IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023

DOI: 10.17148/IJARCCE.2023.12567

Hand Sign Detection System for Deaf and Dumb People

Dinesh Suresh Bhadane[1], Riddhi Mukkawar[2], Srushti Bhasme[3], Shreya Thakur[4]

Assistant Professor, Computer Engineering, Dr. D.Y. Patil Institute of Technology, Pimpri, Pune-18[1]

Final Year Students, Computer Engineering, Dr. D.Y. Patil Institute of Technology, Pimpri, Pune-18[2,3,4]

Abstract: Hand gestures are a type of non-verbal communication that can be utilized in many contexts, such as deaf-mute communication. The automatic interpretation of sign language is a research area that has not gotten much attention, despite the fact that it is essential for hearing impaired and silent persons to live independent lives as sign language is their primary mode of communication. Numerous methods and algorithms have been created in this field with the help of artificial intelligence and image processing. To recognize the signs and translate them into the necessary patterns, any system that understands sign language has undergone considerable training. This will help deaf people to communicate with the outside world easily. This proposed technique helps vocally disabled people to communicate.

Keywords: Human-Machine Interaction, Gesture Recognition, Machine Learning, Neural Networks, Convolutional Neural Network.

I. INTRODUCTION

Hearing loss is one of the most common chronic impairments that appear with age as degeneration of sensory cells. It results from different congenital or acquired causes (e.g., genetic causes, complications at birth, infectious diseases, exposure to excessive noise, among others). It is known as ‘‘Presbycusis’’ and affects approximately one-third of people over 65 years of age, and it cannot be reversed. However, it can be effectively treated with common hearing aids and communication devices. Moreover, some disruptive assistive technologies based on Artificial Intelligence are emerging to improve the well-being and quality of life of hard of hearing and deaf individuals. Sign languages are classified as natural languages and exhibit all the design features of other natural languages. Sign languages' visual and spatial nature and their variability present an exciting challenge for research in several scientific fields, such as linguistics, medicine, machine learning, computer vision, natural language processing, and computer graphics. Interpretation and linguistics of sign languages are primarily concerned with the meaning conveyed using the sign language. With the recognition of sign languages as natural languages in the late 1970 and early 1980, linguist research took an in-depth look into this field. Neural aspects are considered for fully grasping the connection between sign and phonetic languages. Natural language processing is also concerned with interpretation, a task similar to the interpretation and comprehension problems.

In this paper, we focus on sign language research, a relatively young field that took off with the breaking research of William Stokoe. When tackling sign languages, we have identified three areas prominent for research: interpretation and linguistics of sign languages, sign language synthesis and visualisation, and sign language recognition (SLR). Considering the importance of sign languages for the communication of millions of people across the world and the rapid technological developments, this article performs a scoping review of the most recent technologies applied in sign language recognition. One of the novelties of our work is that we start from a systematic mapping (i.e., a scoping review) where the trends in literature in the last decade are explored so that emerging technologies, sensors, algorithms can be analysed. Then, we proceed in a more detail-oriented fashion that is more common in systematic reviews where we identify the most significant works in the field. To that end, we use an NLP-based tool to support and simplify the literature review, which, as a methodological approach, is novel and considerably reduces the manual effort usually involved in such activities.

II. LITERATURE REVIEW

1. Gesture Recognition in an IoT environment: A Machine Learning-based Prototype.
Future of Information and Communication Conference – 2021
The paper has presented a prototype about gesture recognition, relying on a ML approach, based on a neural network classifier. In particular, we have illustrated the processing steps and the obtained results. The adoption of a supervised ML technique has proved effective in handling the variability of different types of gesture patterns, performing a continuous data flow analysis in real time. The prototype tested the feasibility of a user independent gesture recognition that is based only on inertial data

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023
DOI: 10.17148/IJARCCE.2023.12567

Methodology – DTW and Segmentation

Future Scope - Further planned developments include enhancing the ability to face gesture variability, in particular by improving the user independence and the recognition accuracy of smaller or slower movements. The user independence, or more generally, the ability to deal with the differences within each gesture class, will be tackled by introducing an automated cauterization stage, where the different ways of performing the same gesture can be grouped as if they were different gestures. The recognition rate of small and slow movements will be tackled by enriching the features provided to the neural network with more information about each segmented gesture, such as the gesture duration and peak values, that are currently lost during the normalization stage

Gaps – Results for smaller and slower moments is not detected.

