Local Guiding App for Mute/Deaf Persons

Project report submitted in partial fulfillment of the requirement for the degree of Bachelor of Technology

in
Computer Science and Engineering

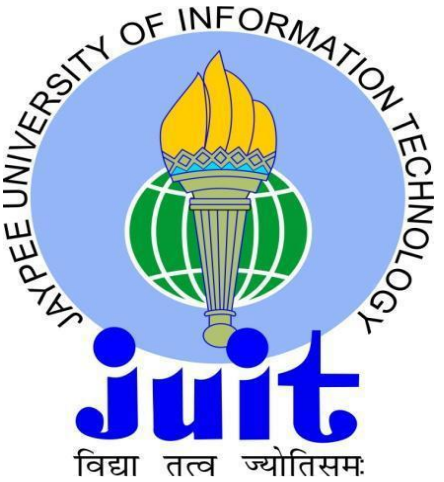
By

Akshay Kumar(131207)

Pragya Gupta(131293)

Under the supervision of

Ms. Nishtha Ahuja
to



Department of Computer Science & Engineering and Information Technology
Jaypee University of Information Technology Waknaghat, Solan-173234, Himachal Pradesh

CERTIFICATE

Candidate's Declaration

We hereby declare that the work presented in this report entitled " Local Guiding App for Mute/Deaf Persons" in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Computer Science and Engineering/Information Technology submitted in the department of Computer Science & Engineering and Information Technology, Jaypee University of Information Technology Waknaghat is an authentic record of our own work carried out over a period from August 2016 to December 2016 under the supervision of Ms. Nishtha Ahuja (Assistant Professor Computer Science and Engineering Department).

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

Akshay Kumar, 131207

Pragya Gupta, 131293

This is to certify that the above statement made by the candidates is true to the best of my knowledge.

Ms. Nishtha Ahuja
Assistant Professor
Computer Science and Engineering Department
Dated:

ACKNOWLEDGEMENT

No venture can be completed without the blessings of the Almighty. We would like to thank all the people who helped us in the completion of our project Local Guiding App for Mute /Deaf people in any form.

We owe our profound gratitude to our project supervisor Ms. Nishtha Ahuja, who took keen interest and guided us all along in our project work till the completion of the project by providing all the necessary information for developing the project. Through the project development we got to know a lot of new things. We are really thankful to her for her constant support, careful supervision and critical suggestions.

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We would also like to thank the laboratory staff of Department of Computer Science and Engineering for their timely help and assistance.

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LIST OF ABBREVIATIONS

HCI	Human-Computer Interaction
ISL	Indian Sign Language
DoF	Degrees of freedom
VQ	Vector Quantization
ASR	Automatic Speech Recognition
MHI	Motion History Image
RGB	Red Green Blue
SVM	Support Vector Machine
AVD	Android virtual device
SDK	Software Development Kit
OHA	Open handset alliance
DVM	Dalvik virtual machine
API	Application programming interface
LIFO	Last in first out
Min	Minimum
PCA	Principal Component Analysis
MHI	Motion History Images
VTC	Video-Teleconferencing
TXT	Text
VOC	Vocalization
SFM	Structure from motion

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ABSTRACT

Communication between the mute/deaf and non-deaf has always been very clumsy. Our project aims to develop an android application for their guidance. One of the methods is use of Wearable communication devices by the mute/deaf people. Under this communication method, there are Glove based system, Keypad method and Handycam Touch-screen. All the above-mentioned three sub-divided methods make use of various sensors, a text to speech conversion module, accelerometer, a keypad, a touch-screen and a suitable micro-controller, which is not reasonable to the needy people.

In this way, Gesture discovery utilizing picture and video preparing can be utilized for supplying the correspondence between quiet, typical and hard of hearing individuals. This venture presents a fresh out of the plastic new android application, which will distinguish the ISL utilizing versatile camera. It breaks the real correspondence crevice between the ordinary and hindered individuals. This application rehearses certain picture preparing techniques to contrast the information and the pre-put away signs. This present application's necessity is just the android telephone and no enchantment gloves or unique markers worn on the hand of client.

CHAPTER-1 INTRODUCTION

1.1 Introduction

A person is considered deaf and mute if the person could neither hear nor speak or both. The count of such type of people is developing in the world. And they are closed reserved society. They communicate between themselves which is about one century old.

The progress of Information and Communication Technology has banged into all aspects of the human life. It has changed the way we study, work, conduct business, travel and communicate Since sign is the primal way of communication in the world when there is no well-suited language, so the sign language is elementary means of communication in the deaf and mute community. Therefore, it is adopted among them.

Sign language relies upon finger spelling. The understandable visual form of finger spelling is simulating the shape of letters in the air, or tactually, determining letters on the hand. Finger spelling can be done using one hand or two hands. One hand is used in Irish Sign Language, French Sign Language and American Sign Language. And two hands in British Sign Language. But, not much work has been done in the ISL recognition till date.

Deaf-Mute people only use sign language to interact with other people, so they face numerous difficulties in their day-today life. For example: government offices, transportation, restaurants, hospitals...etc as only a very few people are familiar with the sign language. Finding a qualified and experienced interpreter each and every time is a very unreasonable and troublesome task. Normal humans never put an effort to be aware of the sign language for interacting with the impaired people. This leads to isolation for deaf people. Therefore, a productive tool is needed for translation of their words from sign language to English language directly so that the discrepancy between the deaf-mute community and the normal people can be diminished.

We have suggested a system which is capable of recognizing various alphabets of ISL for HCI giving precise outcomes in the least possible time. This will not only be beneficial for

deaf and mute people of our country but can also be used in a number of applications in technology field. By using gesture recognition our system depicts human gestures via mathematical algorithms. These commonly begin from face or hand. Simple gestures are used by users so that they can communicate with each other.

Interpretation of gestures using HCI needs that static and dynamic configurations of a person's hand, arm, and also, other human body parts, which can be measurable by the machine. In initial phases of solving the problem, mechanical devices were introduced that directly measure hand or arm joint angles and spatial position. The mechanical devices are termed as Glove-based devices. In order to use these devices the user has to wear a bulky device, and generally bear a load of cables that result in the communication between the device and a computer. This outcomes in obstacle towards the straightforwardness with which the client can speak with PC controlled condition. By utilizing a video-based non-contact connection strategy the ponderousness which is brought about by utilizing gloves and different gadgets can be overpowered. This approach proposes that with a specific end goal to decipher motions utilize an arrangement of PC vision systems and camcorders .

Up to this point, a large portion of the work has been pointed on the acknowledgment of static stances or hand signals. For that reason various models have been used the vast majority of them are taken specifically from the general question acknowledgment strategies. Couple of cases are pictures of the hand, outlines, geometric minutes, 3D hand skeleton models and shapes.

1.1.1 Android

Basically, Android is a software stack for mobile devices that consists of an operating system, middleware and key applications. It is an operating system for mobile devices and a software platform. It is based on the Linux kernel. Code in the Java language is allowed. It is developed by Google and later the OHA.

OHA

To develop open standards for mobile devices a business alliance consisting of 47 companies. Together they have evolved Android, the first open, complete and free mobile platform. Using the Android Platform, they are devoted to commercially deploy handsets and services.

Types of Android Devices

- Tablets
- Android Powered Camera
- Android Powered Washing Machine
- Android Powered Microwave
- Android Powered TV
- Phones
- Android Powered Car Radio
- Android Powered Watch

History

Figure 1- Versions of Android

- **Alpha**

Before beta version two internal releases where there inside google and OHA.

- **Beta**

Released on November 5, 2007.This date is celebrated as Android's "birthday".

- **Cupcake**

Android 1.5(API level 3) first official release to use a codename based on desert items. This was a theme which would be used for all the releases after this.

- **Donut**

Android 1.6(API level 4) was released on September 15, 2009.

- **Éclair**

Android 2(API level 5) was released on October 26, 2009.Under éclair only, two more levels were released Android 2.0.1 (API level 6) and Android 2.1 (API level 7).

- **Froyo**

Android 2.2 (API level 8) was released on May 20,2010.

- **Gingerbread**

Android 2.3 (API level 9) was released on December 6, 2010.Under this name only, another API level was released Android 2.3.3 (API level 10).

- **Honeycomb**

Android 3.0 (API level 11) was released on February 22, 2011.This is the version from where tablets were released. Under this name only other API levels released were Android 3.1 (API level 12) and Android 3.2 (API level 13).

- **Ice-cream Sandwich**

Android 4.0 (API level 14) was publically released on October 19, 2011.It was the last version to officially support Adobe System Flesh player. Under this name only, another API level was released Android 4.0.3 (API level 15).

- **Jelly Bean**

  Android 4.1 (API level 16) was released on June27, 2012.Under this name only, API levels Android 4.2 (API level 17) and Android 4.3 (API level 18) were also released.

- **Kitkat**

On Septemer3, 2013 Android 4.4 (API level 19) was announced. Under this name only, another API level was released Android 4.4W, Kitkat: with wearable extensions (API level 20).

- **Lollipop**

Android 5.0 (API level 21) was released on June25, 2014. Under this name only, another API level was released Android 5.1 (API level 22).

- **Marshmellow**

Android 6.0 (API level 23) was unveiled under the codename "Android M" on May28, 2015.

- **Nougat**

Android 7.0 (API level 24) Android "Nougat" is the premier release of the Android operating systems. The final preview-build was released on July18, 2016.Thereafter android 7.1 (API level 25) was released on October 4, 2016.

