Course Code & Title	:	CSE216L (Microprocessor, Interfacing, and Assembly Language Lab)
Course Instructor	:	Noor-E-Sadman
Assignment No	:	01
Assignment Title	:	Complete the literature review on the given topics.
Corresponding CO's	:	CO1

OBJECTIVES

1. **//Find similar journals according to the assigned topic.**
    a. Break down your topics into various parts and find related publications (i.e., method, area of research, sensors, topology, algorithm, process, etc.).
    b. Review 20-25 recently published Journal Articles. (5 articles per person)
    c. Use Google Scholar to find out recent Journal Articles with maximum citations.
    d. Write down the summary of each paper. i.e., Methodology, equations, component used, findings, novelty, analysis, the problem faced, future work, etc., and complete the following tasks.//

2. **Define summaries with literature:**
 The only way we can express our ideas or get a message over is through communication, but a person with a disability—such as someone who is deaf or dumb—finds it difficult to communicate with regular people. As a result, a person who is deaf or hard of hearing cannot compete in a race against an average person. A person who is deaf prefers visual communication over aural. Dumb individuals typically use sign language to communicate, although they often struggle to communicate with non-sign language speaking people. Therefore, there is a communication gap between these two groups. The goal of our endeavor is to reduce this communication barrier. The primary goal of the suggested project is to create an affordable system that can provide

3. **Identify methodology and design requirements:**
This project consists of two main modules, one is **flex sensor** based gesture recognition module and another is **voice module**. Flex sensors and accelerometer are mounted on the glove and they are fitted along the length of each of fingers. They are used for sensing the

hand movements. Flex sensors are used to measure the degree to which the fingers are bent. Accelerometer within the gesture recognition system is used as a tilt sensing element, which in turn finds the degree to which the finger is tilted. The flex sensor is interfaced with the digital ports of Arduino uno microcontroller. The output data stream from the flex sensor and accelerometer are fed to the Arduino microcontroller, where it is processed and converted to its corresponding digital values. Microcontroller compares these readings with the predefined values and the gestures are recognized and text is displayed. This text output obtained from the sensor based system is then sent to the voice module. The voice module consists of eight channels, in which eight words can be recorded. Voice recording and playback module is used for giving audio information to the person. So that sign alphabets will be available in audio format through speaker.

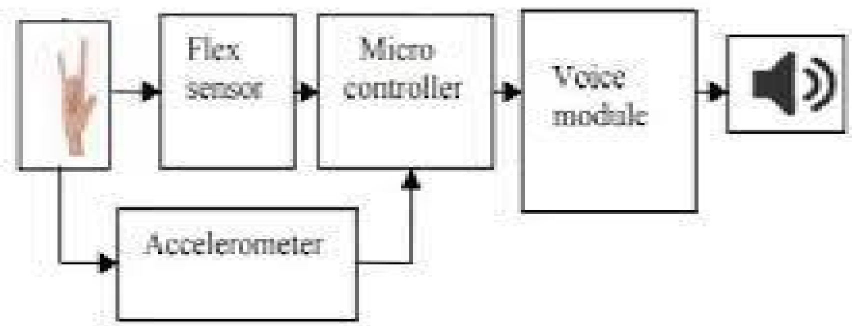


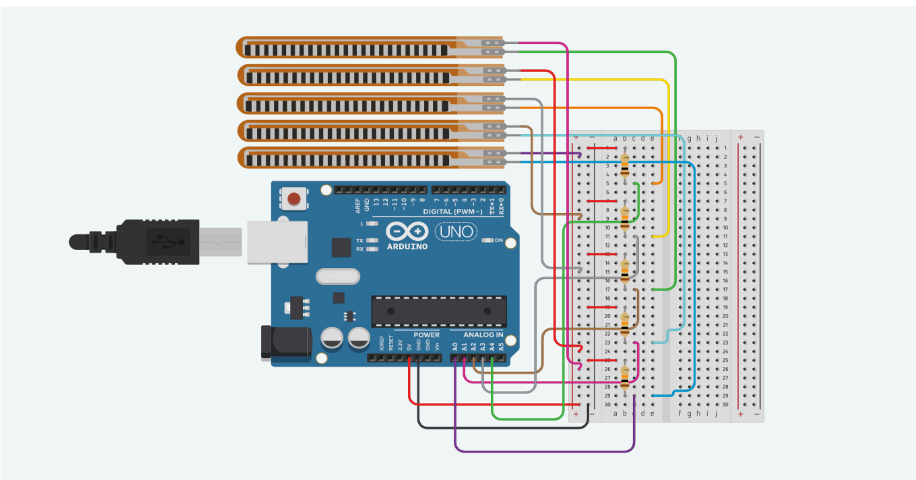
Fig 2. Block diagram of proposed sensor based system