2. Hand Gesture Recognition conversion to speech
International Journal of Information Sciences and Application – 2019
This paper describes the design and working of a system which is useful for dumb, deaf people to communicate with one another and with the normal people. System converts the sign language into voice which is easily understandable by dumb, deaf and normal people. The sign language is translated into some text form, to facilitate the deaf people as well.

Methodology – Convex Hull Detection

Future Scope - It can also be used in the upcoming smart televisions having webcams. Many times we are not able to find the remote to perform specific tasks on tv. Hence, our project can also be used and each gesture can be assigned a particular function to operate from a distance without making use of the remote. System makes use of systematized voice which is implemented with the help of speech modules but in order to make the virtual communication between people more realistic, we can make use of human voice in the place of systematized voice. This makes the words more clear to the local people as it can use any human voice as the sample to the output of all the speeches assigned to each gesture

Gaps – Sentences cannot be detected by using this model.

3. Wireless Glove for Hand Gesture

Acknowledgment: Sign Language to Discourse Change Framework in Territorial Dialect Robotics and Automation Engineering Journal – 2018

This paper helps in sign recognition for deaf and dumb people, the user forms a gesture and holds it approximately for 1 or 1.5 seconds to ensure proper recognition. Each gesture consists of bending of all fingers in certain angles accordingly. Every bend of the sensor (finger) produces a unique ADC value so that when a different hand gesture is made, different ADC values are produced.

Methodology – Flex Sensors, Space Coordinates

Future Scope - The system can be further developed with Wi-Fi connection and enlarged database supporting special characters or symbols. Microsoft Text To Speech (TTS) engine can be utilized to provide compatibility for multiple international languages.
An Android application can be developed for displaying the text and speech output on an Android device.

Gaps – The user has to carry the hardware system everywhere for communication.

4. Hand Gesture Detection and Conversion to Speech and Text
International Research Journal of Engineering and Technology – 2018
The paper aims to provide aid to those in need thus ensuring social relevance. The people can easily communicate with each other. The practical adaptation of the interface solution for visually impaired and blind people is limited by simplicity and usability in practical scenarios. As an easy and practical way to achieve human-computer- interaction, in this solution hand gesture to speech and text conversion has been used to facilitate the reduction of hardware components.

Methodology – Contours detection technique
Future Scope - The application can be integrated with other mobile and IoT devices to improve user interaction and make the system more robust. The accuracy of the program can be further improvised by using neural networks.

DOI: 10.17148/IJARCCE.2023.12567

Gaps - The accuracy of the program can be further improvised by using neural networks.

5. Home Automation System Based on Gesture Recognition System.
International Journal of Emerging Technologies in Engineering Research – 2017
The objective of this seminar is to develop such a system which will help physically impaired to control home appliances by hand gestures using accelerometer. Wireless technology is used for home automation for physically impaired. In this system physical impaired people use the home appliances very easily or they are comfortable with using the devices. This system is simple for operating the devices, this will be replaced by the remote control instead of pushing the button there for this system will be very suitable for operating the home appliances.

Methodology – Instrumented Glove Approach

Future Scope - An alternate stress could be put on the use of the application in the fields of medicines, military, governance etc. A genuine blend of various technologies in mentioned fields could make way for power tools and applications which will serve the community around the world

Gaps - It has distance limit in controlling devices.

