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Real Time ASL (American Sign Language) Recognition

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***Abstract*—**Hand gestures are powerful means of communication among humans and sign language is the most natural and expressive way of communication for dumb and deaf people. Thus, it provides a replacement for speech among deaf and mute people, but no one form of sign language is universal. American Sign Language (ASL) is one of the sign languages which is the most widely used sign language among the English-speaking community. ASL is also widely learned language, serving as lingua franca. The communication between the deaf /dumb and normal people is extremely poor due to the fact that there is no single standalone platform that can bridge the communication gap. Sign language is a way to bridge this gap still cannot a success since the normal people ever learned such sign languages. One of the ways to eradicate this gap is by identifying the sign language's hand gestures thus predicting the language for the normal people. In this way, the normal person will be aware of the dumb and deaf's speech and can respond appropriately. Such a solution will eliminate the level of dependencies which a deaf/dumb person has on a translator for communicating which in turn will provide job opportunities and eradicate many more problems faced by such people in their everyday life.

***Keywords*—**ASL, Gestures, deaf/dumb, OpenCV, Android app, Communication

I. INTRODUCTION

In ASL Recognition System we proposed Real Time recognition of the ASL hand gestures by using OpenCV Library from Python. The data of the ASL hand gestures are captured by an android app's camera unit and will be sent to a python server for processing, the received data will be mapped to its respective meaning from the predefined dataset of the ASL hand gestures. The ASL Recognition System which will provide the deaf/ dumb community with technology that would reduce their reliance on others.

According to a report given by the World Health Organization (WHO) in 2005, approximately 278 million people were being found in the world with moderate-profound hearing impairment. Communication via the written form is also not useful and even it becomes impractical when an emergency occurs. In such a case, Sign language serves as the only medium of communication for them. Communication via Sign Language becomes difficult as it is a nonverbal language which utilizes visual sign patterns such as hand gestures or any other parts of the body to carry out the communication process and its literacy rate in the society is relatively low. Hence, it becomes important to create a platform or a system that demolishes this barrier in communication. Therefore, in order to enable dynamic communication for the deaf/dumb community, this system will use OpenCV Library from Python which will translate in real time the video of the person performing ASL signs into text form.

Using OpenCV, our system will be able to recognize the ASL fundamentals that is
• 26 English Language Alphabets
• Numbers
• Basic Daily Sentences
The Assumptions made by us for the system is that it should have:
• Fixed camera
• Recognize only hand
• Trained for one person
• Depth stays constant

We have provided a literature survey done by us on some significant papers in Section II. In Section III we have depicted various diagrams clarifying the framework usefulness with framework design. We demonstrated a Use Case graph centering the client's collaboration with the framework. Lastly, in Section IV we have provided results and discussion on our paper and Section V contains Future Scope for the advancement of our framework and conclusion of the study.

II. RELATED WORK

The efforts to use technology to improve the communication between the deaf/dumb and normal people have been in existence from a quite a period now. The idea for need of such system arises from the work done by previous researchers.

Thad Eugene Starner in 'Visual Recognition of American Sign Language Using Hidden Markov Models'-June 1991 mainly focusses on using gloves for detecting hand-movement and identify the orientation of hand. In this paper, an extensible system is described that uses a single-color camera to track Hands in real time and recognize sentences of American Sign Language (ASL) using hidden Markov models (HMM's). The hand tracking stage of the system does not attempt to produce a fine-grain description of hand shape, studies have shown that such detailed Information may be unnecessary for humans to interpret sign language. Instead, the tracking process produces only a course description of hand shape, orientation, and trajectory. The user is required to wear inexpensive colored gloves to facilitate the hand tracking Frame rate and stability. This shape, orientation, and trajectory information are then inputted to an HMM for recognition of the signed words.
'A Real-time Continuous Gesture Recognition System for Sign Language' in 1998 by Rung Huei Liang, Ming Ouhyoung. In this paper, a large vocabulary sign language interpreter is presented with real-time continuous gesture Recognition of sign language using a Data Glove. The most critical problem was end-point detection in a stream of gesture input is first solved and then statistical analysis is done according to 4 parameters in a gesture: posture, position, orientation, and motion. This System had implemented a prototype system with a lexicon of 250 vocabularies in Taiwanese Sign Language (TWL).The System uses Hidden Markov Models (HMMs) for 51 fundamental postures, 6 Orientations, and 8 motion primitives. In a signer-dependent way, a sentence of gestures based on these vocabularies can be continuously recognized in real-time and the average recognition rate is 80.4%.

III. METHODOLOGY

Following block diagram is the overview of our system which provides a short overview of our system.

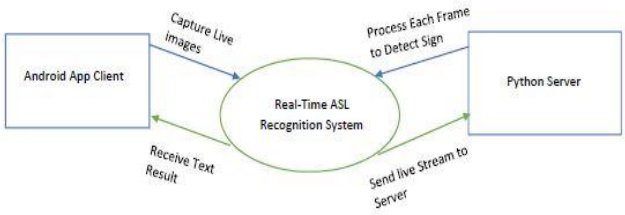

Figure 1: Data Flow Diagram

As shown in the block diagram, different tasks of each entity of our proposed system are defined. For each entity, our proposed system has a different set of input and respective output for that respective input.
In this section, we have explained some features of our system, implementation plan of our system and overview of our system using some labeled charts.

A. Component diagram:

Component diagrams are used in modelling the physical aspects of object-oriented systems that are used for visualizing, specifying, and documenting component-based systems and for constructing executable systems through forward and reverse engineering. Component diagrams are essentially class diagrams that focus on a system's components that often used to model the static implementation view of a system.

