

Gesture Recognition System for Indian Sign Language on Smart Phone

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Abstract: One of the most important things that humans have developed through evolution is the ability to communicate through each other by means of language. This is essential for exchanging ideas and expressions. Hearing impaired people use signs to communicate with others. There is no universal language as every country has its own spoken language so every country has their own dialect of sign language and in India they use Indian Sign Language (ISL). This application will help the person with and without the impairments to communicate with each other. The system consists of two stages. First stage is to capture gestures from real time video. Second stage is to map these gestures into equivalent Indian sign language text output.

Keywords: Gesture Recognition System, Indian Sign Language (ISL), Smart Phone.

I. INTRODUCTION

The current technology is reaching its pinnacle of success. Our everyday surrounding is not untouched by such advancement in technology. Amongst the rapid growth of technology, mobile computing has proved its competency in the vast range of applications^[1] and the impact of smart phone on human life cannot be underrated. In contrast to previous usage of smart phone to stay only connected to people, today smart phone does much more than that. But in spite of this leap in technology, there are certain individuals who are not able to get these benefits. The hearing disabled and mute individuals can't blend with the social world as a result of their disabilities. Involuntarily they are treated differently by the society. They cannot perform well in many areas of interaction. For example, education environment for person with disabilities is not similar as the rest of the people, disabled people do not have any special tools to buy commodities, they have hard time to find work, and much more. It creates a gap between person with and without the disabilities. This gap is ever increasing day by day. There are more than 1 million deaf adults and around 0.5 million deaf children in India use Sign Language (ISL) as a way of communication^[3]. In spite of such large numbers, very less efforts have been fulfilling to bridge the gap.

Smartphone can be defined as the perfect one and all solution for personal digital assistant, media player, camera and several other applications. In contrary to early years where only mobile manufacturing industry was only able to develop the mobile applications, after the introduction of Android OS in 2007, Smartphone application development is also handled by open source community. Android was developed by Google with Linux core kernel GNU software components^[8].

The introduction of Smartphone with camera, Real Time video processing becomes very possible now and they can even perform critical computation tasks. All Smartphone applications are able to access camera permission to use mobile computer vision technology^[1]. Mobile computer

vision technologies are being used widely to develop our day to day activities applications^[1]. For example, These technologies try to accomplish many objectives like object finding, segmenting, and location recognition^[1].

As Smartphone processors such as MediaTek, ARM, NVIDIA Tegra, and Snapdragon are growing day by day and that enables to achieve more computation capability on smaller devices such as image and video editing, face recognition, finger print recognition, virtual reality and augmented reality. Conventionally, Mobile computer vision algorithms are not performed practically on smaller devices because of their long processing time and high computational requirements. To make this possible, researchers and developers have tried to successfully explore the libraries such as OpenGL and OpenCV^[9]. Without having to export these libraries development process can be difficult about not having proper knowledge about the real time video processing. OpenCV library provides solution in such cases because it is developed in C and C++ language and hence it reduces development as well as research time^[9].

In an attempt to overcome the communication barrier, the proposed application will help normal people and speech and hearing impaired people to communicate with each other effectively.

II. LITERATURE REVIEW

Smart phones have provided its versatility on mobile devices since they have programmable Graphical Processing Unit (GPU)^[1] and by using such powerful graphics processors smart phone is able to carry out tasks such as augmented reality and mobile object recognition^[1]. There are two efficient libraries which can be used to carry out this task namely, 1) CamTest and 2) OpenCV^[5]. It purely depends upon the application environment to which of the library is used. But generally OpenCV has proved to give best result than CamTest^[5] Automation of Indian

sign language has always been an active research topic in the field of aiding disabled people.^[3] In sign language, Communication is done by the hand movement, facial expression or combination of both. According to that the gestures can be classified as having Manual Features and Non-manual Features.^[3] Sing language can be automated by either converting sing language gestures into text or text into sing language gestures.^[3] Using manual features of the Marathi words, gestures were identified and translated into its meaning successfully^[6]. Two way communication between deaf and dumb people can be accomplished using portable smart devices as long as smart device is able to carry out image processing^[4]. To carry out image processing efficiently OpenCV library can be used and it can carry out accuracy up to 90%^[2]. The gesture recognition task on smart phone can be carried out with or without the use of the computer acting as a server computer. Since OpenCV is a cross-platform tool, it can work with Windows, Linux, Android, Symbian etc^[7].

