Perspectives in Communication, Embedded-Systems and Signal-Processing (PiCES) – An International Journal
ISSN: 2566-932X, Vol. 4, Issue 12, March 2021
Part of the Proceedings of the 1st All India Paper writing Competition on Emerging Research - PaCER 2020

Wearable Based Sign Language Recognition

B N Meghana
Department of Electrical and Electronic Engineering, Sai Vidya Institute of Technology, Rajanukunte, Bangalore – 560064, megha161097@gmail.com

Priyanka R Vidur
Department of Electrical and Electronic Engineering, Sai Vidya Institute of Technology, Rajanukunte, Bangalore – 560064, pvidur98@gmail.com

Meghana K Jambagi
Department of Electrical and Electronic Engineering, Sai Vidya Institute of Technology, Rajanukunte, Bangalore – 560064, meghana.k.jambagi@gmail.com

Basavanagowda N
Department of Electrical and Electronic Engineering, Sai Vidya Institute of Technology, Rajanukunte, Bangalore – 560064, basavanagowdan755@gmail.com

T G Manjunath
HOD, Department of Electrical and Electronic Engineering, Sai Vidya Institute of Technology, Rajanukunte, Bangalore – 560064, tgnath@gmail.com

Abstract: Money is one of the most required components on one's life. Be it a normal person or a physically challenged individual, finance is required to lead life ahead. Usually ATMs are utilised for withdrawing money from a bank account, but the visually impaired might have a tough time accessing these machines. Simple sign languages can be used by the blind to withdraw the money from the ATMs thus making their lives easy. Here are a few papers that have worked on sign language recognition.

Keywords: Sign Language; ATM; Hand Gestures; Survey; Otsu; Gloves; Wearables

I. INTRODUCTION

The world today has overcome several problems with the help of technology. Right from reducing communication distance to serving humanity, several equipment's, devices and solutions have been proposed. About 285 million people are visually impaired worldwide: 39 million are blind and 246 million have low vision (severe or moderate visual impairment). Preventable causes are as high as 80% of the total global visual impairment burden. Globally, uncorrected refractive errors are the main cause of visual impairment. Cataracts are the leading cause of blindness in 65% of visually impaired, and 82% of blind people are over 50 years of age, although this age group comprises only 20% of the world population.

Several devices such as guiding canes and Braille based mobile phones have been developed to assist the blind. But, one of the main problems faced by them is performing monetary transactions, especially in ATMs. Most of the ATMs have Braille inscribed keypad. A blind person who may be not aware of Braille may not be able to withdraw the money correctly without any assistance.

The other option is the blind person must take others help as the process is displayed on the screen and they have trouble entering the password as well as there is no security as anyone can find out the password when they are entering. The person accompanying him might get to know the password or someone else can come to know of his pin number. A stranger might try to help the blind win the trust and rob him.

Thus, in order to enhance his security while withdrawing money from the ATM, we plan to develop a secure environment for him by designing sign language-based ATM accessing system. This paper focuses on a summary of different techniques employed to identify the gestures as part of literature survey conducted towards this idea.

II. EXISTING TECHNIQUES

A. Smart Wearable Hand Device for Sign Language Interpretation System with Sensors Fusion [3]

Hand gestures are a medium for a deaf/mute person to communicate. The paper brings the possibility to make use of the manually shown hand gestures to be easily displayed. In this paper, the smart sign language interpretation is implemented by a wearable hand device. This device consists of the following components – "five sensors, two pressure sensors and a 3- axis inertial motion sensors". The entire system is thus divided in 3 module – "a wearable device with a sensor module", "a processing module", "and a display unit mobile application module".

When the gestures are shown wearing this device, the sensors present on the fingers collects and analyses the data

using an embedded vector machine classifier, the recognized gesture is then transmitted to the mobile application app through blue tooth. Now, the android based app developed which converts the received text into audible voice output. The method used in this paper is the vision method approach.

First, the gestures were being recorded 20 times at least 10 s each and saved in the file format. Next, at the stage of preprocessing the major challenge was the difference in the hand size. The flex sensors for a smaller hand had less variation when compared to the larger hand. Therefore, they used the mean and SD and computed separately for each person based on the sensor readings. The flexion division were divided in 3 regions— "complete bend" "partial bend" and "slight bend". Recognition of the gestures with only flex sensors and inertial sensor are 1st version and with the addition of pressure sensors for sensor level fusion are 2nd version. There are some alphabets which falls in the same region hence pressure sensors. For example, the U and V-the second pressure sensor which is placed on the middle finger for U is high when compared to V. Likewise, this was done for other similar alphabets.

