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A REVIEW ON SIGN GLOVES FOR DUMB AND DEAF PEOPLES USING ESP32

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Abstract: **Sign gloves are innovative wearable devices that can help people who are deaf to communicate with those who do not know sign language. These gloves use sensors and machine learning algorithms to translate hand gestures into spoken or written language. This paper provides an overview of the key technologies and materials used in sign glove design and discuss the challenges and opportunities associated with this emerging field. The review also highlights recent advances in sign glove fabrication, such as the use of 3D printing and additive manufacturing techniques, and explores the potential for future developments in this area. The objective of this review is to offer a comprehensive overview of the current state-of-the-art in sign glove design and fabrication and to identify critical research directions for future work.**

Keywords: **Sign Gloves, Wearable Devices, Sensors, Hand Gestures**

I. INTRODUCTION

Communication is a crucial aspect of human interaction, enabling individuals to express their thoughts, emotions, and needs. However, for people who are deaf and mute, communication can be challenging as they rely on sign language to communicate with others. Sign language is a visual language that uses a combination of hand gestures, facial expressions, and body language to convey meaning. However, not everyone is proficient in sign language, which can create communication barriers for individuals who are deaf and mute [1].

Figure 1:- Special Students [1]

In recent years, there has been growing interest in the development of wearable devices that can translate sign language into spoken or written language, enabling individuals who are deaf and mute to communicate more effectively with others. Sign gloves are a type of wearable device that use sensors and machine learning algorithms to detect hand gestures and translate them into spoken or written language. These devices have the potential to revolutionize communication for individuals who are deaf and mute, enabling them to communicate more effectively with people who do not know sign language. The declining proportion of literate and employed deaf and mute individuals is due to the hearing disability of deaf individuals and the inability to communicate verbally for mute individuals. This results in a lack of communication between normal individuals and deaf and mute individuals. It becomes a problem similar to two people, who know two different languages, and none of them knows any common language, so it becomes challenging to converse with each other. Therefore, they require a physical interpreter, which may not always be practical to arrange. The same kind of problem occurs between normal individuals and deaf or mute individuals. To overcome this issue, a unique application is presented. The application is an attractive interpreter that translates regular English sentences as text input by a normal person for a deaf person and sign language in the form of gestures by a mute person into synthesized English words, which have a corresponding meaning in sign language. This translates a particular item

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as an audio output for normal people. This will help normal, deaf, and mute communities by removing the communication gap between them. Gesture-based communication is an essential and only method of communication for deaf and mute individuals. It is a formal language using a set of hand gestures for communication (by the deaf). In this project, a replacement of the flex sensor is used, which plays a significant role, and it is set on fingers. As fingers bend, it changes resistance depending on the amount of bend on the sensor [2].

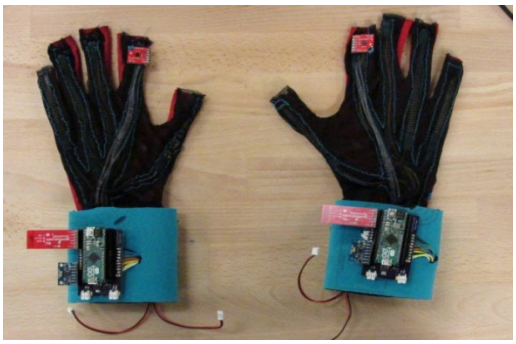

Figure 2:- Smart Gloves For Dumb and Deaf [4]

1.1 Existing Methods

The existing methods for smart gloves for dumb and deaf people are:-

I. The Sign Aloud Glove: This glove was developed by two undergraduate students from the University of Washington, and it translates American Sign Language (ASL) into text or speech. The glove uses sensors to detect hand movements, which are then sent to a computer for processing. The resulting text or speech can be displayed on a screen or transmitted via a speaker [3].

II. The Mobile ASL Glove: This glove is designed to facilitate mobile video communication for deaf users. It uses a camera mounted on the glove to capture the user's signing, which is then transmitted to a mobile device for display. The glove also includes sensors to detect hand movement and orientation, which can be used to control the mobile device [4].

III. The Enable Talk Glove: This glove uses sensors to detect hand movements and translate them into speech or text. It also includes a mobile app that allows users to customize the glove's vocabulary and translation settings. The Enable Talk glove has been tested with users who are deaf or have speech impairments, and it has shown promising results [5].

IV. The Sign Language Glove: This glove is designed to translate British Sign Language (BSL) into text or speech. It uses sensors to detect hand movements and a microcontroller to process the data. The resulting text or speech can be displayed on a screen or transmitted via a speaker. The Sign Language Glove has been tested with deaf users and has shown positive results [6].