III. ANDROID ARCHITECTURE

Andorid operating system is a stack of software components and consists of many layers such as Kernel Layer, System Libraries, Dalvik Virtual Machine (DVM) layer, Application Framework layer and on top Application layer^[10]. Kernel provides functionalities such as network management, memory management, process management, device management etc. Libraries are used for different operations like internet security^[10]. Android run time (ART) is a gateway into the android operating system. ART consists of Dalvik Virtual Machine which is optimized for android operating system. The application framework layer gives services to the installed applications in the form of java class library, which developer uses to create applications. The top most level, the application layer is where applications get installed.

IV. OPEN CV IN ANDROID

The OpenCV (Open Source Computer Vision) is the open source library of programming functions aimed at real-time computer vision. OpenCV was developed by Intel in library was officially developed and introduced by Intel in 1999 to enforce CPU and GPU exhaustive application^[7]. In contrast to earlier version of OpenCV which was written in C, from addition of OpenCV 2.0 it provides C and C++ interfaces. In the edition of OpenCV 2.2 they introduced an android port for application in image processing. As of current version OpenCV 3.1, it has many optimized methods^[7]. The OpenCV library is cross-platform and is distributed under open-source BSD (Berkeley Software Distribution) license^[7], which means that it imposes minimum restriction on the redistribution of software^[7]. It can also take advantage of the hardware acceleration of the underlying heterogeneous compute platform^[7].

V. PROPOSED SYSTEM

The system hardware consists of an android smart phone which is capable of taking pictures. The heart of the

system is the software, hence the flow-chart is the software work flow of the system. The workflow begins with the task of getting a real time picture. The system is divided into two main components namely, Front-end design and Back-end design. The separation between Front-end and Back-end simplifies the overall development process and updating process. Such simplification increases the lifetime of the overall application and hence making it flexible to future advancement of the technology. Front-end design and Back-end design are distinguishable programming interfaces between a presentation layer and data access layer. Front-end is the interface between the user and the back-end system. Where, its main task is to simplifying the underlying system access by providing user friendly graphical user interface (GUI). Front-end designing is thus very important to make the system available for the common use by various groups of society.

Setting up the Environment:

Development environment consists of Java tools and android development tools.

1. Java environment: JDK 6 and Eclipse 3.4
2. Link to android environment: Android SDK
3. Coding in java for android: Android Development Tools (ADT)

Front-end design:

Front-end Design make sure that the user can interact with the system easily and efficiently. To create the Front-end design Eclipse (Indigo) is used in conjunction with the ADT (Android Developer Tools) plug-in to create the camera interface to capture the gesture. ADT is the plug-in for Eclipse IDE (Integrated Development Environment) that enhances the capabilities of IDE to simplify android development process, to create an application GUI, to add packages based on the android framework API (Application Programming Interface), to debug applications using android SDK (Software Development Kit) tools, and to exports signed as well as unsigned .apk files to execute on smart phone using in-built or created AVDs (Android Virtual Device) or to debug the application via ADB (Android Debugging Bridge). Front-end design is the gateway for user to accomplish tasks without having to learn about the underlying mechanisms. That is to use the application user did not need to know about the workings of the system.

Back-end design:

Generic approach to software development is to make the client side component manipulated by the user and the server side code reside on the server. The server can be anything from the remotely accessible computer or any smart device consisting of operating system and communication capabilities to connect to the client side. Back-end design will launch the activity upon request from the Front-end component. Image processing is done by the Back-end design and hence it is the backbone of the system. Conventionally, any programming language can be used to create the server side modules. As of this application, Java programming is used because it is used majorly on the android development process. OpenCV

library is used to carry out the image processing techniques.

Workflow:

The figure 1 shows the overall working flow of the system.