1. **Analyze the design parameters with equations:**

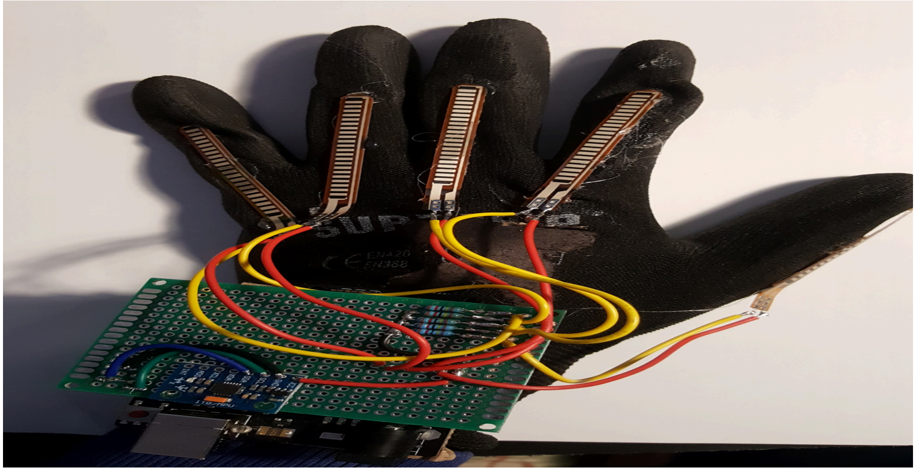
In order to accomplish precise and effective gesture identification in the application of smart gloves for sign language translation, design parameter optimization is essential. Mathematical models and equations are employed to analyze and fine-tune these parameters to enhance the overall performance of the system.

i) Sensor Glove Design:

The five flexible sensors in the wearable sensor glove are connected to an Arduino UNO microcontroller, an accelerometer, an HC-05 Bluetooth module, jumper wires, five units of 220 ohm resistors for the flexible sensors' voltage dividers, and a 6 cm x 5 cm stripboard to which the data processing components are attached. Figure (a) below shows the circuit schematic that shows how these sensors are linked. The real circuit, which is fastened to the back of a hand glove, is seen in Figure (b). The flex sensors, which are used to measure the bending angle of the fingers, are bonded and stitched to the glove's back, as seen in the image. Jumper wires are used to link these flex sensors to the stripboard, which houses the other electrical parts seen in Figure (a). Additionally, the stripboard is attached to the hand glove's back in such a way that it can be removed if necessary.



Figure(a) A circuit diagram of the sensor glove



Figure(b) Circuit attached on the sensor glove

ii) Sensor Parameters for Sign Language Motions:

A flexible sensor is a kind of carbon-based variable resistor. A resistance signal proportional to the angle at which the conductive carbon element surface is bent is produced when it is bent. A user can employ flexible sensors to characterize this connection and therefore establish how a person moves their fingers via a range of hand motions.
Before being installed on the wearable sensor glove, the flexible sensors used in this study were first calibrated. The purpose of this phase was to confirm that the sensor fusion values for a matching gesture were accurate. As a result, for every move, a combination of the analog input values from three (3) accelerometers and five (5) flexible sensors were concurrently acquired. An Arduino Analog-Digital Converter (ADC) was used to transform the acquired analog input values to digital 10-bit resolution data. These digital voltage readings were used to calculate each resistor's bending angle. Using the following equation, the input voltage values were first obtained from the digital input voltage values (in the range of 0 to 1023) using Arduino's ADC.

