Software Engineering Project
ISL Fingerspelling Recognition Tool

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Introduction

Sign Language is a system of communication using visual gestures and signs. They vary from country to country with different vocabulary and grammar. The Indian Sign Language is the most essential means of communication in the deaf-mute community of India. Speech impairments is a common problem globally and in India, with very few schools that teach sign language. Moreover there are very few teachers available in the schools. We propose an application which promotes the knowledge of Indian Sign Language and aids the teachers at the speech impaired schools, so that each student gets an individual attention. We aspire to develop this application as an interpretation medium between the deaf-mute community and the mainstream society. Our goal is to develop a tool that helps you to learn ISL by an image processing algorithm equipped with gesture detection and recognition application.

Objectives

➔ **Inscope**
   ◆ Create an Indian Sign Language Fingerspelling recognition software having minimal hardware requirements. The software will be deployed in the form of an android app to ensure maximum awareness and usage by the target demographic.
   ◆ Create interactive application which promotes learning of Indian Sign Language.

➔ **Outscope**
   ◆ This app can be further modified to act as a translator for Indian Sign Language to English Text and Speech in order to bridge the gap between the deaf and mute individuals and those unfamiliar with sign language.
   ◆ Accurate recognition can help in grading those individuals who aspire to learn the Indian Sign Language and achieve valid Certification from the authorities.

Tools & Hardware Required for the Project

➔ **Tensorflow :**

TensorFlow is an open-source software library for dataflow programming across a range of tasks. It is a symbolic math library, and is also used for machine learning applications such as neural networks. TensorFlow was developed by the Google Brain team for internal Google use. It was released under the Apache 2.0 open source license on November 9, 2015.

◆ **Requirements :** A Machine to train the gesture recognition model is required. The specifications of the computer are as follows :

- Intel i7 with a minimum of 8GB RAM.
- GPU card with CUDA Compute Capability 3.0 or higher for building from source and 3.5 or higher for our binaries.
- CUDA® Toolkit 9.0. For details, see NVIDIA's documentation. Ensure that you append the relevant CUDA pathnames to the LD_LIBRARY_PATH environment variable as described in the NVIDIA documentation.
- The NVIDIA drivers associated with CUDA Toolkit 9.0.
- cuDNN v7.0. For details, see NVIDIA's documentation. Ensure that you create the CUDA_HOME environment variable as described in the NVIDIA documentation.

➔ **LabelImg:**

LabelImg is a graphical image annotation tool. It is written in Python and uses Qt for its graphical interface. Annotations are saved as XML files in PASCAL VOC format, the format used by ImageNet.

➔ **Android Studio and Java 8 SDK:**

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built based on JetBrains' IntelliJ IDEA software and designed specifically for Android development

➔ **An Android Smartphone with Camera Specifications:**

This device will serve as the input agent to collect the video if the sign gesture in real-time

Market Research

➔ The Hand sign recognition technology is divided into two categories-
  ◆ **Glove Based:** In glove based systems data gloves are used which can achieve the accurate positions of hand gestures as its positions are directly measured.
  ◆ **Vision Based:** The Vision Based methods require only a camera (input device for observing the information of hands or fingers), thus realizing a natural interaction between humans and computers without the use of any extra devices.

➔ Due to the unavailability of high end sensors and technologies in rural areas, simple vision based recognition is the most widely used in hand sign recognition all over India. Unlike the other global Sign Languages such as ASL, the Indian Sign Language is still not well documented and has several discrepancies from region to region.

➔ The Department of Empowerment of Persons with Disabilities has established the Indian Sign Language Research and Training Centre (ISLRTC) to educate the Indian society about ISL and spread awareness about ISL as an education mode for the hearing impaired.
  ◆ A part of this initiative is the **TalkHands app** which is an educational interactive application available on the PlayStore. Talking Hands is an Indian Sign Language Portal developed to maintain Communicative environment in Hearing and Hearing disabled people in India and the globe.

➔ The Google PlayStore and the AppStore feature various Apps to aid the learning of the Sign Language:
  ◆ **Let Me Hear Again:** Helps differently abled users, who are hard of hearing or deaf, communicate with others who do not know the American Sign Language. The app was ideated by Dr. Sharon Baisil and developed through the Google App Inventor platform.
  ◆ **MotionSavvy:** The MotionSavvy case embeds the Leap, and the MotionSavvy software leverages the the Leap Motion accelerator AXLR8R's 3D motion recognition, which detects when a person is using ASL and converts it to text or voice.

➔ In 2017, a team from IIT-B worked and published a report on Fingerspelling-Sign Language Tool. The object of the project was to explore various sign languages and assist the learning of ISL. They created a library of 3D-modeled hand gestures as a teaching platform and a gesture recognition software using the WebCam for Desktop and Web Applications.

➔ Most of the apps support the American Sign Language and are simply a portal for learning the sign language. The users have no way to test themselves and ensure their gestures are accurate and uniform throughout India. The users also are unable to receive recognition in learning the ISL as a translator or to pursue further studies.

➔ As of now no application is made that provides proper gesture recognition with no lag and offline support.

➔ A portable mobile application to recognize and test the hand gestures of the Indian Sign Language is still in early development. No reliable application on the mobile platform is available as of today.

Project Overview

In this project we are performing Realtime Gesture Detection in Android using Tensorflow Object Detection API. The main steps involved in this projects are :

➔ **Collection of Data:**
This step involves the creation of our data set. For our project the data set is a collection of images of the gestures of all the respective alphabets in the ISL.

➔ **Creating and Training the Model:**
We create a convolution net, feed our data and and make a training model. After the creation of the training model we obtain our inference graph and test the training model

➔ **Deploying In Android:**
The core of the TensorFlow is written in C++. In order to build for Android, we have to use JNI(Java Native Interface) to call the C++ functions. We will have a .so(shared object) file which is a C++ compiled file and a jar file which will consist of JAVA API that will be calling the native C++. We must have the pre-trained model file and a label file for the classification

Conclusion

The purpose of our Application is to make people learn the Indian Sign Language easily without the help of a teacher at no cost for the software. We aspire to develop such an android app to promote awareness about the Indian SIgn Language and to create an education tool to assist Schools for the Deaf-Mute to impart knowledge through a reliable and user-friendly channel.

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