III. METHODOLOGY

1. Image Segmentation

An image is made up of many individually unique pixels that are combined to form an image. The process of image segmentation divides or partitions a picture into more manageable pieces. The smaller regions are referred to as segments or pixels. The bulk of the time, the entire image is composed of a variety of tiny parts that are useless for image processing. Photographs serve as both the input and the output of this process, although the outputs are created entirely from the original photos. A matrix in the output contains the object's location. Using this technique, we can locate objects in images and image borders. The objects in the image are located by measuring the change in image intensity. Through this process, we convert a grayscale or RGB image into a binary (black and white) image. By dividing the image into a black and white image and a colour image, this lessens the complexity of the original image. The colour white on a dark background denotes our hand. The Otsu technique is used to convert images into binary. We need to make sure that neither the hand nor any part of the background can be recognized to boost the algorithm's effectiveness. By choosing the most accurate threshold value, segmentation can be carried out to produce the most accurate result.
In above figure on mixing of RGB and Grayscale image we found black and white image

Figure 1. Black and White Image

2. Edge Segmentation

Edge-based segmentation is one of the methods for image segmentation that is most frequently used in image processing. It focuses on identifying the edges of distinct objects in an image. This is a crucial stage since it allows you to recognize the different elements in the image's features because edges provide a plethora of valuable information. Edge detection is popular because it enables the removal of unnecessary and supplemental information from an image. The image's size is drastically reduced, making it easier to analyse. Edge-based segmentation algorithms use variations in texture, contrast, grey level, colour, saturation, and other properties to identify edges in an image. we move from one place to another; the shade of grey may change. So long as we can discover that discontinuity, we can locate the edge. The resulting image is an intermediate segmentation result and should not be mistaken for the segmented image, even though there are numerous edge detection operators available. More processing needs to be done to segment the image. Additional methods include combining the edges segments that were collected into one segment to reduce the number of segments rather than chunks of small borders that can obstruct the process of region filling. This is done to make the boundaries of the item appear continuously.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023

DOI: 10.17148/IJARCCE.2023.12567

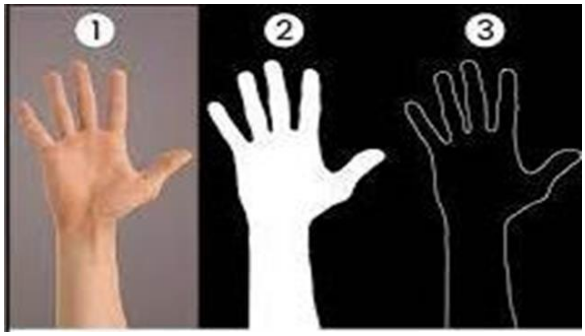

Figure 2. Edge Detection

In above figure boundaries of object is detected to convert it into binary image

3. Threshold

Image thresholding segmentation is a simple method of image division. By applying a threshold value to the pixel intensity, it is a method for transforming an original image into a binary or multi-colour image. When thresholding, we will take each pixel's intensity histogram into consideration. The image will then be segmented when we set a threshold. There are three different kinds of threshold approaches.
Trial and Error Thresholding
Otsu's Method

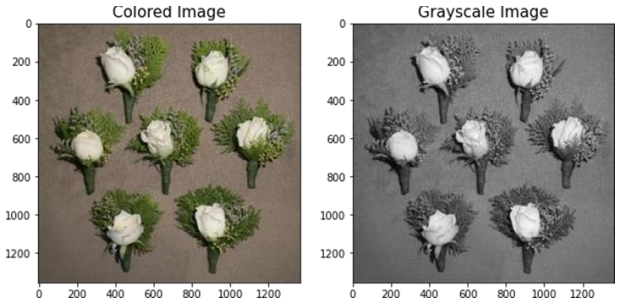

Figure 3. Image Threshold

In above figure the colourful image is converted into a grayscale image.