$$Vi = \frac{Vd}{2^n} (Vcc) \tag{1}$$

Where, Vi is the input voltage value, Vd is the digital input voltage values from Arduino's ADC, Vcc is the power supply voltage, and n is the size of ADC. Then, the resistance value for each flexible sensor was calculated based on the voltage divider equation as follows:

$$R\,flex = \frac{Rd}{Vi - 1} (Vcc) \tag{2}$$

Where Vcc is the power supply voltage, V is the input voltage value found in Equation (1), V is the resistor's resistance value to establish a voltage divider, and V is the resistance value of the flexible sensor. The bend angle of every flexible sensor was then determined by mapping the resistance values of the flexible sensors, $Rflex$, to their bend angles. Using the Arduino IDE map() function, the mapping of the values was carried out. For example, map(Rflex, flat_Res, bend_Res, 0, 90.0) maps the value of the flexible sensor when it is flat to the target angle of 0 degrees, and bend_Res maps the value of the flexible sensor when it is bent to the target angle of 90 degrees. Equation (2) yields the resistance value of the flexible sensor, Rflex, which has to be mapped to the bend angle.

2. **Find out experimentations and hardware components:**

    1. Flex Sensors: Flex sensors are used to detect the bending of fingers. These sensors can be attached to each finger to capture the movements accurately.

    2. Accelerometers and Gyroscopes: These sensors detect the orientation and movement of the hand. They provide additional information about the gestures made by the user.

    3. Microcontroller: A microcontroller such as Arduino or Raspberry Pi processes the sensor data and controls the overall functioning of the smart gloves.

    4. Bluetooth Module: To enable wireless communication with other devices such as smartphones or computers, a Bluetooth module can be integrated into the gloves.

    5. Battery: A rechargeable battery powers the smart gloves, providing the necessary energy for operation.

    6. Vibration Motors or Haptic Feedback Devices: These components provide tactile feedback to the user, helping them confirm that their gestures have been recognized.

    7. Electrodes or Touch Sensors: In some designs, electrodes or touch sensors may be integrated into the gloves to detect additional hand movements or gestures.

    8. Text-to-Speech Module (Optional): For gloves that convert sign language into speech, a text-to-speech module can be included to vocalize the translated text.

    9. Microphone (Optional): If the smart gloves are designed to recognize spoken language as well, a microphone can be integrated to capture audio input.

    10. LEDs or Display: Visual feedback mechanisms such as LEDs or small displays can be incorporated to provide feedback to the user or display the translated text.

11. Embedded Camera (Optional): An embedded camera can be used to capture hand movements and gestures, providing additional data for recognition algorithms.

In addition to hardware components, sophisticated signal processing algorithms and machine learning models are essential for accurately recognizing sign language gestures and translating them into text or speech. These algorithms may involve techniques such as gesture recognition, pattern recognition, and deep learning.

Overall, creating smart gloves for sign language translation involves a multidisciplinary approach, combining expertise in electronics, signal processing, and machine learning. It also requires collaboration with individuals proficient in sign language to ensure accurate translation and usability of the system.

3. **Investigate the system performance:**

Investigating the system performance of smart gloves for sign language translation involves assessing various aspects of their functionality, efficiency, and effectiveness. Here are some key performance metrics to consider:

1. Accuracy of Gesture Recognition: Evaluate the accuracy of the system in recognizing sign language gestures. This can be measured by comparing the system's interpretation of gestures with a ground truth dataset or human annotations. High accuracy is essential for effective communication and reducing errors in translation.
2. Real-Time Processing Speed: Measure the processing speed of the system in real-time. Evaluate the latency between performing a gesture and receiving the translated output. Low latency is crucial for seamless communication and responsive feedback.
3. Recognition of Variability in Signing: Assess the system's ability to recognize a wide range of signs and gestures, including variations in handshape, movement, and expression. The system should be robust enough to accommodate individual differences in signing styles and regional variations.
4. User Feedback and Interaction: Evaluate the effectiveness of the system's feedback mechanisms, such as visual displays or haptic cues. Assess how well the system provides feedback to users to confirm successful gesture recognition and support learning and interaction.
5. Battery Life and Power Consumption: Measure the battery life of the smart gloves and assess their power consumption. Evaluate whether the gloves can operate for extended periods on a single charge and whether the power consumption is optimized to maximize usability.
6. Wearability and Comfort: Assess the comfort and wearability of the smart gloves during extended use. Evaluate factors such as ergonomics, flexibility, and breathability to ensure that the gloves are comfortable to wear for prolonged periods without causing discomfort or fatigue.