Architecture-

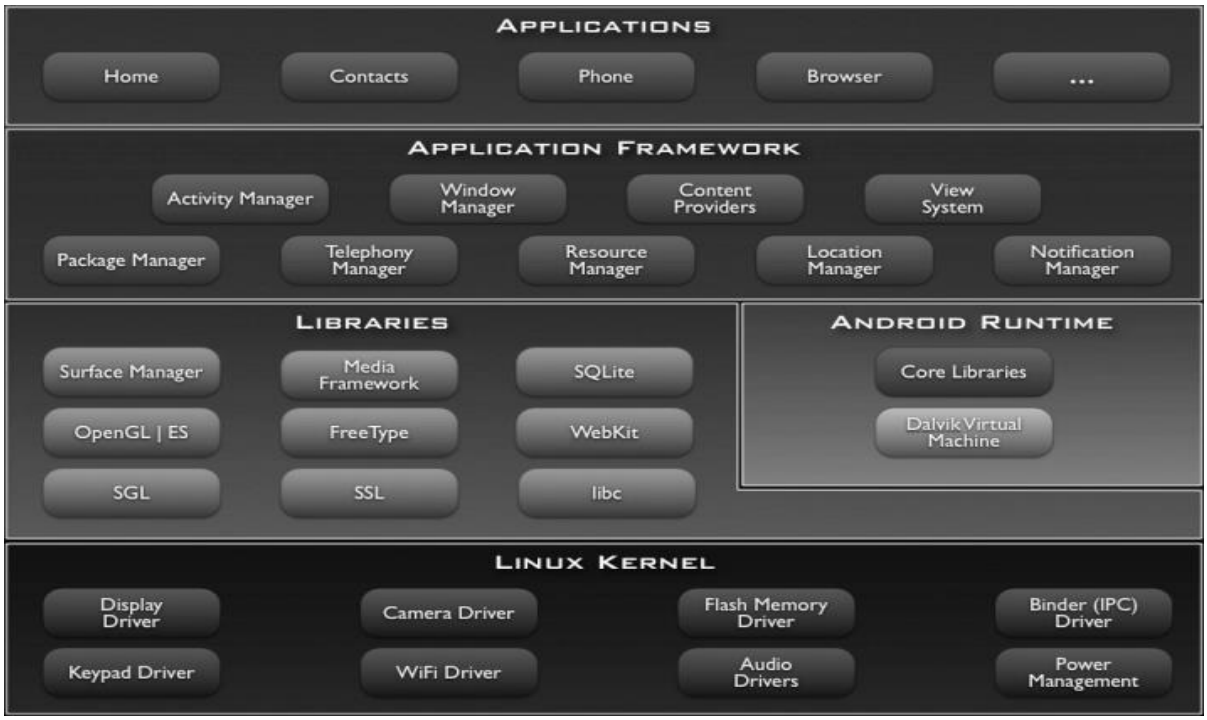

Figure 2-Architecture of Android

Linux Kernel

Linux is the bottom-most layer of Android architecture. An abstraction level is arranged between the device hardware. It consists of all important hardware drivers for example: camera, flash light, display, buttons, keypad etc. Also, the Linux is quite good at a number of jobs which are handled by the kernel like, networking and a large array of device drivers, which take the actual pain out of interfacing to peripheral hardware.

Libraries

There is a specific set of libraries which includes open-source Web browser engine WebKit, SQLite database, well known library libc, which is a beneficial repository for storage and sharing of libraries to play and record audio and video, application data, SSL libraries responsible for Internet security etc on the top of the Linux kernel.

Android Runtime

It is the third section of architecture and is available on the second layer from the bottom. This section provides a key element called DVM, which is a kind of JVM specially optimized and designed for Android.

The DVM uses Linux core characteristics which are intrinsic in the Java Language such as memory management and multi-threading. It allows each Android application to run in its own process, with its own instance of the DVM.

Application Framework

This provides in the form of Java classes many higher-level services to applications. These services can be used in applications by the application developers.

Applications

Java language is used to write all the applications. Android provides a set of applications. Some of them are as follows-

- Contacts
- Email Client
- SMS Program
- Maps
- Browser
- Calendar
- Etc

1.1.2 Android Application

An application developed for use on mobile devices, which is powered by Google's Android platform. Play Store or supported websites can be used for downloading these applications.

1.1.3 Android Studio

For the Android platform, Android Studio is an IDE for developing. It is designed specially for Android development and is based on JetBrain's IntelliJ IDEA software. It is can be downloaded on Windows, Linux and Mac OS X, and replaced Eclipse ADT as Google's primitive IDE for primary Android application development.

1.1.3.1 Android Features

With every release of Android Studio is rolled out with new features. In the prevailing version the following features are supported:

- Users allowed to drag and drop UI components by rich layout editor

- Support for Gradle-based build.
- Support for building Android Wear apps
- To catch performance, version compatibility and other issues Lint tools are provided.
- To create familiar Android designs and components, Template based wizards were introduced.
- App-signing capabilities.
- Pro Guard integration.
- Android quick fixes and specific refactoring.

1.1.3.2 System Requirements

Table 1- Android Studio- System Requirements

	Windows	Mac OS X	Linux
OS Version	Microsoft Windows 10/8/7 (32- or 64-bit)	Mac OS X 10.9.5 or higher, up to 10.11.6 (El Capitan) or 10.12.1 (Sierra)	KDE desktop or GNOME
RAM	3 GB RAM min, 8 GB RAM recommended		
Disk space	500 MB disk space for Android Studio, at least 1.5 GB for Android SDK, caches and emulator system images		
Java version	JDK 8		
Screen resolution	1280x800 min		

1.1.3.3 Eclipse ADT vs. Android Studio comparison

Table 2- Eclipse ADT Vs Android Studio

Feature	Eclipse ADT	Android Studio
Build system	Gradle	Apache Ant
NDK support	Yes	Yes
Build variants and multiple-APK generation	Yes	Yes
Graphical layout editor	Yes	Yes
Advanced Android and refactoring and code completion	Yes	Yes
APK signing and keystore management	Yes	Yes
Maven-based build Dependencies	Yes	Yes

1.2 Problem Statement

Local Guiding App for Mute/Deaf Persons which doesn't require the person to wear a glove which is assimilated and gyroscope. These are used to recognize the movement of hand in the 3D plane in order to help and reduce the communication problems faced by Specially Abled Persons. By excluding the gloves and devices for gesture recognition we will be able to make a low cost application which can also be used by poor people.

1.3 Objectives

To provide an app that operates as an interpreter and translator, facilitating communication between Deaf\ Mute and normal people. This app will provide the following functionalities-

- Increase interaction of deaf and mute with normal people
- Bridge this notch by introducing an android mobile in the communication path so that the ISL can be captured inevitably, detected and also, translated to text for the benediction of the people who cannot apprehend the sign language.
- Increase the quality of living of deaf-mute people.
- To have low cost system which prohibits the use of any accelerometer or gyroscope for the detection of gestures.

1.4 Methodology

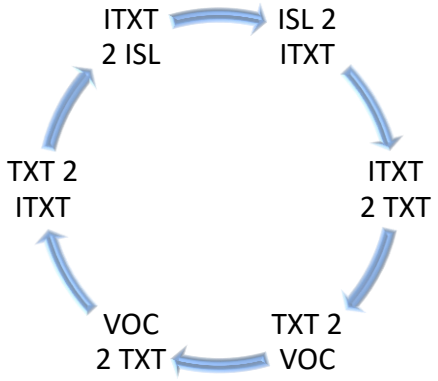

Figure 3-Main Method

Initially, a video would be captured by the user through the camera of the android phone. After that extracting images from the video through image processing techniques. To get the ITXT the selected images which correspond to the ISL would be then compared with the stored images in the database. This ITXT then would be converted to the TXT by the help of database only so that a deaf/mute people can figure-out the message. As similar gestures have quite different meanings so continuous enhancement is required.

Conversion of TXT2VOC, the TXT is displayed to the hearing person and audible VOC is played. In order to achieve this, existing text-to-speech technology is used. One direction of a conversation is completed in first three steps, from gestures of the ISL to audible speech. Collectively, they form a reverse ISL dictionary.

The hearing person's reply can be in form of text or vocal. In order to convert VOC to TXT, speech recognition is used by the computer i.e., discourse to-content. Thereafter make an interpretation of the TXT into ITXT. Finally, demonstrate sign language gestures featured along with ITXT and TXT.

1.5 Organization

1.5.1 Project Design

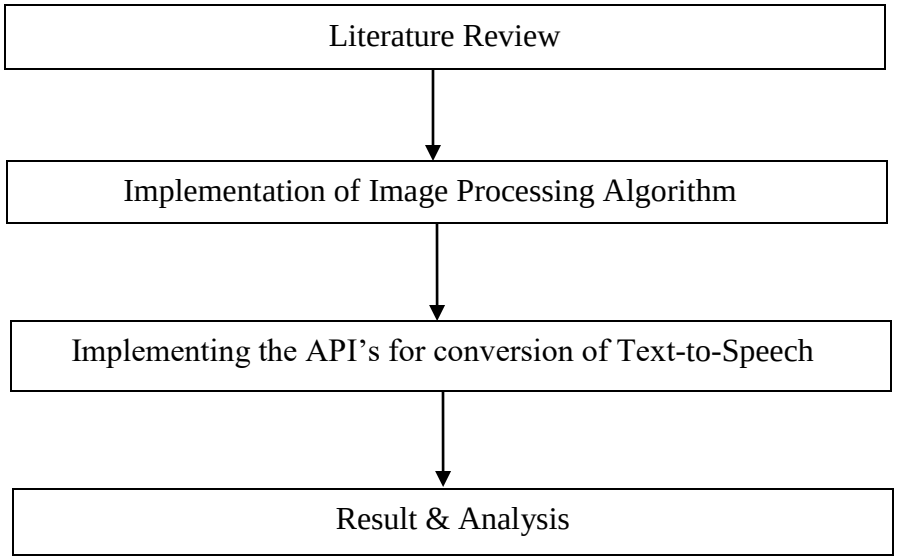

Figure 4-Project Design

In this project we have studied a number of papers published around Local guiding App for mute/deaf people. In order to fetch the hand gestures from the video recorded, image processing algorithm has been implemented. In the next phase of the project for text to speech conversion API's will be implemented. After successful completion of the project final result will be recorded and analysis done.

Organization of the reminder of this report is as follows. Chapter 2 discusses about the text of scholarly paper which includes the current knowledge as well as methodological and theoretical contributions to the topic. Chapter 3 describes our proposed application in details. Chapter 4 provides the related performance evaluation. Finally, Chapter 5 concludes this report.