1.2) Main Components

I. Data Glove

Data glove is a typical hand glove which is associated with adaptable metal strips along the fingers and thumb where the strips are appended to the glove by threading.

II. ESP32 Microcontroller

The ESP32 microcontroller is a versatile and powerful device that is widely used in various IoT and automation applications. It is designed by Espressif Systems and is based on the Xtensa LX6 processor, featuring dual-core CPU clocked at 240 MHz. The ESP32 offers a broad range of peripherals, including built-in Wi-Fi and Bluetooth connectivity, making it an excellent choice for projects requiring wireless communication. One of the key features of the ESP32 is its low power consumption, making it ideal for battery-powered applications. Its power management system allows it to operate at different levels of power consumption, depending on the application's requirements. The ESP32 also has a hardware encryption engine, making it suitable for secure applications. The ESP32 includes several built-in sensors, such as a temperature sensor, making it ideal for environmental monitoring and control applications. It also supports SD cards, which can be used to store data locally [7].

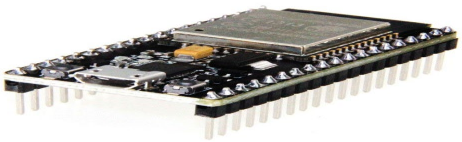

Figure 3: - ESP32 Microcontroller [7]

The ESP32 is widely supported by the Arduino IDE, making it easy to program and use. It also has extensive documentation and support, including numerous tutorials and examples. The ESP32 has become a popular choice for hobbyists and professionals alike, due to its versatility and low cost [8].

III. Gyroscope Sensor

A gyroscope sensor is a device that measures the angular velocity or rotational rate of an object. It is commonly used in aerospace, navigation, robotics, and other fields where precise motion control is necessary. Gyroscope sensors operate by utilizing the principle of angular momentum, where a spinning mass resists any attempt to change its orientation. This resistance can be measured and used to determine the object's rotation rate.

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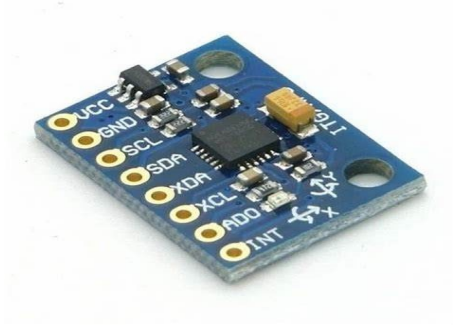

Figure 4: - Gyroscope Sensor [9]

Gyroscopes can be classified into two main categories: mechanical gyroscopes and MEMS (micro-electromechanical systems) gyroscopes. Mechanical gyroscopes use a spinning wheel or disc to measure rotation, while MEMS gyroscopes use microstructures to detect motion. One of the key advantages of gyroscopes is their ability to maintain their orientation in the absence of external references, making them useful for navigation and stabilization applications. Gyroscopes can also be used in conjunction with accelerometers to provide more accurate motion sensing [9].

II. LITERATURE REVIEW

Sign gloves are a novel technological innovation designed to assist individuals who are deaf and mute in communicating with others. This technology involves a pair of gloves that are equipped with sensors and software, allowing the wearer to translate their sign language into written or spoken words. In recent years, there has been a significant amount of interest in sign gloves, as they have the potential to revolutionize the way that deaf and mute individuals interact with the hearing world. One of the earliest studies to investigate sign gloves was conducted by researchers at the University of California, Los Angeles (UCLA) in 2015. The study involved the development of a prototype sign glove that could recognize and translate American Sign Language (ASL) gestures into spoken English. The researchers found that their prototype was able to recognize ASL gestures with a high degree of accuracy, paving the way for further development of this technology [10].

A recent study conducted by researchers at the University of Toronto in 2019 explored using sign gloves in a classroom setting. The researchers found that sign gloves could be an effective tool for improving communication between deaf and mute students and their hearing peers. Specifically, the sign gloves allowed deaf and mute students to participate more fully in classroom discussions, resulting in improved academic performance and social integration [11].

Another area of research related to sign gloves is their potential use in healthcare settings. A study published in the Journal of Medical Internet Research in 2020 investigated the use of sign gloves in telemedicine consultations with deaf and mute patients. The study found that sign gloves could improve the quality of communication between deaf and mute patients and healthcare providers, leading to better health outcomes for these patients. In addition to research studies, there have also been a number of technological advancements related to sign gloves in recent years. For example, a company called Sign Aloud has developed a pair of sign gloves that are able to translate ASL into spoken English in real time. This technology has the potential to greatly improve the lives of deaf and mute individuals, allowing them to communicate more effectively with others in a wide range of contexts. Despite the potential benefits of sign gloves, there are also some challenges that must be addressed in order to fully realize the potential of this technology. One major challenge is the need for standardization of sign language across different countries and regions. Currently, different sign languages are used in different parts of the world, which could make it challenging to develop sign gloves that are universally applicable [12].