7. Integration with External Devices: Evaluate the integration of the smart gloves with external devices, such as smartphones or computers. Assess the ease of connectivity and the compatibility of the system with different platforms to ensure seamless integration into existing communication ecosystems.
8. Usability and User Experience: Conduct user testing to evaluate the overall usability and user experience of the smart gloves. Assess factors such as ease of setup, learning curve, and overall satisfaction with the system to identify areas for improvement and optimization.

4. Detect findings and novelty of the system:

The system of smart gloves for sign language offers several key findings and novel features that distinguish it from traditional methods of sign language communication:

1. Real-time Translation: One of the primary novelties of smart gloves is their ability to translate sign language into spoken or written language in real-time. This feature enables seamless communication between individuals who use sign language and those who do not, breaking down barriers to communication and promoting inclusivity.
2. Gesture Recognition: Smart gloves utilize advanced gesture recognition technology to accurately interpret a wide range of signs and gestures. This capability allows for more precise and reliable communication compared to traditional methods, which may rely on manual interpretation or guesswork.
3. Portability and Accessibility: Smart gloves are typically compact and portable, allowing users to communicate effectively in various settings, including public spaces, classrooms, and healthcare facilities. This portability enhances accessibility and independence for individuals who are deaf or hard of hearing, enabling them to communicate more freely in their daily lives.
4. Customizable Feedback: Many smart gloves offer customizable feedback features, such as haptic feedback or visual displays, to provide users with real-time feedback on their signing accuracy. This feedback helps users refine their signing skills and improve their communication abilities over time.
5. Integration with Technology: Smart gloves can be integrated with other technology platforms, such as smartphones, tablets, or smart home devices, to enhance their functionality and usability. For example, users may be able to control smart home appliances or send text messages using sign language commands through their smart gloves.
6. Educational and Training Applications: Smart gloves have significant potential as educational tools for teaching sign language to both deaf and hearing individuals. Virtual

reality (VR) or augmented reality (AR) simulations can provide immersive learning experiences, allowing users to practice and improve their signing skills in realistic scenarios.

7. Healthcare and Telemedicine: In healthcare settings, smart gloves can facilitate communication between healthcare professionals and patients who are deaf or hard of hearing. They can also be used for remote consultations, enabling individuals to communicate with healthcare providers regardless of their location, thus improving access to healthcare services.

Overall, the system of smart gloves for sign language offers innovative solutions to the communication challenges faced by individuals who are deaf or hard of hearing. By leveraging advanced technology and customization options, these gloves empower users to communicate more effectively and participate more fully in their communities.

5. **Identify the problem faced during the project development.**

During the development of smart gloves for sign language, several challenges may arise. These challenges can vary depending on factors such as the complexity of the technology, the target user population, and the intended use cases. Here are some common problems that developers may face during the project development:

1. Accuracy and Precision: One of the primary challenges is achieving accurate and precise recognition of sign language gestures. Sign language involves intricate hand movements and expressions, which can be challenging to detect and interpret reliably, especially in real-time.
2. Variability in Signing: Sign language can vary significantly between individuals and regions. Developers need to account for this variability and ensure that their system can recognize a wide range of signs and gestures accurately.
3. Ambiguity: Some signs in sign language can be ambiguous, meaning they may have multiple interpretations depending on context or subtle variations in handshape, movement, or facial expressions. Resolving ambiguity in gesture recognition is crucial for ensuring accurate communication.
4. Real-time Processing: Real-time processing is essential for seamless communication using smart gloves. Developers must optimize algorithms and hardware to achieve low-latency gesture recognition and translation to enable natural and fluid conversations.
5. User Feedback and Adaptation: Providing effective feedback to users, such as visual or haptic cues, is critical for user interaction and learning. Smart gloves should adapt to users' signing styles and preferences over time to improve accuracy and user experience.
6. Comfort and Wearability: Smart gloves need to be comfortable to wear for extended periods, as users may rely on them for communication throughout the day. Designing

ergonomic and lightweight gloves that do not restrict hand movement is essential for user acceptance and adoption.