CHAPTER 2 LITERATURE SURVEY

2.1 Literature Review

Table 3-Literature Survey

Serial Number	Author and Year	Techniques Used	Objective
1	Rajeev Sharma, Member, IEEE, Vladimir I. Pavlovic, Student Member, IEEE, and Thomas S. Huang, Fellow, IEEE	HCI Systems	To make utilization of hand signals to give an appealing contrasting option to badly arranged interface gadgets for HCI.
2	Sujith Kumar Shahabaz Begum (2014)	• Video Relay System(VRS) • Outfit 7 Application • American Sign Language	To create an android application for specially abled persons to communicate easily.
3	K. Sangeetha L. Bartha Krishna (2014	Image Processing	To create inexpensive system to obliterate the communication notch between deaf and normal persons.
4	G.V.S Subhaashini S. Divya S. Divya Suganya Vimal Tharani	• VRS • Outfit 7 • Speech Recognition	To create an application which translates ASL to text and voice and vice-

	(2015)	• Automatic Translation	versa
5	Chandrika Jayant Christine Acuario William A. Johnson Janet Hollier Richard E, Ladner (2010)	Braille Language using Haptic Feedback on a touchscreen mobile phone.	To provide a system for mute, deaf and blind people to communicate.
6	Dalia Nashat Abeer Shoker Fowzyah Al-Swat Reem Al-Ebailan (2014)	Android application development Java	Creating a sign language keyboard for easy access to sign language and translational of the same
7	Patil Diksha Y. Jadhav Ashwini A.8Chavan Amruta V. Nikam Shrutika M. (2016)	Hidden-Markov Model(HMM) Linear Predictive Coding(LPC)	Introduce a system for the deaf to communicate using images of sign language and translation of those images into speech for normal person to hear.
8	Sunitha K. A Saraswathi P Aarthi M Jayapriya K Lingam Sunny (2016)	Gesture Detection Wearable Smart Devices	Introduce a wearable system for deaf and mute acting as an interpreter to communicate using sign language and speech conversion.
9	Koli P.B.	Image Processing	To create a Image

	Chaudhari Ashwini Malkar Sonam Pawale Kavita Tayde Amrapali	Gesture Detection Speech-To-Text Conversion	processing based language converter for deaf and dumb.
10	Shiri Azenkot Emily Fortuna (2010)	Android applications Braille-Haptic Feedback	To provide a system for blind and mute-deaf person to use public transit easily.

2.2 The Indian Sign Language (ISL) Alphabet

- The right hand or both the hands are used for signing all letters, which is achieved such that the viewer is facing the palm therefore; a straight finger will normally point skywards.
- When the thumb is collapsed it crosses the palm towards the little finger.
- When fingers are collapsed they point down over the palm.
- In these depictions right and left are from the position of the watcher.
- In the situation where the hand is tilted or turned the places of the fingers is depicted first for an upright hand and the turn or tilt is included.

Figure 5-Only right hand used for letters

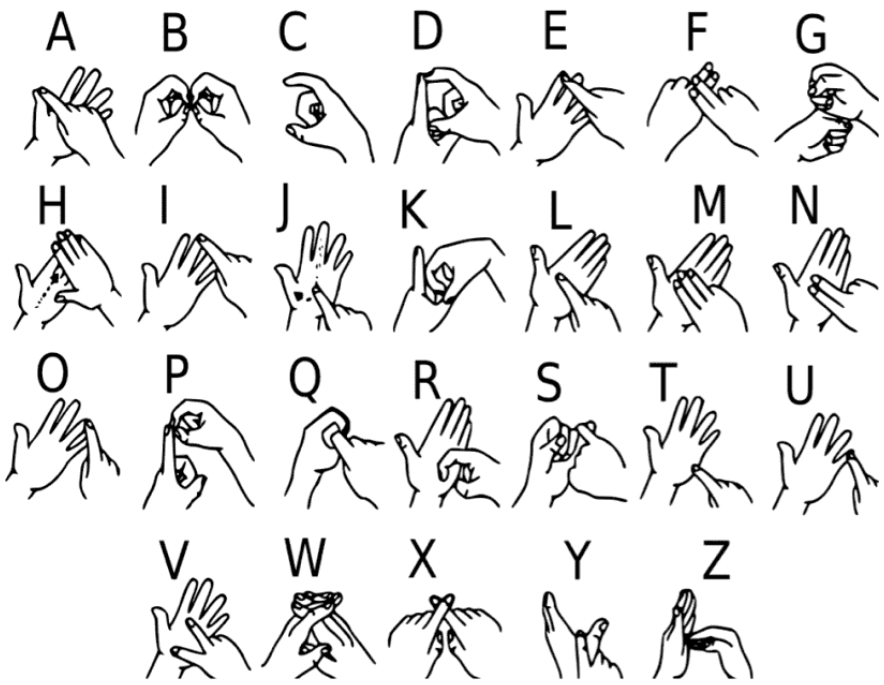

Figure 6- Both the hands used for letters

Gesture Recognition Features:

- Time saver
- More accurate
- Ease to access

2.3 Gesture Recognition System

Hand gestures are considered as dynamic actions. As much meaning as the posture of the hands conveys, the motion of the hand discloses the same. Various methodologies have been proposed for motion investigation, going from the worldwide hand movement examination to the autonomous fingertip movement investigation.

The interpretation of a gesture recognition system consists of the below mentioned components–

- Gesture Modeling
- Gesture Analysis
- Gesture Recognition
- Gesture-based Systems and Applications

2.3.1 Gesture Modeling

For HCI the span of a gestural interface is totally identified with the genuine showing of hand signs. For example, Webster's Dictionary depicts signals as"...the usage of developments of the members or body as a techniques for expression; an improvement as a general rule of the body or extremities that conveys or underscores an idea, presumption, or perspective." Social and mental surveys tend to tie this widely inclusive definition and relate it more to human's appearance and social affiliation. Signals is genuinely unmistakable in the space of HCI.

In a PC controlled condition in order to perform assignments, the customer needs to use the hand to do that duplicate, both the trademark usage of the hand as a controller, and its use in human machine correspondence like, utilize in charge of PC works through the signs. Of course, settled implications of signs are hardly stressed with the quondam suggested usage of the human hand, claimed reasonable movements.

Indistinguishable to talked dialect, a methods for correspondence is hand signals. The discernment and creation of signals can along these lines be explained utilizing a model usually found in the field of talked dialect acknowledgment. A digestion of this model, connected to signals, is spoken to underneath

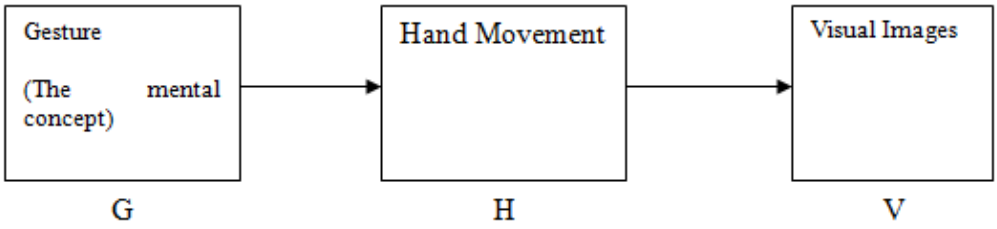

Figure 7-Perception and production of gestures.

Motions of hand rise as a mental idea spoke to as G, are communicated (Thg) by hand and arm movement H and are foreseen (Tvh) as visual pictures spoke to as V.

As per above model, motions begin as a client's mental idea, in conjointment with discourse. Through the movement of arms and hands they are communicated, the comparative path through the human vocal tract discourse is made via air stream regulation. Likewise, the spectators conclude motions as different floods of visual-pictures, which are then, represented utilizing anxiety they obtain about those motions. The creation and view of signals can be condensed as:

$$H = T_{hg}G$$
$$V = T_{vh}H$$
$$V = T_{vh}(T_{hg}G) = T_{vg}G$$

Changes (T) can be considered as various models. A model of arm or hand movement given signal G is T_{hg} , a model of visual pictures given hand or arm movement H is T_{vh} , and T_{vg} speaks to how V are shaped given some G. With the parameters related to their separate parameter spaces M_t the models are parametric, In light of this documentation, the objective of hand signals of visual understanding is to finish up G from their V utilizing a suitable motion demonstrate ,T_{vg} or

$$\hat{G}=T^{-1}_{vg}V$$

Then, every realization of a single gesture can be seen in model-parameter space as a trajectory. For instance, in formation of a gesture, the position of hand of a person in the 3D space shows orientation. Natural characteristics of gestures attest the stochastic property. The gesture's dynamic nature is suggested by the existence of time interval.

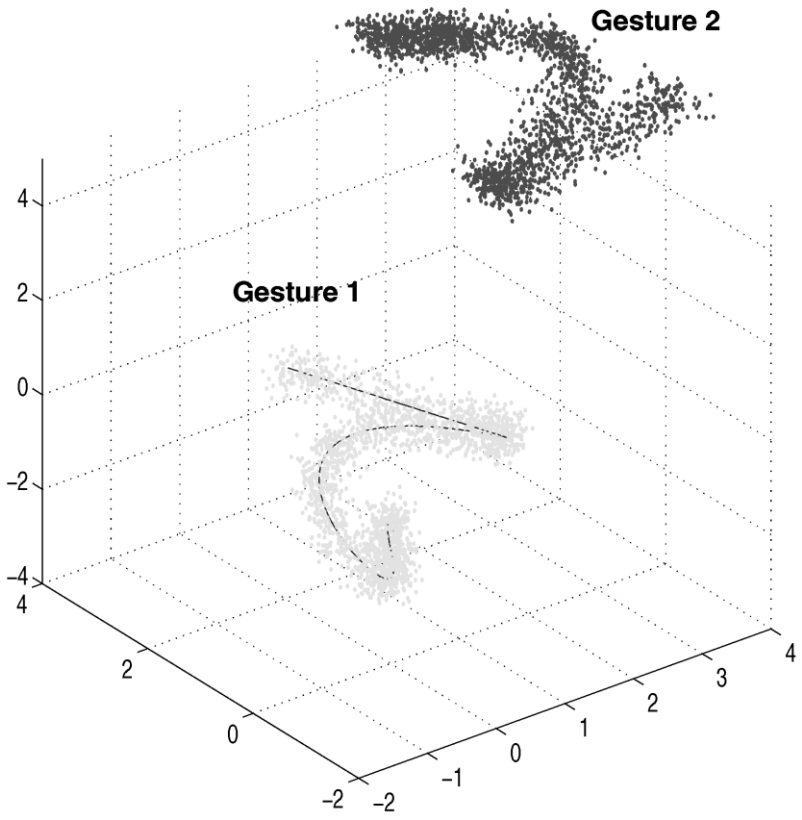

Figure 8-Gesture - stochastic process.