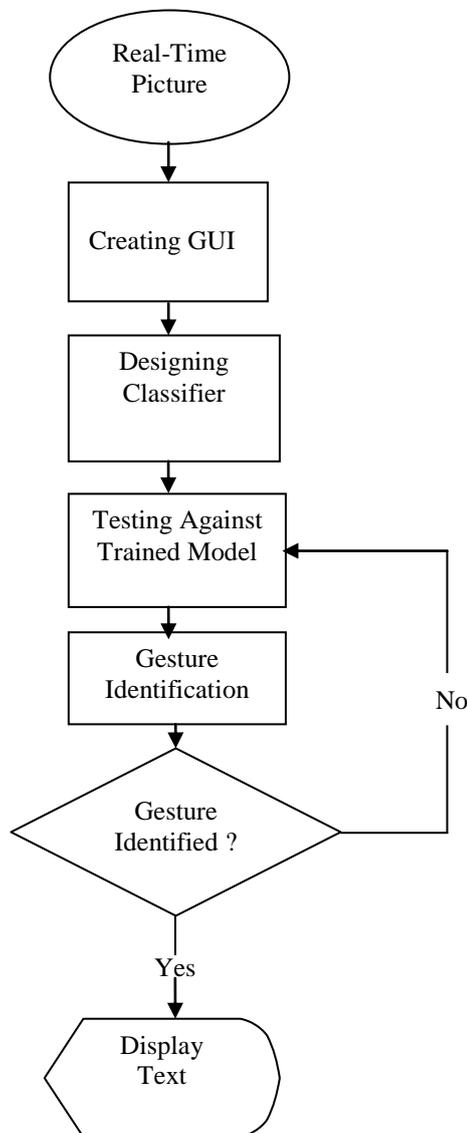


Fig1. Flowchart describing gesture recognition system

The first step for the system is to configure hardware, which is accompanied by the underlying software of the system. Since as of recent advancement of mobile system most of the smart-phone consists of a camera module hence device need not to be configured to use the camera. The mobility of the application is such that it can be used on any platform that can support android operating system, so if the application is needed outside the smart-phone computing environment (Such as in Cars, small systems in Stores etc) than the application can be ported by modifying the system to access the camera hardware and let the hardware respond to android operating system. Real time picture is taken when the GUI views will send request for permission to use camera services provided by

android operation system. Trained model images are shown in figure 2. When the captured gesture matches with the database images then the appropriate text is displayed on the device display and hence the communication is established. If the gesture is not recognized then the iteration is repeated until the correct text is not displayed.

Image Database:

On contrary to non manual feature, manual feature of Indian sign language does not include movement of head, shoulders, facial expressions and such signals which is used in addition with signs to create a meaning.^[3] Indian sign language with manual features are used in the development of the application.

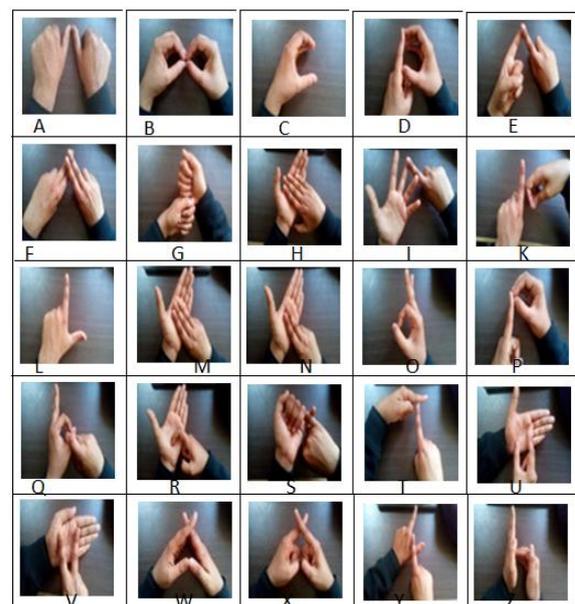


Fig2. Some of the Database images

Non manual features are not used mainly because of the simplicity of the application. Indian Sign Language has many dialects depending on the part of the country and their advancement in sign language. So instead of building a database for each dialect and their respective expression, 26 alphabets and 10 digits with their respective gestures, and in addition, such five samples for each alphabet and digit is considered. Images are taken with Sony Xperia C2305 (Android Version 4.2.2) smart phone. Dark background is used so the gestures are clearly visible on the captured image. Each Image is resized to 64x64 pixel resolution.

VI. FUTURE WORK

Future work is needed in order to make the system usable in the real world. Majority of the future works consist of programming with OpenCV and android development. OpenCV library should be successfully imported to android development environment. That will ensure that the Image processing will be carried out on the device. When the Gesture is recognized system needs designed to display the text which is clearly visible to the user. The

system can be further enhanced to make sure that it works well in real time as well.

VII. CONCLUISON

The technological advancement is on its highest zest. Image processing and computer programming are the areas which can help to make sure that the physically handicapped people can benefit from the technology as well. Here the system design to automate the Indian sign language is discussed. Android and OpenCV are the open source projects hence the cost of the system is reduced to zero. The Automation of sign language can be done if it is successfully converted to text.

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