WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Hand Gesture Based Voice and Text Output Using IoT

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DOI : https://doi.org/10.55248/gengpi.5.1124.3403

A B S T R A C T

Hand Gesture Based Voice and Text Output Using IoT Enabled Smart Gloves Hand gesture recognition technology has revolutionized human computer interaction, enabling individuals to communicate more intuitively and efficiently. This project aims to design and develop IoT enabled smart gloves that convert hand gestures into voice and text output, facilitating communication for individuals with speech or hearing impairments. Current assistive technologies for individuals with disabilities often rely on cumbersome devices or require extensive training. Smart gloves offer a wearable, user friendly solution, leveraging gesture recognition to bridge the communication gap. The integration of IoT enables real time data processing, enhancing accuracy and responsiveness. The smart glove system consists of flex sensors and accelerometers to detect hand movements and gestures, a microcontroller for data processing and IoT connectivity machine learning algorithms for gesture recognition and classification, a Text to Speech engine and speech synthesizer for voice output and an IoT platform (e.g., AWS IoT, Google Cloud IoT Core) for data analytics and cloud services. A literature review and market analysis were conducted to identify existing gesture recognition technologies. The smart glove prototype was designed and developed, followed by sensor calibration and data collection for machine learning model training. The text to speech engine and speech synthesizer were integrated, the system was tested and evaluated for accuracy, responsiveness and user experience. This project offers several advantages and applications, including enhanced communication for individuals with speech or hearing impairments, an intuitive, accessible interface, real time data processing, analytics, a wearable, compact, lightweight design, potential applications in healthcare, education and gaming industries. Future developments will focus on improving gesture recognition accuracy, robustness, integrating additional sensors enhancing user experience through personalized settings and exploring in various industries.

Keywords: Smart gloves , Gesture Recognition , Speech Synthesizer.

INTRODUCTION

Start by introducing the concept of gesture based communication and its role in enabling human machine interaction. The gesture recognition technology has advanced due to machine learning and sensor technology. Touch upon the historical development of gesture based systems, from early experiments to modern applications in areas like virtual reality, robotics and accessibility for those with disabilities.The recent developments in gesture recognition, such as computer vision, sensor based approaches and AI driven algorithms. Mentioned how gesture recognition systems are increasingly reliable and widely applicable due to deep learning, image processing and natural language processing.Itemphasizes the importance of gesture based communication for people who have speech or hearing impairments. It translates gestures into text or voice output could provide an essential communication tool, enhancing independence and ease of interaction for these individuals.It highlights some emerging trends, such as real time gesture recognition, portable devices and their potential for integration into mobile applications or smart home environments.It concludes with a statement on how this technology presents an opportunity to innovate in assistive devices, applications and directly leading to the need for a solution.

PROBLEM STATEMENT

The main problem that the project seeks to address: The communication barriers faced by people with speech or hearing disabilities. The project explains how existing communication methods, such as sign language or text messaging, may not fully meet their needs in real time or verbal interactions.Itdiscusses the limitations of current solutions for gesture based communication, such as the requirement for specialized hardware, high computational costs, or lack of real-time output. For instance, some systems may only provide text output, neglecting the voice synthesis aspect or may not be mobile friendly.Address the need for a system that provides real time, multimodal output (both text and voice) to enable more versatile, natural interactions. It highlights how a system that can accurately interpret gestures and convert them to text and voice outputs could bridge significant communication gaps.The problem statement definesthe lack of accessible and efficient tools for real time conversion of hand gestures into voice and text output poses a communication barrier for people with disabilities.

LITERATURE SURVEY

Xiaofei ji, Zhibo wang.., "Design of human machine interactive system based on hand gesture recognition" in 2019 by "International journal of Electrical and Computer Engineering".In recent years, technology for gesture detection has drawn increasing attention. Hand gesture interaction features are currently lacking in many of the most popular human computer interaction systems Preprocessing, hand gesture detection and recognition, tracking and interaction make up the bulk of the interactive system. In order to implement the function of human computer interaction, the tracking and interaction module tracks user gestures using Kalman tracking and controls virtual hardware in accordance with the results of gesture recognition. The system has been tested in challenging conditions, demonstrating its resilience to varying illumination and intricate backgrounds. The processing performance is increased to more than 50 frames per second on average by using CPU to GPU parallel computing. The suggested system processes images and videos using open source Python tools and the Kinect camera. The parallel computing technique has a quick response time, it is resilient to varying backgrounds. The limitation is high cost of sensors and complex algorithms consume a IoT of processing time.**Munir** Oudah et al., "Hand Gesture Recognition Based on Computer Vision" in 23 July 2020 by "Journal of imaging"**.**This paper describe Hand gestures are a type of nonverbal communication that can be employed in a variety of contexts, including medical applications, human computer interface, robot control and communication between deaf and mute individuals. Many different methodologies have been used in research papers based on hand gestures, including computer vision and instrumented sensor technology. It also tabulates the effectiveness of these techniques, concentrating on computer vision methods that address similarity difference points, utilised dataset, detection range (distance), classification techniques, amount types of movements, hand segmentation approach and camera type. With a brief discussion of some potential applications. Hand gesture recognition addresses a fault in interaction systems. Controlling things by hand is more natural. Casier more flexible and cheaper. There is no need to fix problems caused by hardware devices, since none is required.