Movements can be viewed as discretionary bearings in parameter spaces, which depict arm or hand spatial states. In this event, two specific signs are showed up in a 3 D parameter space.

Classification of hand movements-

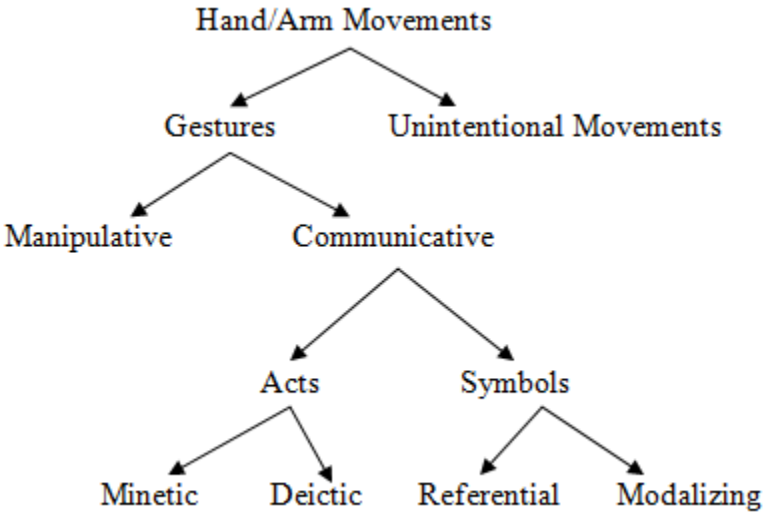

Figure 9-Hand Movements Classification

The hand/arm movements which do not transmit any meaningful orientation are termed as Unintentional movements. The ones that are used to act on the objects in an environment are Manipulative gestures. Communicative gestures have an innate communicational purpose. They are acts or symbols. The symbols are gestures that have a linguistic role.

Three phases that lead to a gesture-

- Preparation
- Nucleus
- Retraction

Preparation phase has a preparatory movement that sets the resting hand in motion. The nucleus has enhanced dynamic qualities and definite form of a gesture. Lastly, the hand either returns repositions for next gesture phase or to the resting position. "Withdrawal" is portrayed by fast change in the position of hand.

Gestures Spatial Modeling

Gestures, actions in 3D space are observed as arm and hand movements. The characterization of gestures spatial properties involves the description of gestures. The major two approaches used are-

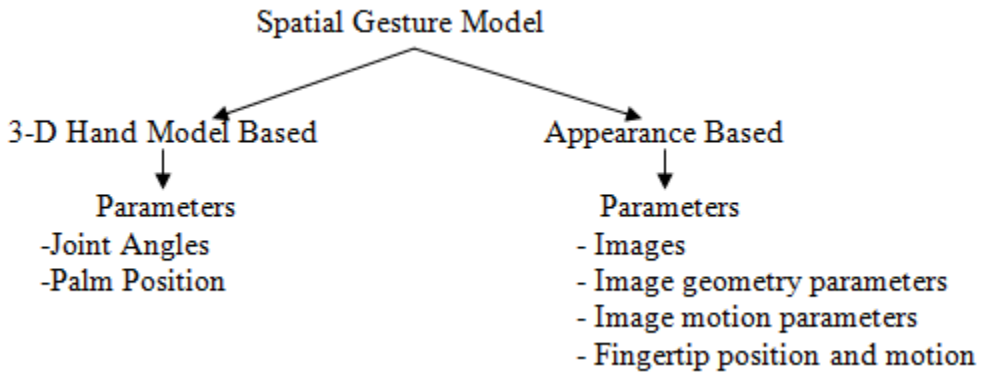

Figure 10-Model for Spatial Gesture

Keeping in mind the end goal to gauge development parameters of hand and arm, verbalized models are utilized by 3D hand demonstrate based. Afterward, the developments are perceived as motions. While in Appearance-based models the presence of the hand and arm developments is specifically connected to particular signals in visual pictures.

(A) 3 D Hand Model

3D arm and hand models always have been an option for the hand gesture modeling. They are further characterized into two groups :

- Volumetric models
- Skeletal models

With a particular ultimate objective to delineate 3D visual occurence of human arms volumetric models are used. Most by far of these models are used as a piece of PC development. These are brain boggling 3D surfaces and they encompass the parts of human body which they illustrate. There is without a doubt these models are sensible anyway, they are outstandingly mind boggling to be shown logically. An all the all the more captivating approach to manage show the human body is the usage of clear 3D structures. The parameters are outstandingly fundamental of finger associations, upper arm or lower arm. The models of the less demanding parts are then, related together to procure the 3D models for complex body parts. Complex parts fuse hands, arms and legs. Thought to the parameters of the fundamental models, these structures have the information on relationship between the simple parts. The correspondence between essential parts in the structure is delineated by the information which may moreover incorporate prerequisites. There are two achievable issues in using such frustrated hand and arm models. Models with decreased course of action of tantamount joint point parameters close by part lengths are much of the time used. These models are named as skeletal models. They are broadly considered in biomechanics and moreover in the human hand morphology.

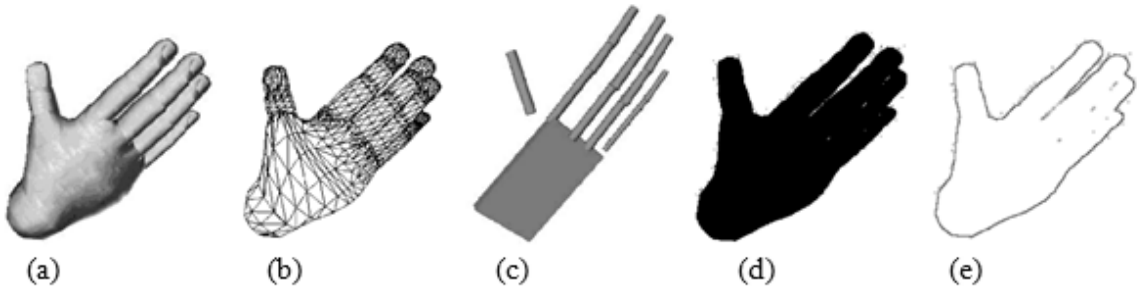

Figure 11-Similar Posture symbolized by different hand models.

(a) 3D Textured -volumetric model. (b) 3D wireframe- volumetric model. (c) 3D skeletal model. (d) Binary silhouette. (e) Contour.

The skeleton of human hand consisting of 27 bones is classified into three classes:

1. carpals (wrist bones - 8)
2. phalanges (finger bones - 14)
3. metacarpals (palm bones - 5)

Different DoF is exhibited by the joints connecting the bones. Very limited freedom of movement is there in almost all of the carpals joints. The same is true for the carpal-metacarpal joints. The most flexibility is shown by the finger joints. Just a specific scope of points are there that are expected by the hand joints normally. In this way, imperatives can be set on joint edge developments of two sorts: Static and Dynamic. Statics alludes to range and element for conditions.

Table 4-Constraints-Static and Dynamic

Static Constraints	
Fingers	Thumb
$0 \le \theta^{y}_{MCP,s} \le 90°$ $-15° \le \theta^{x}_{MCP,s} \le 15°$	
Dynamic Constraints	
$\theta^{y}_{PIP} = \frac{3}{2}\theta^{y}_{DIP}$ $\theta^{y}_{MCP} = \frac{1}{2}\theta^{y}_{PIP}$ $\theta^{x}_{MCP} =$ $\frac{\theta^{y}_{MCP}}{90}\left(\theta^{x}_{MCP,converge} - \theta^{x}_{MCP,s}\right) +$ $\theta^{x}_{MCP,s}$	$\theta^{y}_{IP} = \theta^{y}_{MCP}$ $\theta^{y}_{TM} = \frac{1}{3}\theta^{y}_{MCP}$ $\theta^{x}_{TM} = \frac{1}{2}\theta^{x}_{MCP}$

(B) Appearance Based Model

Appearance of hands/arms implies that model parameters are in a roundabout way got from the 3D spatial depiction of a man's hand. Motions are demonstrated to the presence of the arrangement of re-imagined, layout signals.

This gathering comprises of a substantial assorted qualities of models. Some of them depend on deformable 2D layouts. The layouts might be of the human hands, arms, or even body. Deformable 2D layouts utilized as an interjection hubs for question plot guess are association of focuses on blueprint of the protest. A piecewise straight capacity is the most

straightforward interjection work utilized. The layouts contain point changeability parameters, the normal point sets and furthermore the outer misshapenings. The "normal" shape inside a gathering is portrayed by the normal point sets. The allowed shape assortment is delineated by the point variability parameters inside a comparative get-together of the shapes. These sorts of parameters are suggested as internal. For framework, the human hand has one shape in empty position on the typical, and in each other portrayal the human hand can be surrounded by fluctuating the ordinary shape imperceptibly. A powerful segment of the arrangement sets of data have become internal parameters through PCA. External misshapenings are used to clear up the overall development. Such developments are depicted by the turns and translations. For hand-taking after purposes and for essential flag plan in light of tremendous number of classes of the organizations, format based models are by and large used.

2D hand picture game plans are used by a stand-out social event of appearance models as movement designs. Each flag from the course of action of perceived movements is exhibited by a movement of delegate picture n-tuples. Besides, every variable of the n-tuple is for all intents and purposes indistinguishable to one point of view of the tantamount hand or arm. In the most expansive case, just monoscopic or stereoscopic points of view are used. Their parameters can be either envisions themselves or couple of parts imitated from the photos.