2.1 Viability of Project

The Sign Language Translator project has great potential to provide a useful solution for speech-language experts, especially in serving the needs of those in rural areas and patients with special needs. What sets this project apart from others is its user-friendliness, which can greatly benefit individuals with physical difficulties in communicating with others [13].

2.2 Methodology

To implement the project, the glove is equipped with an ESP32 microcontroller, metal strips, and sensors. The metal strips are used to reduce the cost of the project so that it can be affordable to those who need it [14].

The variable resistors on the sensors are used to display the bending of the finger, while sensors are used to detect contacts between the fingers. Gyroscope sensors are used for movement and gesture recognition, with specific hand movements used to recognize letters such as J and Z. For letters like D, G, and Q, the finger pointing upwards, sideways, and downwards, respectively, are used for recognition. For letters M and N, contact sensors are used to distinguish between them [15].

The hand talk glove is designed to help deaf people communicate with others who do not understand sign language, and even those who speak aloud may have a self-conscious "deaf voice" that can make them hesitant to communicate. The glove is a normal cloth driving glove with a steel plate connected to gyroscope sensors along the length of each finger and thumb, with sensors outputting a stream of data that varies with the degree of bends. The output from the sensor is digital and processed by a microcontroller, transmitted wirelessly through Bluetooth to

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the receiver section, and processed using voice responses from the speaker or connected to a smart phone. Flex sensors are used to sense finger movement, converting the change in resistance into electrical output and input. They are usually in the form of a thin strip from 1"-3" long that varies in resistance, ranging from approximately 10 to 20-kilo ohms, and are often used in gloves to detect finger movement [16].

2.2.1 Coding Methodology

I. Create a Circuit Diagram: Using Wokwi software, we can create a circuit diagram of the smart glove by selecting the components and wiring them together. We can also connect the ESP32 to the Bluetooth module and the flex sensors (which we replace with metal strips).

II. Write the Code: We can write the code for the smart glove using the Arduino IDE, which is compatible with the ESP32 microcontroller. We need to write the code to read the sensor data, recognize hand gestures, and transmit the data over Bluetooth.

III. Upload the Code: After writing the code, we need to upload it to the ESP32 microcontroller using the Arduino IDE. We can select the appropriate board and port from the IDE and upload the code to the microcontroller.

IV. Test the Smart Glove: After uploading the code, we can test the smart glove by wearing it and performing various hand gestures. We can use a Bluetooth serial monitor app on a smartphone to check the sensor data and the translated text or speech.

V. Refine the Code: Based on the testing results, we can refine the code to improve the accuracy of hand gesture recognition and translation.