IV. BLOCK DIAGRAM AND FLOWCHART

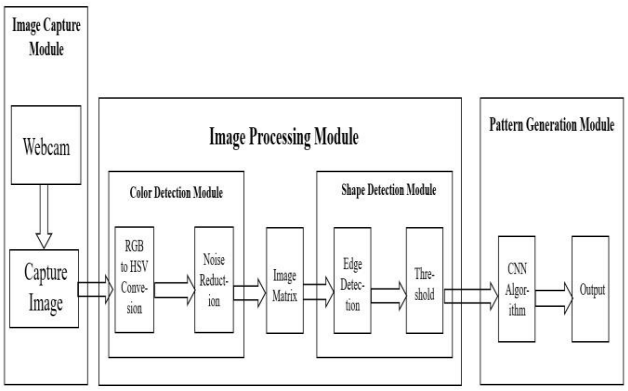

Figure 4. Block Diagram

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023

DOI: 10.17148/IJARCCE.2023.12567

Input:-

1) First of all, at input stage camera is present it will take image as a input signal for that next step is preprocessing.
2) Preprocessing: - In the preprocessing phase, remove the noise and blur part of the image, rescale and resize the image.
3) After Preprocessing of the image, the next phase is training that image. For that image goes through feature Extraction and Classification.

Train the dataset: - In this process we train the image by following steps.

1) Feature Extraction: - In feature extraction, we extract the features like edges, size, etc. from the images. After Feature Extraction the next Step is segmentation.
2) Segmentation: - In Segmentation we divide images in multiple parts.
3) Classification: - We used CNN algorithm for the classification. Classification is the process of categorizing and labelling groups of pixels or vectors within an image based on specific rules. After all the training phase is done machine creates model i.e., trained model and it is 80% model.
4) Testing: - Testing is 20% model. We give input as an image for Testing. Then the model can go the testing phase and then provide the output to the user.

V. ALGORITHM

Convolutional Neural Network:

Convolutional neural networks, a type of deep learning algorithm, are incredibly good at analysing pictures. The best algorithms for automatically processing photographs are currently those mentioned. Images contain RGB combination data. Using Matplotlib, an image from a file can be imported into memory. The computer cannot see images; it can only see a list of numbers. Coloured images are stored in 3-dimensional arrays. The first two dimensions correspond to the