In a finger taking after application just pictures of fingers are used as formats. Another approach has been to model unique gestural exercises by MHIs. MHIs are basically, 2D pictures induced by totaling the development of each pixel in visual picture. By thusly the energy of pixel in the MHI implies what sum increased development is seen at that pixel. However the a substantial segment of appearance-based models use parameters imitated from pictures in the arrangements. This class of parameters are demonstrated as parameters of hand picture property. To state a couple they include: shapes, edges, picture eigenvectors, and picture minutes. An impressive parcel of these are used as parts in examination of movements. Shapes are consistently used as quick model parameter. A couple cases: clear edge-based structures, "marks" (shapes in polar bearings). For further examination of eigen space, shapes can be picked. Picture minute which is used now and again, is viably enlisted

from hand or arm structures or diagrams. Various distinctive parameters have furthermore been used. For example: Orientation histograms and Zernike minutes.

Another kind of model, parameters fuse use of fingertip positions . It relies on upon the theory that position of fingertips of the human hand identifying with the palm, is regularly enough to isolate a set number of exceptional signs. The hypothesis holds in 3D space under different restrictions. The palm must be reenacted to be unbendable, and fingers can simply have a bound number of DoFs. In any case, immense quantities of the models use only 2D address of fingertips and palm. Only a document fingertip and some reference point on the hand or body are used for the applications that are in reference with deictic signs.

2.3.2 Gesture Analysis

In the last area, particular methodologies for displaying motions for HCI were talked about. In this segment the investigation stage is considered. The objective of this stage is to rough the attributes of signal model from video pictures of a human administrator enlisted in HCI utilizing estimations In the examination two for the most part back to back assignments are included. The underlying errand includes separating proper picture highlights from the picture grouping or crude picture . The following undertaking makes utilization of these picture highlights for figuring model parameters.

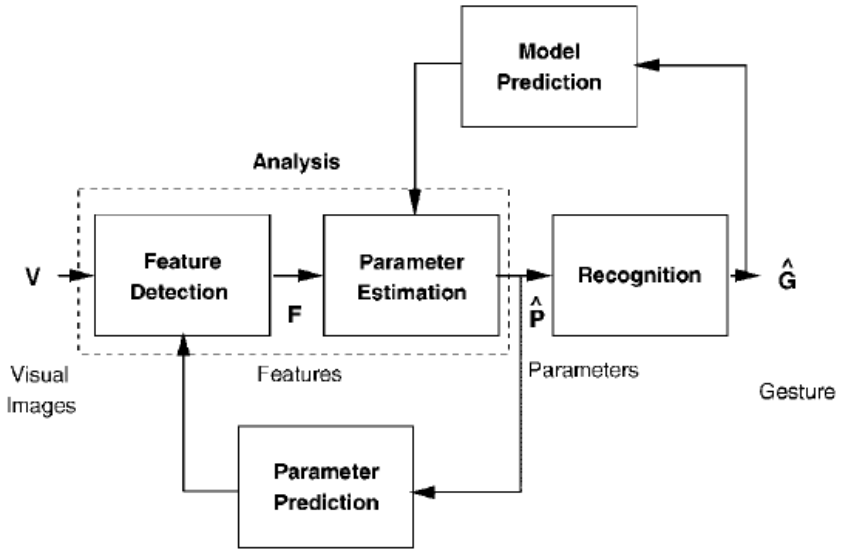

Figure 12-Gestured Analysis and It's Recognition.

In the analysis stage, features F are extorted from visual images V. Model parameters P^ are estimated. Gestures G are identified in the recognition stage.

Feature Detection

In highlight area orchestrate, the ID of components is of essential concern which is used for the estimation of parameters of the picked gestural model. To keep the gesturer is the basic walk in area handle. The proper plan of components can be perceived once the gesturer is constrained.

Localization

Gesturer restriction is a procedure in which gesturer is separated from the remaining parts of the visual picture. In the localization process mainly two types of cues are usually used namely:

- Color cues
- Motion cues

Due to the trademark shading impression of the skin of people, shading signs are pertinent. For the most part, the shading impression is more trademark and less touchy to brightening variety in the tint immersion space set up of the standard RGB shading space. In light of skin's encompassing regions and the preparation set, all the shading division systems utilize a clear look-into table approach [12] or depend on histogram matching[6]. The significant disadvantage of shading based restriction strategies is changeability of skin shading impression in various lighting conditions. This irregularly brings about dishonestly identified non skin surfaces or undetected skin districts. By considering just region at certain spatial position or of a specific size, named as positional separating and scale sifting individually the confusion can be lightened. One more middle class answer for the entanglement is the use of prohibitive foundations and furthermore the apparel. For instance: uniform dark foundation.

Positively, the utilization of antagonistically hued gloves or markers on hands/fingers is turn by an extensive number of motion acknowledgment techniques. The utilization of previously mentioned arrangement makes it conceivable to confine the hand smoothly and furthermore, continuously, however forces the obvious limitation on the client and on interface setup. On the opposite side, a couple of the shading based confinement techniques, for example, the ones that utilization histogram coordinating are computationally significant and by and by difficult to execute continuously.

As a rule, development provoke is moreover associated for gesturer limitation. Besides, is used as a piece of association with certain hypothesis about the gesturer. For example: in HCI setting, it is generally the case that without a moment's delay only a singular individual signs. In addition, the gesturer and the establishment are stationary concerning each other. Thusly, the development of the arm/hand of the gesturer is the principal section of development in the visual picture. Also, that is the reason it can be used to restrict the gesturer. The doubts is the genuine drawback in the development sign approach. While the suppositions hold over an extensive variety of cases, there are a couple of occasions when the establishment is not stationary or more than one gesturer is alert on the double i.e. dynamic part move periods.

To conquer the requirements of the individual prompts, countless have been proposed for limitation. One approach is by the utilization of expectation systems in which the restriction issue can be generously facilitated. Another way is the combination of shading, movement and other visual signals or the combination of visual prompts with non visual signs like discourse or look. In light of model elements and the beforehand known areas these procedures give appraisals without bounds highlight areas.

Features and Detection

Despite the fact that the distinctive sorts of parameters are the premise of various motion models, the picture highlights utilized to process those parameters are extremely unified. For instance: models that utilization finger directions and about 3D hand/arm models, all oblige

fingertips to be separated first. Shading or dark scale pictures are frequently utilized as components which themselves include hands and arms or gesturers. This choice of components is exceptionally regular in the appearance based models of motions where worldly formats of motions are framed utilizing groupings of pictures [5].

Hand and arm frameworks are most as frequently as conceivable used parts and are among the least demanding. Extraction of diagrams is done easily from close-by hand and arm pictures in restrictive establishment setups. Because of complex establishments, systems that use shading histogram examinations, as depicted in the gesturer limitation stage, can be used. Instances of the use of layouts as parts are found in both 3D hand indicate based examinations and moreover in the appearance-based strategies. When in doubt, the use of such combined segments brings about lost data which can impact the execution, especially for the 3D hand act estimators.

For example, in 3D hand act estimation issue twofold blueprint precludes the correct estimation from claiming spots of a couple fingers. Another social occasion of much of the time used segments is addressed by shapes. To convey shapes, different unmistakable edge revelation arrangements can be used. Some are excerpted from reasonable hand-arm layouts, and thus, are equivalent to them, while others start from shading or dim level pictures.

In 3D indicate based examination, structures are used. In such conditions, to pick finger, shapes can be used and arm interface contenders by gathering of the courses of action of parallel edges or through the photo frame to-model shape organizing for instance. Of course, in appearance-based models, changed kind of parameters can be connected with shapes: for example "stamps" and "size limits". Marks imply the portrayal in polar headings of the spotlights on the shape.

The fingertip highlight is frequently used as a piece of movement examination. The parameters of the 3D hand models and what's more the 2D appearance-based gestural models can be gotten by using Fingertip ranges. Regardless, recognizable proof of the fingertip ranges in 3D or in 2D space is not insignificant. By using checked gloves or shading markers,

the fingertip acknowledgment issue can be settled. By then the extraction of fingertip zone is unraveled and it can be performed using the shading histogram-based strategies. Another way to deal with recognize the fingertips is to use the case planning strategies. For example: organizations can be the photos of fingers or fingertips or non particular 3D barrel formed model.

Such sort of case organizing procedures can be opened up by using additional photo highlights. For instance, frames. The trademark properties of fingertips in the photo rely on upon a bit of the fingertip extraction counts. For example, a trademark plan i.e. low-high-low is trailed by recurring pattern of a fingertip outline which is profitable in the part disclosure. Diverse heuristics can be used moreover. For instance, for deictic flags a doubt can be made that the essential motivation behind the hand is addressed by the finger.

Broadly, various distinctive procedures in recognizable proof of the fingertips have been used in a couple of events, as uncommonly tuned Gabor partitions used for picture examination. The fingertip's defenselessness to hindrances being utilized of the fingertips as components is the rule obstacle. All the time no less than one fingers are hindered by the palm from a given camera point of view and heading. The most broadly perceived response for this hindrance issue incorporates the use of various cameras. Diverse responses for the issue rely on upon the estimation of disheartened fingertip positions in light of all the known information of 3D model of the movement being alluded to. Regardless, restrictions are put on the gesturer to represent the hand so that the deterrents are constrained.

Parameter Estimation

The final stage of the gesture analysis phase comprises of computation of model parameters. For arm or hand tracking systems, parameter computation stage normally yields the final output. The model parameters and the features together, select the type of computations used.

2.3.3 Gesture Recognition

In Gesture acknowledgment stage, the information broke down from visual pictures of signals is perceived as a particular motion. There are two errands that are by and large connected with the acknowledgment procedure.

Specifically,

- Optimal parceling of the parameter space
- Implementation of the acknowledgment strategy

The errand of the ideal dividing of model parameter space is in connection with the decision of gestural models and their parameters. Some kind of parameter grouping procedure originating from VQ is normally used to perform acknowledgment of those signals. Quickly, in VQ, in view of preparing illustrations and some metric, a n-dimensional space is isolated into raised sets utilizing n-dimensional hyper-planes for deciding the closest neighbor.