BLOCK DIAGRAM

The block diagram represents a hand gesture recognition system utilizing various sensors, an ESP32 based gesture recognition module and components to translate gestures into speech or text. The system works by capturing hand gestures through sensors placed on a glove, processing the signals and converting the recognized gestures into spoken words or text displayed on a screen. This system is designed for the applications such as sign language interpretation or human computer interaction.

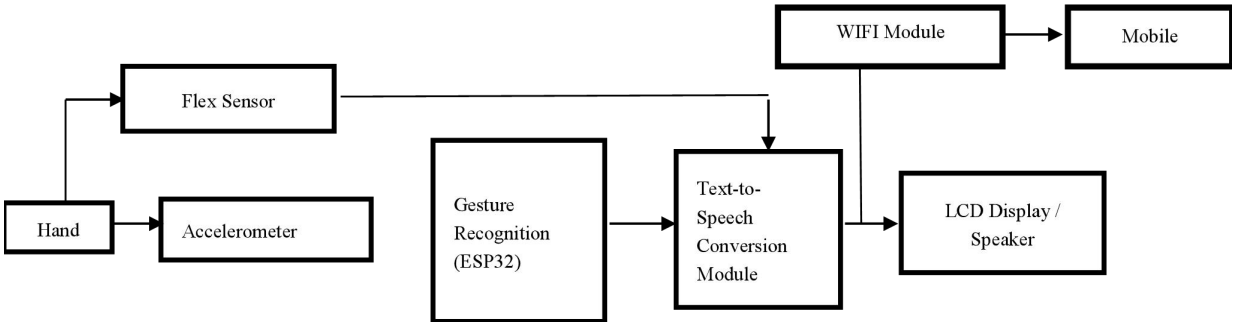

Figure 1: Block Diagram

SIMULATION DIAGRAM

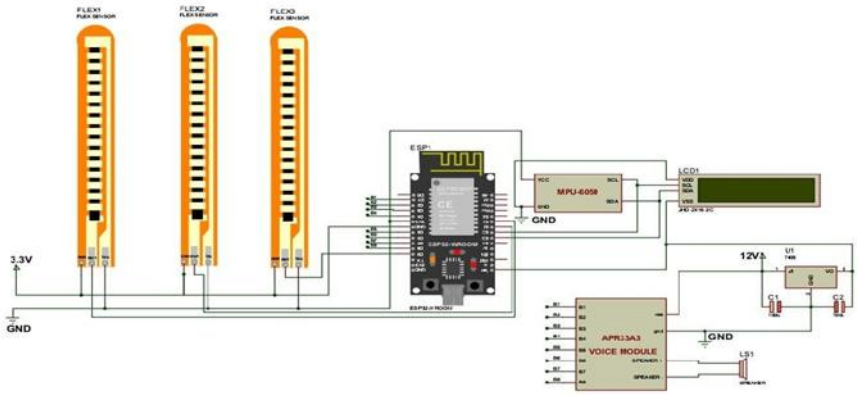

Figure 1 : Simulation Diagram

This circuit diagram consists of three flex sensors connected to an ESP32 microcontroller. The flex sensors detect bending and the ESP32 collects their data. An MPU-6050 sensor is also connected, which measures motion and orientation. An LCD is used to display sensor readings and an APR33A3 voice module is included to provide audio output based on the sensor data. The system is powered by a 12V supply for the voice module, with the other components powered by a 3.3V line. This setup is likely for a motion or gesture recognition project.

INITIALIZATIONOFHAND GLOVES

Figure 2 : Hardware Implementation

The glove is embedded with multiple flex sensors, particularly on the fingers, to detect bending or movement. Flex sensors change resistance as they are bent, enabling the detection of hand gestures.The device includes an ESP32 microcontroller, which serves as the central processing unit. The ESP32 is a versatile board capable of processing data from sensors and handling wireless communication such as Wi-Fi or Bluetooth.A character LCD is included for visual feedback, which might display the interpreted gesture or other relevant information to the user.An innovative application of embedded systems, integrating sensor technology, microcontroller processing, and user interface components. Its purpose is likely aimed at aiding individuals with communication barriers, particularly those who use sign language. The design demonstrates a practical approach toward creating assistive technologies for enhanced accessibility.

CONCLUSION

This project has been meticulously designed to create an advanced and intelligent wearable device for hand gesture recognition. Leveraging the Internet of Things (IoT), this device ensures a reliable system characterized by its rapid functionality and user-friendly access. A mobile application, based on IoT, is employed to detect gestures made with a glove. This application features a text-to-speech module, providing audible feedback to facilitate communication. The developed system has versatile applications across various fields. A significant advantage of this system is its ability to operate autonomously, without the need for human intervention during the hand gesture recognition process. The components utilized in this system are both cost-effective and durable compared to other devices, and the overall design is compact and portable. The hand gesture recognition system allows for the execution of intricate gestures and simulations through sensors integrated into gloves, particularly in engineering applications. There is potential for further enhancement of the system, including the integration of RFID tags on the glove, enabling data transmission alongside gesture recognition for multiple users. Additionally, an LCD screen can be connected near the microcontroller to improve efficiency, accuracy, and ease of access for controlling household devices.

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