Touchless Interaction System for Diffrently Abled Users Using Gesture Recognition

Prof. M.K. Madhushree

Assistant Professor, Department of Computer Application
Acharya Institute of Graduate Studies, Bengaluru, Karnataka, India

Prof. P. Pranitha

Assistant Professor, Department of Computer Application
Acharya Institute of Graduate Studies, Bengaluru, Karnataka, India

Prof. R. Geetha

Assistant Professor, Department of Computer Application
Acharya Institute of Graduate Studies, Bengaluru, Karnataka, India

Editorial history	*Cite this article*
Received: 24.02.2026	Madhushree, M.K., Pranitha, P. & Geetha, R. (2026). Touchless Interaction System for Diffrently Abled Users Using Gesture Recognition. *Journal of Advanced Research and Innovation, 2*(3), 13-18.
Accepted: 25.04.2026	
Published Online: 08.05.2026	

Abstract

Human Computer Interaction (HCI) plays a vital role in creation of inclusive technologies for differently abled users specially speech and hearing impairment. These users are often physiologically disabled when using traditional interface such as keyboard and voice recognition devices. The best ever solution could be provided by AI based gesture recognition which makes it possible to communicate by hand gesture in a natural and intuitive way. This works presents an intelligent gesture recognition system including hand gestures which are integrated into meaningful texts or audio output using computer vision and machine learning approaches. This technology increases the independence of the users and helps in the improvement of the efficiency of communication. This technology enables the real time contact with the digital devices.

The issues encountered regarding gesture variable, environment factors and ethical issues such as data security and privacy are also taken into consideration. The results generated by AI - enabled gesture recognition using HCI are user friendly especially for differently abled people.

Keywords: Interaction, Gesture Recognition, Disabilities, Touchless, HCI

Introduction

Despite the massive technological advances in digital technology, many systems are designed based on the assumption that all users will be able to use a keyboard, mouse, or touchscreen with ease. As a result, there is a digital divide which makes it challenging for people with disabilities to access communication tools, employment opportunities, healthcare services, and education platforms. Social isolation, lesser work opportunities, and dependence on caretakers could be caused by inaccessible interfaces.

Gesture Recognition is a methodology that makes a automated system to interpret human gestures--such as hand movements, finger positions, or body moments--as input .which plays major role to communicate globally isolating human inference or any other physical devices.

Another problem comes with the need to be inclusive. Even though society is moving towards systems that automate tasks, create smart settings and offer online services, accessibility features often are thought of as an afterthought and not a fundamental part of the design to begin with. A large segment of the population is not served either without inclusive solutions. Automated system(Automated driving- Chaitanya Shinde, 2024) Safety and hygiene is also of utmost importance especially in the wake of recent health emergencies across the world that has led to the necessity of reducing the physical contact with shared electronics. Touchless technologies (ensure constant access to technology, while avoiding the spread of diseases. Affordability and flexibility are greater issues.

Many of the assistive devices are costly, or require special training. Systems which use commonly available cameras and open source software able to provide a more affordable and easier to use option which can be based on gesture. By solving these social challenges, touchless interaction through gesture recognition is one way of promoting equal participation, dignity and independence of disabled users.

There are now many areas that gesture recognition is being used in. These are HMI,HCI navigating robots, Automatic home system, Augmented Reality, Gamification, Desktops application navigating, Smart environments, Entertainment etc. The major objective of this research is to examine the hand gestures.

It is aimed to explore their features and ways of recognition in human-machine interaction applications(Hand Gesture Recognition allows for intuitive and natural communication between people and machines Machine learning models which are widely used in the different areas of hand form extraction and hand gesture recognition.

Concept Overview

In this paper, we are literally using Personalized Hand Gesture Recognition, that is adopted in such a way that systems are trained prior for adopting new personalized questers especially for every individual other that using already predefined dataset which will not be comfortable for the people who are using the devices by this with the social concern we can make all categories of users to use the system in real-time without spending money for any hardware devices this requires no plugins.

Traditional recognition system uses pre stored dataset for storing the gestures our model adopts dynamic based hand recognition. By using personalized system we can achieve the following

Better Accuracy - since each individual vary in their own prospective they perform or make gesture movements in a different way if there is predefined data set then it becomes complex and does not match with data set already defined which will leads to miscommunication but personalised reduces this and it generates accuracy and provides clarity to the system input for reaching better results.

Accessibility

This feature specially caters to the need of disabled people who cannot go with predefined data set because their mobility will be purely different.

Affordable and low cost - performs with normal webcams and sensors without hampering device and no need to mount extra hardware.

Dynamic Learning and Supervising

Since the data input is dynamic the model improves and learns and proviAlthough most systems are aimed at enhancing the accuracy of models with the help of deep learning, very few systems: Naturally respond to the gesture of one user. Deliver camera-based and low-cost personalization. Provide adaptive learning to users with low mobility. Maximize assistive application performance. Therefore, there is a necessity of cost-effective, adaptable, and personalized hand gesture recognition

system that will be able to identify gestures correctly depending on the particular features of the user. des better accurate results.