Instead of the static motions, gestural activities include the fleeting and also the spatial setting. The acknowledgment of the gestural activities relies on upon the decision of gestural models as on account of static stance acknowledgment. In the model's parameter space, directions are delivered for the greater part of the gestural models. Since common setting is controlled by gestural action, the essential duty for any gathering strategy is that it be time scale invariant and time case invariant. For instance, a commending signal should be perceived in this manner, paying little mind to whether it is performed quickly or slowly, now or in 12 minutes.

Different banner affirmation techniques oversee such issues, the most fitting of these being ASR. Since, talks and furthermore flags are a mean of standard human correspondence, a likeness is drawn among them and computational gadgets are delivered for ASR which are a great part of the time used as a piece of movement affirmation handle.

Starting late, another approach is proposed to see gestural exercises in light of transient configurations, asserted development imperativeness or MHI's. Such development designs add up to the development history of a movement of visual pictures into a singular 2D picture.

Each MHI is parameterized by time period history window which was used for its own specific figuring. The configurations are figured for a course of action of history windows of different ranges to finish time length invariance, going between two qualities which are predefined. By then, the affirmation is basically proficient using a 2D picture gathering frameworks, in light of sets of the readied designs. Its unbelievable computational ease is great position of such transitory format approach. In any case, Artifacts can be exhibited by the development over the whole visual picture of body parts or superfluous articles appear in the photos.

2.3.4 Application and Systems

Most recent immersion in gestural interface for HCI has been driven by various potential significance. Hand signals are utilized for correspondence and additionally for manipulative activities in common habitats. In any case, lessening is there for open territory of motions, since hand signals go about as a steady some portion of the discourse. In the present use for HCI manipulative part of motions have additionally been won. Be that as it may, a few applications which have risen hitherto exploit informative piece of motions.

With the end goal of examination, stockpiling or transmission of motions, messages can be uncovered utilizing HCI. Such open doors are given by handling of ASL and VTC. Distinguishing proof of ASL is considered as a substitute application that normally makes utilization of the human signals as a methods for correspondence. Such applications assume an imperative part in speaking with individuals who have correspondence hindrance. On the off chance that signals and ASL are made an interpretation of by a gadget into discourse plainly, then a positive effect would be there on such people. Be that as it may, the more

balanced purpose behind utilizing ASL as a proving ground for present hand-signal acknowledgment frameworks, is its very much characterized structure in examination with other common motions a man employments. This reality means that appearance-based demonstrating strategies are appropriate especially for such ASL translation. As was demonstrated by various late applications.

2.4 Paper- SIGN MOBILES - An Android App for Specially Able People

A.Sujith Kumar*M.Tech(SE) & SNIST, Hyderabad, India and Shahabaz Begum B.Tech(CSE) & JNTU, Hyderabad, India

In this paper, the main prominence is on communication between normal and deaf person. Texting may be replaced by the video chats but, that would be between only the deaf callers. Outfit-7 application which is for the mobile phone is used with an image movement who will repeat all the things said in high-pitched voice. We can use this app without actually dialing numbers on the phone.

2.4.1 Sign Language Interpreter

Sign language interpreter[13] is accountable for helping deaf people to comprehend what is being said in a wide-variety of situations. These may also be used in one on-one situations. In order to provide services from a remote location, technology might be used.

There are primarily three parts-

- Speech-Recognition Engine
- Database
- Recognized Text

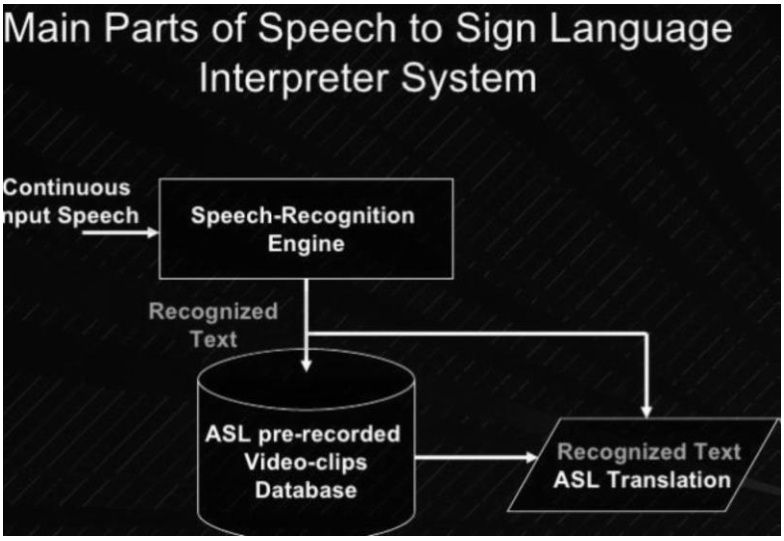

Figure 13-Sign language interpreter

2.4.2 Existing System

The two existing frameworks are –

- Communicate through cell (while dialing number)
- Face to face correspondence (without dialing number).

While dialing numbers hearing and hard of hearing individual can convey. A hard of hearing individual signs which is converted into content and hearing individual understands it. A mouthpiece is utilized by the hearing individual to talk. At that point, the discourse is converted into content and hard of hearing individual understands it.

Without dialing numbers, an application – Mimix is utilized with the end goal of correspondence. Anything a man says is instantly converted into gesture based communication through the application making it very less demanding to have a two-way clear correspondence with a hard of hearing individual without really, knowing the gesture based communication. Its working depends on recorder.

2.4.3 Proposed System

(i) Outfit-7 application

The Slovenian startup company created a series of mobile applications Talking Friends, “Outfit7” for Samos Login. The app series grants users to touch a character and vocalize to it, to make the based 3D character paralleling it.

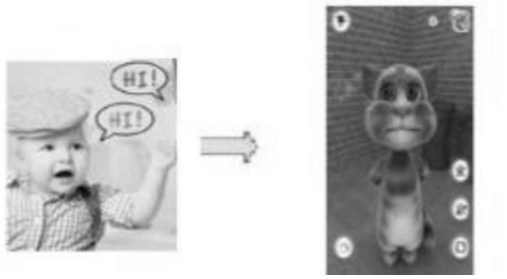

Figure 14-Application- Outfit-7

(ii) Process Flow

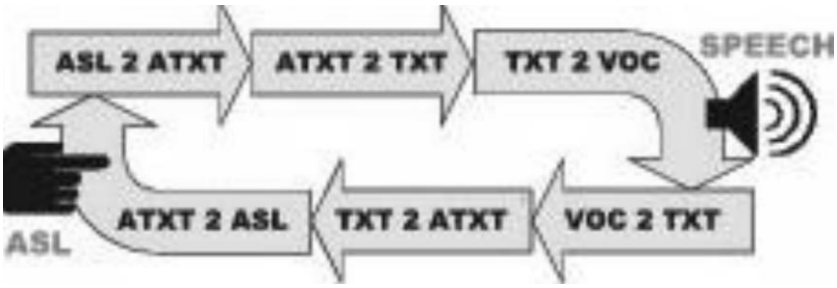

Figure 15-Process Flow

To begin with, portable pursuit usefulness must perceive video pictures. Press the record catch. Motion communication via gestures is recorded. Squeeze stop catch. At that point, press the decipher catch. Video pictures and their relating ATXT might be put away in a database which may live in the advanced cell or on the web. Second, the ATXT must be changed over into TXT. Third, show to the hearing individual in English TXT and play the perceptible VOC. This is expert with the current content to-discourse innovation. These three stages finish one method for a discussion, from motioned ASL to discernable discourse. Together they include a switch ASL lexicon. The hearing individual could answer through content or vocals. To change over VOC to TXT, the PC would utilize discourse acknowledgment, i.e., discourse to-content. At that point make an interpretation of TXT into ATXT. This progression displays considerably similar difficulties. At long last, show communication through signing motions subtitled alongside the ATXT as well as TXT.

2.5 Challenges

There are a number of challenges that are associated with the usefulness and accuracy of gesture recognition software. Video or images may not be under uniform lighting, or in the identical location. Items in the background or specific features of the users may make recognition of gestures more troublesome.

The variety of implementations for image-based gesture recognition may also cause issue for viability of the technology to general usage. For instance, an algorithm developed for one camera may not work for a different camera. The amount of background noise also causes recognition and tracking difficulties, especially when obstructions occur that may be partially or fully. Furthermore, the camera's resolution and quality, distance from the camera, and also cause difference in recognition accuracy.

Robust computer vision methods are required in order to capture human gestures by visual sensors. For example: for hand posture and hand tracking recognition or for capturing movements of the facial or head expressions.

CHAPTER-3 SYSTEM DEVELOPMENT

3.1 Architecture for Hand Gesture Recognition on Android

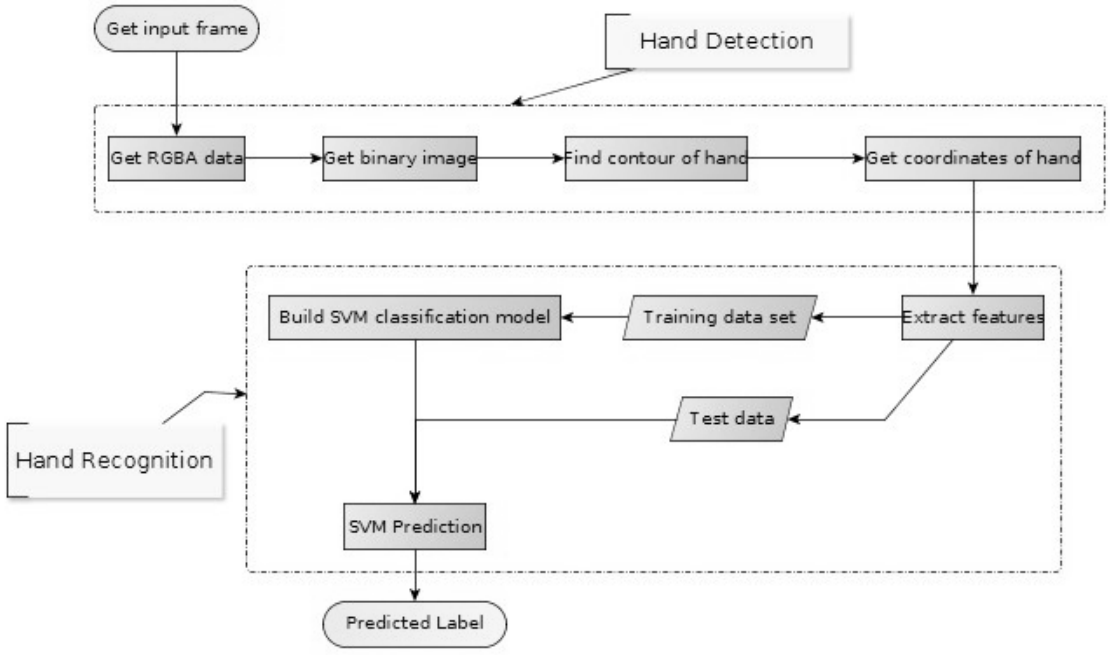

Figure 16- Hand Gesture Recognition on Android Architecture

Basically, our app comprises of two main steps i.e. Hand Detection and then, Hand Recognition. Further, Hand Detection is divided into four sub-steps. After extracting the input frame, the color space of the hand is recognized using seven distinct points. This space is converted into binary color space so that we can get binary image in the form of 0 and 1 so that further computations on the image become easier. The contour i.e. outline of the hand is identified. Then, other features like deformity focus, engraved hover are also found in order to get the co-ordinates of the hand.

