for on-the-go interpretation
- Cross-linguistic support for multiple sign languages

10. CONCLUSION

AI-powered Sign Language Recognition Systems offer immense potential in making communication more inclusive and accessible. With continual advancements in computer vision and deep learning, these systems can evolve from recognizing simple alphabets to complex gesture sequences, truly transforming the lives of millions of people.