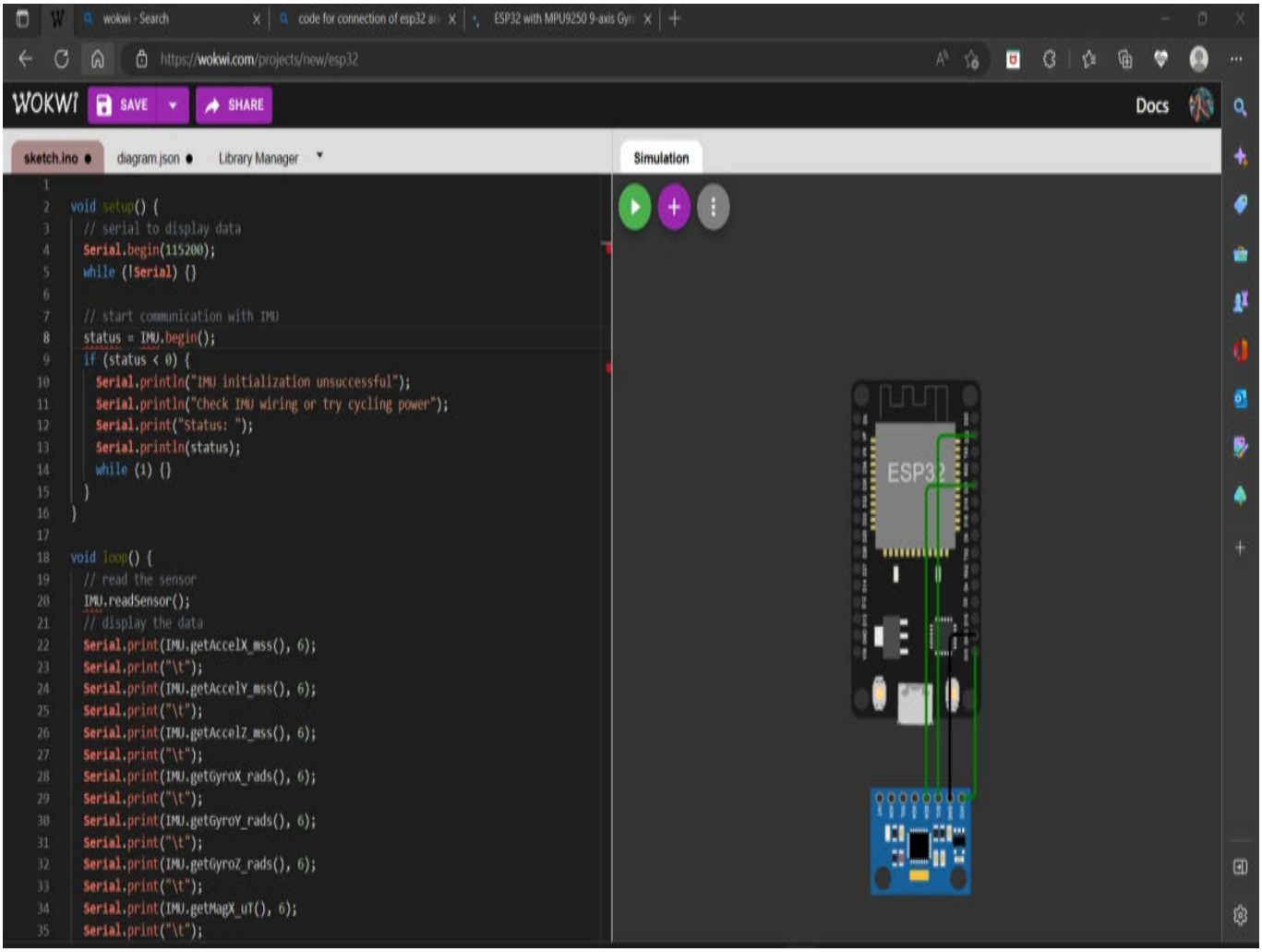

Figure 5: - Connection of ESP32 to Gyroscope Sensor

III. SUMMARY

The development of wearable devices that can translate sign language into spoken or written language has the potential to revolutionize communication for deaf and mute individuals. Sign gloves are a type of wearable device that use sensors and machine learning algorithms to detect hand gestures and translate them into spoken or written language. The declining proportion of literate and employed deaf and mute individuals is due to hearing disability and inability to communicate verbally. A unique application is presented to overcome the communication gap between normal and deaf and mute individuals. It translates regular English sentences as text input for a deaf person and sign language into synthesized English words for a mute person.

This will help normal, deaf, and mute communities by removing the communication gap. The existing methods for smart gloves for dumb and deaf people include the Sign Aloud glove, MobileASL glove, Enable Talk glove, and Sign Language Glove. Sign gloves are a novel technological innovation designed to assist individuals who are deaf and mute in communicating with others. They involve a pair of gloves equipped with sensors and software, allowing the wearer to translate their sign language into written or spoken words. In recent years, there has been a significant amount of interest in sign gloves, as they have the potential to revolutionize the way deaf and mute individuals interact with the hearing world.

Research has found that sign gloves can be used to recognize and translate ASL gestures into spoken English, improve communication between deaf and mute students, and improve the quality of communication between deaf and mute patients and healthcare providers. Additionally, there have been technological advancements related to sign gloves in recent years. Sign Aloud has developed a pair of sign gloves that can translate ASL into spoken English in real time. This technology has potential to improve the lives of deaf and mute individuals, but there are challenges to address. The Sign Language Translator project has great potential to provide a useful solution for speech-language experts.

IV. CONCLUSION

Smart gloves for dumb and deaf people, also known as assistive technology gloves, are devices that can help those with speech and hearing impairments communicate and interact with the world around them. They typically incorporate sensors and other technology that can translate hand gestures or finger movements into speech or text, allowing users to communicate with others or control devices such as smart phones or computers. Overall, these gloves can be a useful tool for people with speech and hearing impairments to improve their communication and independence. Smart gloves for people who are deaf or hard of hearing can be a useful tool for communication and navigation. They can convert sign language or speech into text or audio, allowing for more effective communication with hearing individuals. They can also supply navigation help through haptic feedback, helping users navigate unfamiliar spaces. However, it is important to note that these devices are not a replacement for sign language or other forms of communication used by the deaf and hard of hearing community. Additionally, the development and accessibility of such technology is still ongoing, and more research is needed to improve the usability of these devices.

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