In the next step i.e. Hand Recognition, firstly features of the hand are extracted. After extraction we can either train the data set or test data. Training is done in order to build up the model while testing is done to validate the built model. After training the data set one additional step of SVM classification model is there so that the recoded hand gesture can be added in the database and further, used while communicating. Last sub-step is SVM

Prediction, in this the gesture is separated and finally, labeled is predicted for that particular gesture.

Feature Extraction

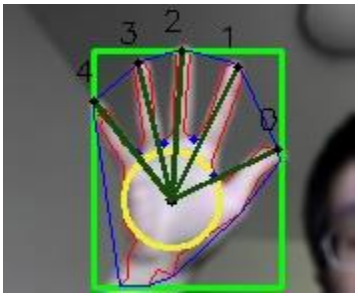

Figure 17-Elements for calculating features.

Green box is utilized for speaking to the bouncing box. The arched frame is spoken to by blue line. Red line for contour of the hand. The Green specks between the fingers are the deformity focuses. The yellow hover is for the engraved hover in the hand.

Low level elements are utilized to speak to the components used to speak to the hand, which are the finger vectors. It is essential to discover areas of the fingertips and the palm focus to register them. From a double picture, OpenCV capacities can specifically give back the arched body and form purposes of the hand containing portioned hand. These directions and bouncing box can be utilized to register the inside and range of the recorded circle. This part is actualized in C++ code and is computationally costly.

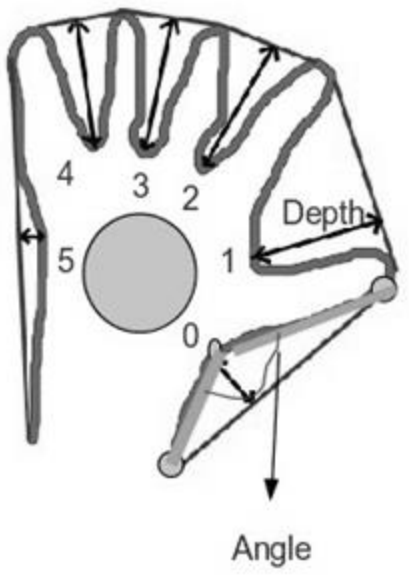

Figure 18- Conditions to eliminate the point.

I. Depth<=CircleRadius*0.7
II. Cosine(Angle)<= -0.7
III. IsClosedBoundry()==True
IV. Index of Defect>4

The point will be eliminated, if any of the above four conditions are satisfied,.

Using the defect points, the locations of fingertips are calculated. To do as such, excess deformity focuses are discarded by checking imperatives on the edge and profundity of the imperfection focuses , as is spoken to in the above figure. In the following stride, remaining deformity focuses are driven and from the returned arranges the fingertips are gotten. At long last. to get the last element vector, the finger vectors are measured and separated by range of the engrave circle

$$X=[x_0/r, y_0/r, x_1/r, y_1/r \ldots x_4/r, y_4/r]$$

Training Set

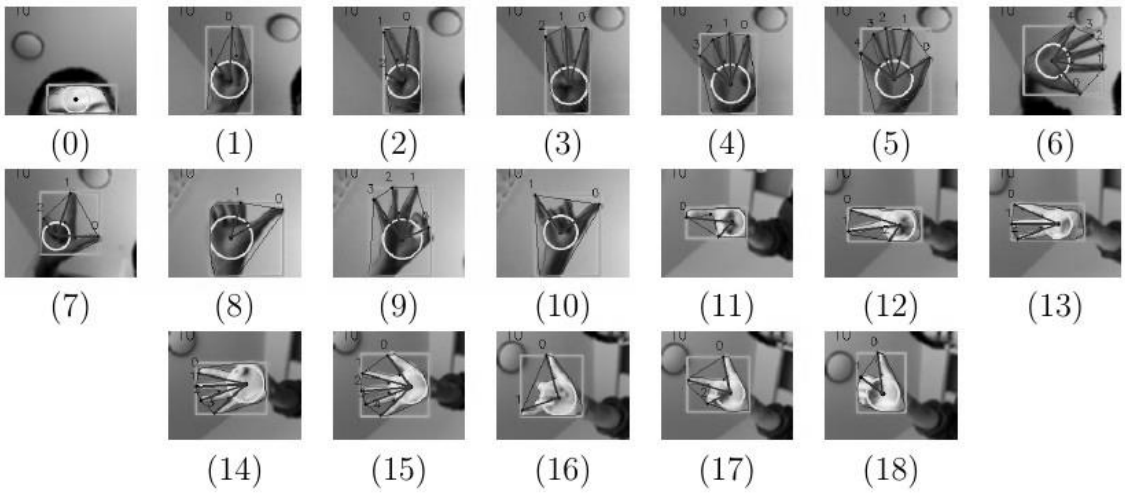

Figure 19- Set for Training

As of now 19 signals from 0 to 18 have been gathered to develop the underlying informational index, as is appeared in above figure. In spite of the fact that the removed component vector is reliable to various hand sizes, it is variation to unmistakable introductions since motions of these sort of introductions are dealt with as particular signals. It can likewise be seen from above picture that the "signal" which is named as 0 is not a motion really. Name 0 is held, to speak to whose signals are not found. It is considered speaking to as a contradicting illustration. One of the restrictions is that the "clench hand" motion can't be distinguished.

The client can incorporate whatever motions he/she jumps at the chance to the essential informational index utilizing the application. For whatever length of time that the hand is all around recognized, the preparation procedure can be executed in any conditions. Because of the time requirement, just 10 casings are gathered for each motion. For building the preparation demonstrate and to make the expectations multi-class SVM is utilized.

CHAPTER-4 PERFORMANCE ANALYSIS

Task Analysis is the examination of how a task is accomplished, in addition to a detailed description of both the mental and manual activities, element and task durations, task frequency, task allocation, environmental conditions, task complexity, necessary equipment as well as clothing and any other unique factors required for or involved in one or more people to accomplish a given task.

4.1 Analysis

Description of all the experiments that happened in the project-

- **Choosing the correct Android Development Tool(ADT)**

For making android applications, Eclipse and Android Studio are widely used development platforms. So, in this project Android Studio has been used. Different operating systems have also been used in the development, namely MAC OS X, Windows 7 and Windows 10.

- **Issues in setting up the SDK**

Al already mentioned above, this project is developed over various platforms and operating system, so while setting the SDK, the process was quite varying.

- **Using different emulator**

Using Android virtual device(AVD) that is included in Android Studio for debugging proved to be an entirely different experience as using an actual android device for debugging. For an actual devise, an android device running on android Marshmellow version.