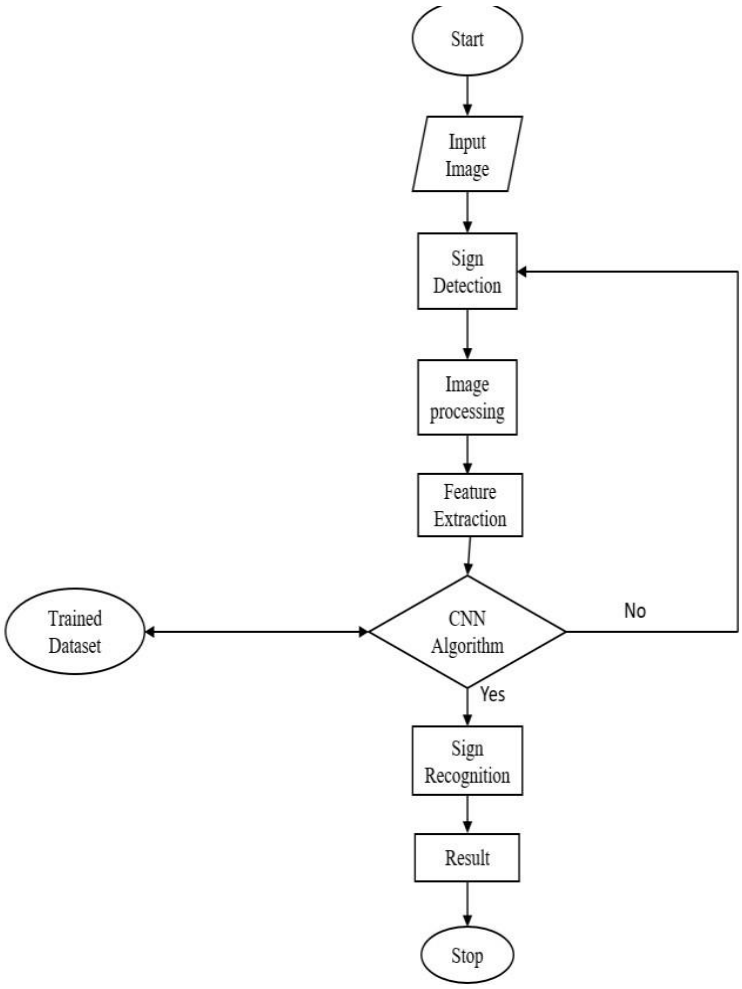

Figure 5. Flowchart

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023

DOI: 10.17148/IJARCCE.2023.12567

height and breadth of the image (the number of pixels). The final dimension is a representation of the red, green, and blue colours found in each pixel.

There are three types of layers in Convolutional Neural Networks: 1) Convolutional Layer: Each input neuron in a typical neural network is connected to the following hidden layer. Only a small portion of the input layer neurons in CNN are connected to the hidden layer of neurons. 2) Pooling Layer: The feature map's dimensionality is decreased using the pooling layer. Inside the CNN's hidden layer, there will be numerous activation and pooling layers. 3) Fully-Connected layer: The final several layers of the network are known as Fully Connected Layers. The output from the last pooling or convolutional layer is passed into the fully connected layer, where it is flattened before being applied.

VI. SYSTEM SPECIFICATIONS

Hardware Specifications

- System Processors: Intel i5
- Speed: 2.4 GHz
- Hard Disk :150 GB
- RAM: 8 GB

Software Specifications

- Operating system: 64 bit Windows 10
- Coding Language: Python
- Design constraints: VScode

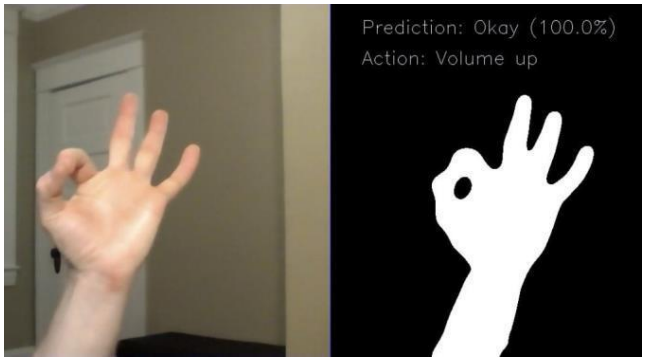

Figure 6. Conversion to HSV

Here the RGB image is converted to Black and White image

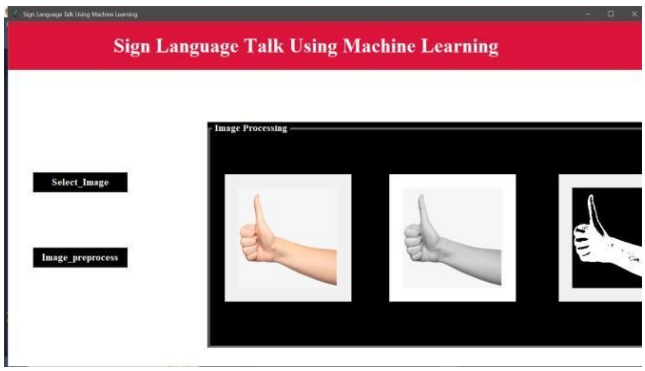

Figure 7. Image Processing

RGB (Colourful image) is converted to Black and White image using Image Processing.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023

DOI: 10.17148/IJARCCE.2023.12567

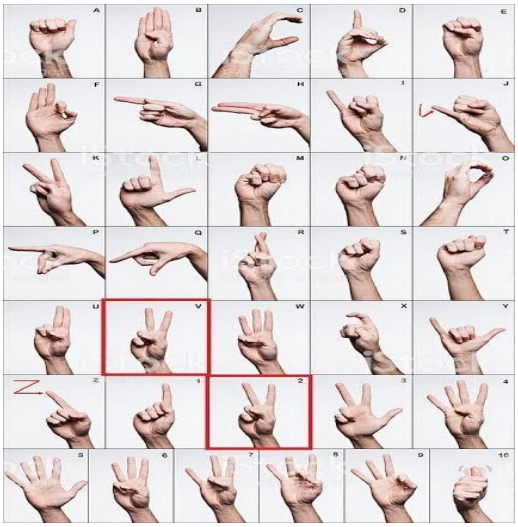

Figure 8. American Sign Language (ASL)

VII. RESULTS

Figure 9. Alphabets

These are some of the signs which can be recognized through this project. The significance of these signs will be shown in the output.