The experiment results indicated that for sign language recognition accuracy rate of 65.7% can be achieved on average in the 1st version without pressure sensors. Foe 2nd version of the wearable system with the pressure sensors increased the recognition accuracy rate dramatically to 98.2%.

The major challenge the paper faced is that there is different sign language in different country like American sign language (ASL) or German sign language (GSL) and there is a slight variation. To develop a standard sign language interpretation becomes challenging

B. *Techno-Talk: An American Sign Language (ASL) TranslatorObservation [4]*

In the respective paper the American Sign Language Translator is implemented. First, an electronic wearable glove is made such that deaf/ mute person can wear and communication via an LCD display and a speaker.

Here the input are the flex sensors which are mounted on the gloves alongside an accelerometer. The flex sensor resistance produces a potential difference when they are bent. The angle of bent is calculated based on the potential difference measure. This variation of these resistance is converted into voltage which is processed by the microcontroller after performing A/D conversion.

Next, the flex sensors values are compared with a pre-defined value set in the controller. If all the values for a particular sign gets matched, then the respective alphabet is shown in the LCD display. The challenge here is when the flex sensor values are almost similar values like "U" "V". In such circumstances we make use of the accelerometer to record the hand axes.

The next stage, both these data are sent as the input to Arduino Mega 2560 and Voice Box shield, LCD and Speaker for the outputs. Finally, based on the information being processed the microcontroller identifies the gesture shown.

The drawback in the paper is that the wearable gloves are not comfortable to wear all the time. Also, considering the unhealthy practice as the germs can spread in the interface.

Also, several image processing based gesture recognition methods have been incorporated. The use the following two methods, as part of their algorithm.

C. *Applications of Morphological Filtering To image analysis and processing [5]*

This paper summarizes some applications of morphological erosions, dilations, openings, and closings to image edge-detection, cleaning of impulsive noise, median-filtering, region-filling, skeletonization, and 2-D shape recognition.

Erosion is a process of removing the white pixels from the background. Dilation is process of removal of black pixels from the hand gestures. Region Filling is a morphological algorithm in image processing. Here the region may me interior region or boundary region.

D. *A Threshold Selection Method from Gray-Level Histograms [6]*

A nonparametric and unsupervised method of automatic threshold selection for picture segmentation is presented. An optimal threshold is selected by the discriminant criterion, namely, so as to maximize the separability of the resultant classes in gray levels. The procedure is very simple, utilizing only the zeroth- and the first-order cumulative moments of the gray-level histogram. It is straightforward to extend the method to multi-threshold problems. Several experimental results are also presented to support the validity of the method.

III. CONCLUSION

The methods showcase "invasive" methods of gesture recognition - the devices that have been developed have to be worn by the user, which may be unhygienic in scenarios of accessing publicly available ATMs. Also, most of the papers have worked on image processing algorithms that maybe slow, when implemented for live video. Thus, our motive becomes to develop a faster algorithm to secure the person's funds without ay "invasive" techniques.

REFERENCES

[1] Sasirekha, K. & Nivetha, M. & Indumathi, A. & Renukadevi, D.. (2016). Atm machine for blind people. 14. 911-916.

[2] Singanamalla, Sudheesh & Potluri, Venkatesh & Scott, Colin & Medhi-Thies, Indrani. (2019). PocketATM: understanding and improving ATM accessibility in India. 1-11. 10.1145/3287098.3287106.

[3] B. G. Lee and S. M. Lee, "Smart Wearable Hand Device for Sign Language Interpretation System With Sensors Fusion," in IEEE Sensors Journal, vol. 18, no. 3, pp. 1224-1232, 1 Feb.1, 2018.

[4] A. Arif, S. T. H. Rizvi, I. Jawaid, M. A. Waleed and M. R. Shakeel, "Techno-talk: An American Sign Language (ASL) Translator," 2016 International Conference on Control, Decision and Information Technologies (CoDIT), St. Julian's, 2016, pp. 665-670.

[5] P. Maragos and R. Schafer, "Applications of morphological filtering to image analysis and processing," ICASSP '86. IEEE International Conference on Acoustics, Speech, and Signal Processing, Tokyo, Japan, 1986, pp. 2067-2070.

[6] N. Otsu, "A Threshold Selection Method from Gray-Level Histograms," in IEEE Transactions on Systems, Man, and Cybernetics, vol. 9, no. 1, pp. 62-66, Jan. 1979.