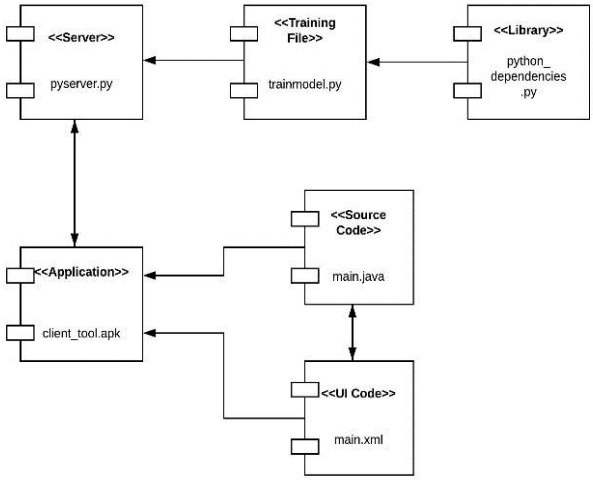

Figure 2: Component Diagram

B. Use case diagram:

Use case diagram is the primary form of system/software requirements for a new software program underdeveloped. A use case is a list of actions or event steps typically defining the interactions between a role (an actor) and a system to achieve a goal. Use cases specify the expected behaviour (what), and not the exact method of making it happen (how). A key concept of use case modelling is that it helps us design a system from the end user's perspective. It is an effective technique for communicating system behaviour in the user's terms by specifying all externally visible system behaviour.

The fig. given above shows us the behaviour of the system i.e. what the system does with respect to the user. And also hiding the internal characteristics of the system i.e. How the System works. In our case, the actors in the system are the Normal person and the Deaf & Dumb Person.

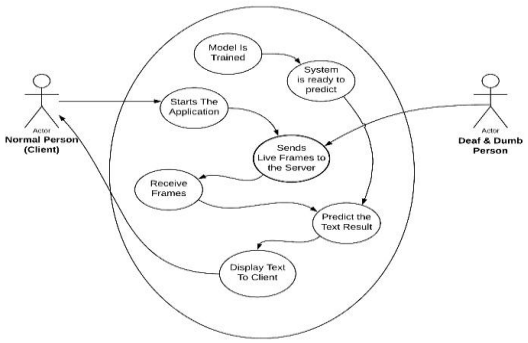

Figure 3: Use Case Diagram

C. Activity Diagram:

Activity Diagrams describe how activities are coordinated to provide a service which can be at different levels of abstraction. Typically, an event needs to be achieved by some operations, particularly where the operation is intended to achieve several different things that require coordination, or how the events in a single use case relate to one another, in particular, use cases where activities may overlap and require coordination. It is also suitable for modelling how a collection of use cases coordinates to represent business workflows.

In Fig. it gives us the knowledge about the interactions or the activities that take place between the System, the Normal person and the Deaf & Dumb person and how they coordinate their activities to achieve their intended goal.

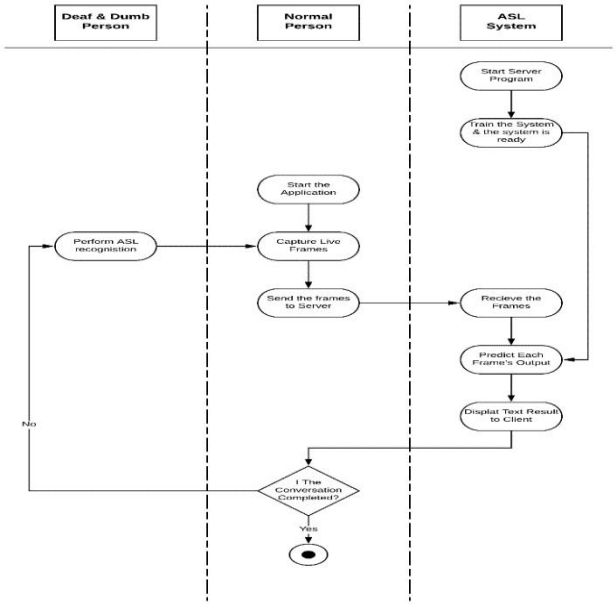

Figure 4: Activity Diagram

IV. RESULT AND DISCUSSION

Recently the deaf/dumb community uses technologies in order to ease their communication with the world opposite to their world. Technologies used by them have not yet completely made them independent enough to express their thoughts effectively to the world. Development of technologies in this area is currently advancing in two directions i.e. firstly to express the normal person's thoughts to the deaf/dumb person in sign language and secondly the thoughts of a deaf/dumb person to the normal person.

Technologies with respect to the first direction (i.e. thoughts of a normal person to the deaf/dumb person) have greatly advanced in order to depict the usual languages to the American Sign Language or any other sign language efficiently with the help of graphics or even videos. Such solutions are available as desktop apps websites and even been made portable with the help of a phone, there are currently 8 highly popular apps in the app market for iOS and Android users. The quantity, as well as quality of such apps, are increasing day by day.

But the development of technologies in the second direction (i.e. thoughts of the deaf/dumb person to the normal person) is advancing slowly and currently is restricted to only 26 English alphabets and numbers. This partially developed solution is only available to the desktop apps and till date never been made portable for the users with help of Android/ iOS apps.

V. CONCLUSION AND FUTURE SCOPE

The system will be able to predict in real-time the American Sign Language performed by the deaf/dumb person which will greatly bridge the communication gap between the deaf/dumb person and the normal world. Our System aims to become an efficient translator which can replace the need of a human translator used by the deaf/dumb person for expressing their thoughts to others.

The system will not completely take the position of the human translator after the deployment of our system instead, it will be able to learn from its errors and environment slowly to match the ability of a human translator. The System will efficiently predict the hand gestures for the English Alphabets which includes all 26 Alphabets, numbers and simple basic day to day communication sentences.

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