Literature Survey

Touchless interaction system has become a good importance in the today's world. This plays a vital role in revolution of human computer interaction. This literature survey provides an insight of cutting edge technologies in medical field, underlying principles and various advancement in technologies. In 2024, 29 % of persons with disabilities reported difficulty when using mobile phones, due to their condition. This includes issues with downloading apps, using touchscreens or controlling them. Nearly 45 % of persons with disabilities experience barriers in online activities when using ICT (including smartphones). This rises to 74 per cent for people with more severe activity limitations. Persons with disabilities are less likely to own or use mobile phones than non-disabled counterparts. For example, research shows that the disparity in mobile ownership between people with and without disabilities can be over 20 % in some countries. Only on average 10-22% of disabled mobile users use the built-in features of accessibility (screen readers, voice commands, etc.).

- In 2020, this research paper has focused on hand gesture as interaction tool as it is the primary tool of interaction for human beings. VR and AR is the most promising platform for the application of gesture based interaction. The domains which are benefitted from this technology are robotics, agriculture, health care and heavy industry, space industry. Feature extraction and Pattern recognition in which movements are labelled to be belonging to a given class is called gesture recognition.
- A gesture recognition systems may solve several problems in different fields like medicine, VR, AR, security, Automobiles and so on. This literature review is a longer version of the work presented in the 2019 conference of ICSE.
- In 2023 Touch-Less Controls Using Hand Gestures Detection This research paper give clear picture to intricate landscape of hand gesture detection technology this technology uses infrared sensors, webcams that use emitted waves for detecting reflection providing guestures this paper uses critical algorithms and machine learning models decodes these movements.
- In 2023 Intelligent Touchless System based on Gesture Recognition - in this paper an app for food ordering is present, in which guesture based recognition using mean average precision using tensor flwolite for the use with mobile devices (kios) .
- In 2025 this paper shows the light on implementation of HCI), which concentrates on systems that do not require physical contact via gaze, voice, gesture, and proximity sensing. Touchless interface offers hygienic, intuitive and accessible interactions with digital environments.

References

1. Masaki Kuroso, "Human – Computer Interaction, Multimodal and Natural Interaction ", Thematic Area, HCI 2020 Held as Part of the 22nd International Conference, HCII 2020 Copenhagen, Denmark, July 19-24, Proceedings, Part II.
2. Xizhao Wang, Daniel S. Yeung, "International Journal on Machine Learning and Cybernetics", published on 12 July 2021.
3. Aditya Deepak Soude, Vrushali BapuJagtap, Gauri Rameshwar Pawar-International journal of creative thoughts,published 0n 12 december 2023.
4. Aishwarya Babu, Zahiriddin, Sherzon Turaev, Intelligent Touchless System based on Gesture Recognition, Journal of Theoretical and Applied Technology,31may 2023
5. Bharti Patle, Roshni Banothe, Bhagyashree Kumbhare, Yamini Laxane4 Student, MCA, Smt. Radhikatai Pandav, Prof. MCA, Smt. Radhikatai-The Future of Touchless Interfaces in Human Computer Interaction, international journal published on 9th March 2025.

Proposed Methodology

The latest innovation in technology has become better in most of the people everyday life. Humans is now dealing with wide range of technology's which help them in day-to-day life. There is an increased human computer interaction with the advancement in the information technology. Touchless Human Computer Interaction is a new research field which focuses on the improvement of lifestyle of the people with disabilities. Hand gestures are - a kind of body language which represented by position of the palm from the centre, position of the fingers and shape of the hand. Hand Gestures are of two types: Dynamic and Static. Static hand gesture is the position of the hand is fixed. Constant movement like waving and hand shake are referred to as dynamic hand gesture.

System Overview This system is supposed to build-in an affordable system that use just a regular camera for recognizing gestures in the way thats personal for people who has disability. It makes stuff like touch less controls no hands easier to do. The main idea I think is ability to set your own gestures which sound helpful to the user.

It starts to sense what the user is doing with the help of an RGB camera and then process them using computer vision and some machine learning to figure out the patterns. Once it knows the gesture it then predicates the gesture with commands to where the device responds immediately to the command. That part appears to be important to the hands free operation.

The whole process breaks down in to stages and not too complicated I guess. First there is getting the data then clean the data up in pre-processing. when the important bits are purchased from extractions. It takes some time to train individualized model like it was made tailored to the user. Classification takes place to determine what gesture has been done, and then actually carrying out the command.

Some of these steps overlap to a degree, or at least, it would appear that it might be the case. Data acquisition is basic, of video or images of gestures. The noise or whatever is processed by processing before the actual processing.

The model training is where it gets custom which is interesting but maybe tricky to get right every time. For gesture classification what was learned is used and command execution just comes out to execute the action. the hierarchy is about those six main elements like data acquisition extraction of feature personalized training model gesture bifurcation and execution of commands I am not totally sure if they all flow perfectly but it does cover the basics

Data Acquisition

Real time video input is received from normal web camera or mobile camera. Continuous frame acquisition is done with some optimum frame rate, so as to ensure smooth interaction. This model can be executed under any normal indoor lights excluding other gadgets or complicated sensors or high-endwearables

Image Pre-processing

In order to improve the result of recognition and the speed of the calculation, every frame of caught image will be treated in advance, which include: In order to make deduction about computational load we have frame resizing Noise interruption can be lessened using the use of Gaussian Filtering technology Background normalization RGB to grey scale conversion Facultative it can be implemented under recommended conditions if necessary These pre-processing steps prove useful to make the system more robust to environmental variations such as lighting variations and background interference.