VIII. CONCLUSION

The use of sign language can help those who are deafmute and hearing people communicate more effectively. The system that is being suggested above provides a mechanism intended to achieve the same results as two way communication. The method presented is designed to make it easier to translate signs into speech. Since real-time conversion is used, the need for a translator is eliminated. The device serves as the deaf-mute person's voice. This project is a step in the right direction for people with disabilities. This can be improved still further by making it easier to use, more effective, portable, compatible with more signs, and capable of supporting dynamic signs. Using the phone's built-in camera, this may be further enhanced to make it mobile phone compatible. System can utilize a longer transreceiver module or Wi-Fi to extend the range at which it can be used.

IX. FUTURE SCOPE

1. The system can be further developed by improving the image processing to increase the overall accuracy of the system.
2. It can also be further developed to interact with objects to perform specific tasks.
3. We can further develop a system by using raspberry pie to make it a moveable device. We can also try to recognize motion gestures.

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 12, Issue 5, May 2023
DOI: 10.17148/IJARCCE.2023.12567

REFERENCES

[1] Abdul Mannan, Abdul Abbasi, Abdul Rehman Javed, Anam Ahsan, Thapa Reddy Gadepalli , and Qin Xin "Hypertuned Deep Convolutional Neural Network for Sign Language Recognition" April 2022 Hinai Computational Intelligence and Neuroscience Volume 2022.

[2] Carl Jose M. Guingab, Ron Andrew Relayo, Mark Joseph C. Sheng, John Ray D. Tamayo "Using Deep Learning in Sign Language Translation to Text" March 7, 2022 International Conference on Industrial Engineering and Operations Management Istanbul, Turkey.

[3] Joyeeta Singha , Karen Das "Indian Sign Language Recognition Using Eigen Value Weighted Euclidean Distance Based Classification Technique" .Assam Don Bosco University Guwahati, India

[4] Peng Liu , Xiangxiang Li , Haiting Cui, Shanshan Li and Yafei Yuan "Hand Gesture Recognition Based on Single -Shot Multibox Detector Deep Learning " 30 December 2019

[5] Aerpula Swetha, Vamja Pooja, Vundi Vedavyas, Challa Datha Venkata Naga Sai Kiran, Sadu Sravani "Sign Language To Speech Translation Using Machine Learning" July 2022 Journal of Engineering Sciences Vol 13 Issue 7

[6] M. Madhiarasan, Partha Pratim Roy "A Comprehensive Review of Sign Language Recognition : Different Types, Modalities, and Datasets" April 2022 Journal of Latex class files

[7] Phat Nguyen Huu and Tan Phung Ngoc "Hand Gesture Recognition Algorithm Using SVM and HOG Model for Control of Robotic System".

[8] Kulandai Josephine Julina Joseph, Sree Sharmila Thangaswamy "Recognition of Hand Signs Based on Geometrical Features using Machine Learning and Deep Learning Approaches" 2021 Revis Argentina de Clínica Psicológica.

[9] Paulo Trigueiros, Fernando Ribeiro, Luís Paulo Reis "A comparison of machine learning algorithms applied to hand gesture recognition" 2021.

[10] Sura Abdulmunem Mohammed Al-Juboori, Hissah Almutairi, Rasha Almajed, Amer Ibrahim, Hassan Muwafaq Gheni "Detection of hand gestures with human computer recognition by using support vector machine" April 2022 Periodicals of Engineering and Natural Sciences Vol. 10, No. 32