4.2 Outputs at Various Stages

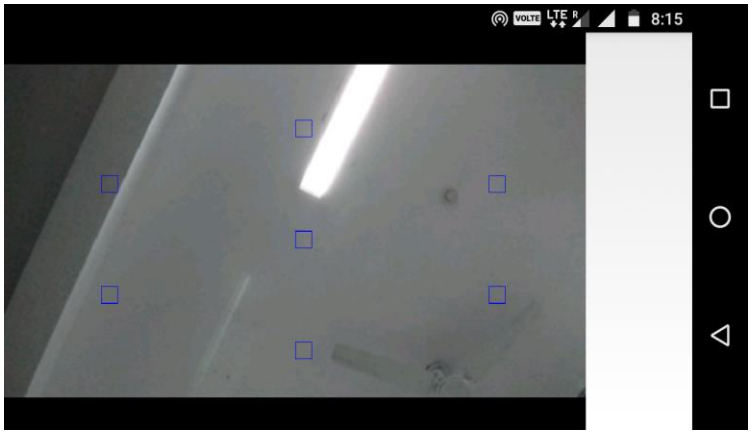

Figure 20-Background Sampling

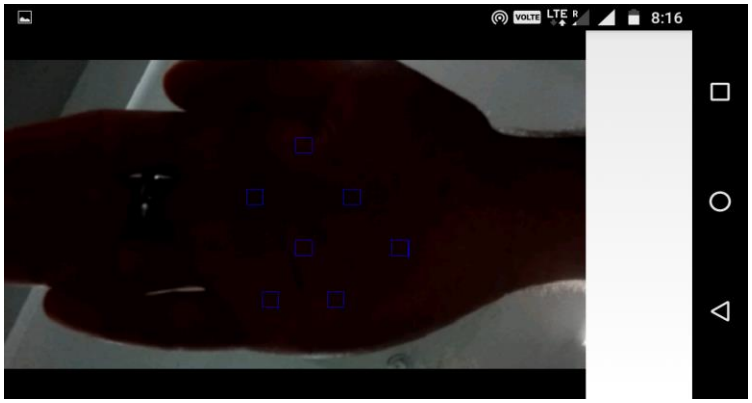

Figure 21- Hand sampling

Figure 22-Hand Segmentation

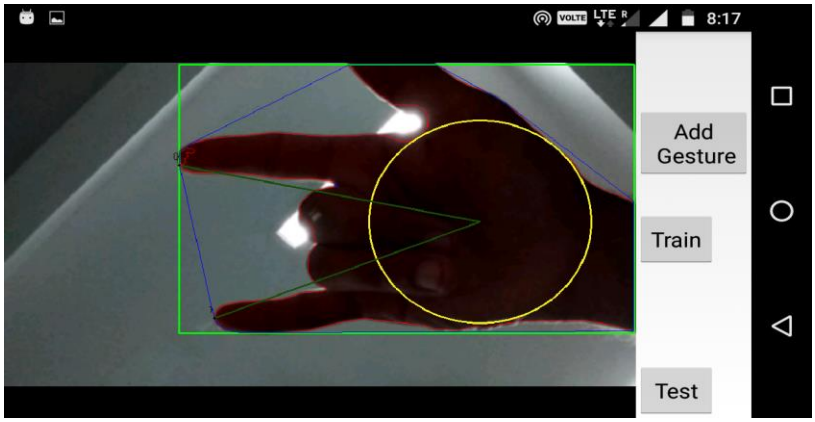

Figure 23-Extracted Features with the three buttons

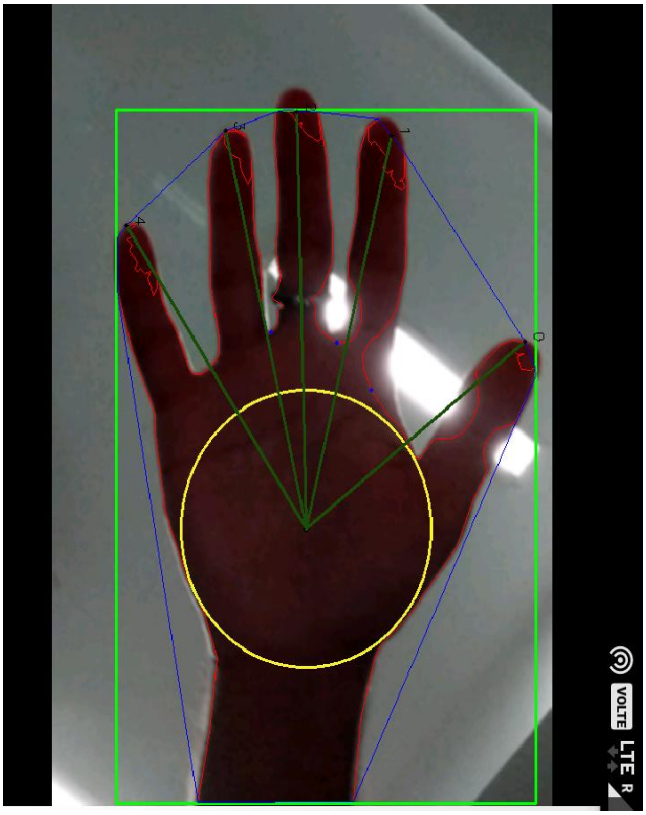

Figure 24-Feature Extraction

4.3 Application Testing

Testing requires the developers to find the errors from the android application. There are various types of testing that can be performed-

- **Database Testing**

The back and front ends are very complex so this type of testing is required. Each transaction that a DB performs has to adhere ACID properties i.e. atomicity, consistency, isolation and durability.

- **Unit Testing**

In this testing technique, individual components of an application are tested. The purpose of this is to verify that all the components work as expected.

- **Black Box Testing**

Main goal in this is to be fully unconcerned about the internal working and structure of the app. The tester just needs to know what the app is supposed to do and checks for valid and invalid input.

4.4 Tests

To show outcomes, about a few tests were directed in various lighting conditions and distinctive foundation. For each signal, 3 edges were caught with the known names. This is appeared as red numbers in the pictures. Keeping in mind the end goal to demonstrate exactness three casings are sufficient. Thusly what truly matters is the execution of the hand location rather that of hand acknowledgment. The execution of the hand identification can be measured from the photographs caught, which show distinctive components of the hand like shape and finger vectors. Presumably, three edges are sufficient to watch if these components are steady or not and on the off chance that they are right.

Figure 25- Results of Scenario 1

Figure 26- Results for Scenario 2

Figure 27- Results for Scenario 3

Three situations are utilized for testing the application. Above figures demonstrate the outcomes. It can be inferred that the application is functioning admirably in Scenario 1 and Scenario 3. All the anticipated names are right. A large portion of the signals are distinguished accurately, with the exception of that there is one motion not recognized. Because of sharp complexity in shading between the foundation and the hand, this application is effective. Just the shading matters grouping or no-bunching of foundation does not make a difference.

A portion of the signals in Scenario 2 are not very much identified. Most likely, due to the light the auto alteration of the camera winds up plainly more grounded in this situation.

Taking everything into account, the application can distinguish and perceive the hand well and stable with the assistance of pre-tested hues in the vast majority of lighting conditions and foundations, the length of the complexity of is not very poor. In any case, once the pre-test process is done the foundation must be kept same. This is the principle imperative. What's more, that implies to evade changes of hues for both the hand and the telephone ought not move much.

CHAPTER-5 CONCLUSIONS

5.1 Conclusions

The venture goes for proposing an effective and a straightforward gesture based communication acknowledgment framework to eradicate the correspondence holes between the quiet and hard of hearing individuals with ordinary individuals. The strategy, we proposed doesn't require any gloves and gadgets for the identification of the hand developments, attributable to this the cost of the framework is decreased by an awesome edge. This framework can be utilized by the general population, by contributing less cost when connected to the current framework. Since in the last mentioned, extra gadgets are required to distinguish hand motions. There are three purposes behind awkward execution of the testing information. At first, we had skin location issues. Since there is no unmistakable limit set for skin probabilities, we set our edge observationally. Be that as it may, here and there foundation shading is likewise skin-like in shading, so it might be recognized as skin itself. An enormous variety in the pictures additionally had an influence in low precision rates. This includes distinctive size of motions in pictures, diverse introductions, diverse foundation of the pictures and edge of signals and numerous others.

Potential Improvements

- Build measurable model for the shade of foundation and hand rather than basic testing and summing.
- Use versatile thresholding to get the last parallel picture.
- Add end procedure of skin-like parts like wrist, lower arm and face.
- Add include portrayal for the "clench hand" signal.
- Make expectation as per likelihood, as opposed to straightforwardly yield the forecast outline by edge.

Limitations

Two most apparent disadvantages said before are impacts of progress in foundation hues and lighting conditions. One thing found is that the camera on the telephone has auto-modification like auto-introduction and auto white adjusting which change the shade of the hand and foundation as the view or position of the hand changes. This makes shading based techniques not attractive to be utilized on cell phones. The main arrangement is either discovering approaches to cripple the auto modification, which I believe is unrealistic on the vast majority of the gadgets, or forsaking the strategies and rather utilize hand discovery techniques in light of surface like elements together with some machine learning strategies.

Furthermore, since low-level elements are utilized to speak to the signal, a few motions can not be spoken to. Additionally it is difficult to dispose of false-positives.

5.2 Future Scope

We have wanted to convey our venture to the advanced mobile phones running on Android stages, since many individuals around the globe utilize their PDAs to speak with other individuals. So lion's share of individuals can manage the cost of the advanced mobile phone since its cost it continues diminishing because of accessibility of many brands with less cost. Our application may utilize the camera of the telephone to identify the sign appeared by the hard of hearing or quiet individuals and process it to content yield which will help other individuals to comprehend the hard of hearing and quiet individuals effortlessly. Our point is to connect the correspondence crevice between the hard of hearing and unable to speak individuals with the world (other individuals).

In future enhancements the software's like Mimix, Outfit – 7, VRS on speech and audio processing and language may be used to involve both speech recognition and translation components. By using this application deaf people can communicate with normal people. It can also include the following special criteria:

- Automatic Translation
- Automotive Speech Recognition
- Speech-to-Sign Transmission

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APPENDICES

Appendix A-Description of Tools

OpenCV is a library of programming functions mainly developed by Intel and now supported by Willow Garage. It is free for use under the sources. The library is Cross-platform. It focuses mainly on real-time image processing. If library finds, Intel's integrated Performance on the system, it will use these commercial optimized outlines to accelerate it.

Areas included in OpenCV's application:

- Toolkits for 2D and 3D feature
- Motion Tracking
- SFM
- Gesture recognition
- Facial recognition system
- Mobile robotics
- Object identification
- Motion understanding

In order to support some of the above mentioned areas, OpenCV includes a statistical machine library that consists of:

- Decision tree learning
- Boosting
- K-nearest neighbor algorithm
- Artificial neutral networks
- Random forest

Appendix B-Glossary

- API: a set of procedures and functions that allow creation of applications which access the data or features of an application, operating system or other service.
- Artifact: artificial defect in an image, due to problems in sensing equipment (scratches in X-ray digitized films) or during examinations (patient motion).
- Binary Image: image where pixels of an image have only two values, primarily 0 and 1
- Contrast: the amount of gray level distinction within an image.
- DoF: the number of independent parameters that define its configuration
- Feature: any property that is characteristic of an image, from which a interpretation, understanding or description of the scene can be provided by the machine.
- Handset: a mobile phone or a device that a person holds to the ear to hear the audio sound through a receiver.
- Micro-controller: a device which incorporates a micro-processor.
- Noise: degradation of an image due to equipment i.e. sensor, camera focus, type of modality, motion, turbulence.
- Object boundaries: linked edges that characterize shape of an object.
- Pixel: slang for a picture element, the smallest element of the image.
- Sampling: used to represent spatial resolution of the image.
- Segmentation: separation of different objects in the image. For instance by extracting their boundaries.
- Software: is a collection of a number of instructions that enable user to interact with a computer, its hardware and perform various tasks.
- Stack: an abstract data type that serves as a collection of elements, with two principal applications: *push*: adds an element to the collection, and *pop*: removes the most recently added element that was not yet removed. The order in which elements come off a stack gives rise to its another name, LIFO
- Threshold: the intensity or magnitude that must be exceeded for a certain reaction, phenomenon, result, or condition to occur or be manifested.