Feature Extraction

A hand tracking system that in picking up the hand landmarks is light. It calculates the coordinates of x and y axis of the hand, finger tips and then converts it in to feature vectors which is string that contains numbers which denotes hand gesture and its position Let's call these coordinates F ={(x1,y1), (x2,y2), . . ,(xn, yn) } Irrespective of size and shape of the hand and how the hand is placed our model generalizes by considering the hand pattern by choosing coordinates

Customised Training of Gestures

Rather than making every users to push to the same pregenerated gestures or patters our paper facilitates each users to customize their own hand gestures. during training time you perform your chosen gestures a few times during training time. These feature vectors are stored in a local database by the system. By adopting this model it may reach all kinds of people in the society with different challenges and abilities and system also supports them to use all sorts of smart phones

Classification Model

The Model utilize simple supervise learning algorithm like K-Nearest Neighbour algorithm or Vector Support Machine algorithm Our customize model does not take much of the processing power and execute accurately for even small customized dataset The supervised training machine maps every feature of vector f to customized gesture label C in this manner it learns how to customize gestures that the users are performing When you use the system it recognizes your gestures in real-time. 3.7 Command Mapping and Execution After the gesture is recognised by the model it matches to its suitable command like scrolling launching app or invoking alert messages and placing the cursor by clicking The classifier then in built interfaces to implement the command sexecute them through touchless facility

Performance Optimization

The model works on lightweight machine learning techniques to increase processing speed and time by incorporating feature vectors very tiny so that it can vevn work on minimum hardware requirements for that we need not use any complicated or higher end GPU and it works even on minimum configuration system. Existing Systems Proposed System (your Project) Feature/Parameter Input Device Often requires special hardware such as sensor gloves, depth cameras (Kinect), or wearable IMUs|Standard webcam, or mobile camera (low-cost hardware) Cost Moderate to high because of sensors or proprietary devices Very low -- uses common devices found in most households Personalization Usually fixed gesture sets; users need to cope with system User defined gestures - tailored to individual ability Calibration Time Long calibration or training needed|Minimal training/ calibration -- faster set-up In reality the performance index may be not consistet from time to time with a small delay that could be reduced for interaction onspot Accessibility for Different Abled Users Some work for able users primarily, few were designed for disabled users Specially designed for people with limited mobility Training Data Dependency Requires large pre-trained data sets|learns gestures using small user-specific dataset Hygiene (Touchless) Touchless in Camera based systems Fully touch less -- ideal for health and safety Algorithm Complexity Can use heavy models not suitable for low end hardware| Can use light weight models suitable for low resources User Interface Design Traditional UI Sometimes not accessible Designed for clarity and easy for differing abled users Scalability/ Future Expansion Dependent on hardware support Easy to integrate voice, eye tracking, IoT controls Mobility System Often fixed (hardware mounted) Can be used on laptops and mobile devices Results and Discussion

Experimental Setup

We have tested this system using an average RGB web camera (720p) connected to an average laptop computer (Intel i5 with 8GB of RAM with no GPU boost). For training the system we are using customized inputs as a datasets collecting from 15 to 20 people with different levels of disability Each person came up with 5 custom gestures. We associated those gestures to simple gestures: moving the cursor, clicking, scrolling, launching apps and sending an emergency alert. For each of the gestures we collected 50 examples for the training and 30 for the test. To calculate the performance of a trained system we have considered key matrix like accuracy pattern recognition and quick response in terms of milliseconds After examining through experiments this model reached an accuracy score about exactly 94.2% Static gestures where the users puts the hand gesture rated about 96% Similarly the dynamic gestures alike static came down to 91.5% Static gestures that are preferred due to their less complexity and it is readable easily by the model

Response Time

The avearge end users interaction starting from customized gesture working to execution was around: 185 milliseconds From this we can understand that our model is doing in real world situation without negligable interruption and delay

Discussion

From the experience and the experiments carried out it can be concluded that customized gesture recognition performs better in all environments with negligible delay In this paper the model that we have used will obviously executes with the hardware that is inbuilt in cell phones without spending a penny for hardware or software A couple things leap out. The basic requirement is customizing and if that is done perfectly then the accuracy of the system increases Secondly, you do not need some gigantic machine learning model. if the dataset is too small the models can throw exception The trained system will work irrespective of environment and weather condition As a minimum software is required it is easily accessible to all kinds of people around the world Still, it's got its weak spots. Any kind of fluctuations in light the accuracy will be consistent in providing results It is also struggling with picking up those tiny, subtle micro-gestures. So, what's next? Fix the lighting issues and perhaps combine this system with other methods of input to deal with the tricky stuff.