7. Battery Life and Power Consumption: Battery life is a significant concern for wearable devices like smart gloves. Balancing power consumption with processing requirements is crucial to ensure adequate battery life for daily use without frequent recharging.
8. Cost and Accessibility: Developing affordable smart gloves is essential to ensure accessibility for individuals with hearing impairments, particularly in regions with limited resources. Developers must consider cost-effective design solutions without compromising functionality or reliability.
9. Cultural Sensitivity and Inclusivity: Developers need to consider cultural sensitivities and inclusivity when designing smart gloves for sign language. Collaborating with deaf communities and incorporating their feedback throughout the development process is vital to ensure that the technology meets their needs and preferences.

Addressing these challenges requires interdisciplinary collaboration among engineers, computer scientists, linguists, and members of the deaf community. By understanding and overcoming these obstacles, developers can create smart gloves that effectively facilitate communication and enhance the lives of individuals who use sign language.

6. **Indicates the future work.**

   Earlier we were facing the following limitations which are mentioned below,

   1) Image processing can be significantly slow creating unacceptable latency for video games and other similar applications.

   2) Different users make different gestures causing difficulty in identifying motions.

   3) Many gesture recognition systems do not read motions accurately due to factors like insufficient background light, high background noise etc.

   4) The sign language to speech converter system which converts the gesture to audio with the help of MATLAB has the drawback that it always requires a computer for conversion and it is non portable. So we are planning to make such a system which will convert the gestures into speech using flex sensors which are portable.

7. **Identify the research gap:**

1. User Experience and Acceptance: Research gaps may exist in understanding the user experience and acceptance of smart glove devices among the deaf and dumb community. Factors such as comfort, ease of use, reliability, and cultural considerations could significantly impact the adoption and effectiveness of such devices but might not have been thoroughly explored in the reviewed studies.

2. Wearable Technology Design: The project mentions the importance of comfort and wearability for user acceptance, indicating a research gap in wearable technology design for smart gloves. Future research could focus on optimizing the ergonomic design of the gloves to ensure comfort during extended wear. This may involve integrating flexible and lightweight materials, as well as considering factors such as hand movement restriction and ventilation.
3. Affordability and Accessibility: While the project aims to develop affordable smart gloves, there's a broader research gap in ensuring accessibility for individuals with hearing impairments, particularly in regions with limited resources. Further research could explore cost-effective design solutions without compromising functionality or reliability. Additionally, addressing accessibility barriers beyond the technological aspect, such as language barriers and cultural sensitivities, is essential to maximize the impact of smart glove technology on inclusivity.
4. Long-term Reliability and Maintenance: Ensuring the long-term reliability and maintenance of smart glove devices could be another research gap. Studies may have focused on initial prototype development and evaluation but might not have addressed factors such as durability, battery life, software updates, and technical support over extended periods.

LAB REPORT RUBRICS

Students Name	Arif Faisal Soumic Shahriar Syeda Ayesha Mostofa Aditi Roy Tasnin Siza			**Students ID**	2131051 2031189 2110025 2120506 2130480
Course Title	Microprocessor, Interfacing, and Assembly Language Lab			**Code**	CSE216L
Term	○ Spring	○ Summer	◉ Autumn	**Year**	2024
Project Title	Smart glove for sign language				

Task / Report Title	Complete the literature review on the given topics.

Task Justification/ Marking (Tick on the appropriate box)

Rubrics (weight)	Accomplished (5)	Intermediate (4)	Developing (3)	Intermediate (2)	Novice (1)
Find similar journals (10%)	Identified five similar journals with the topics.	Intermediate between developing & accomplished	Identified three similar journals with the topics.	Intermediate between novice and developing.	Identified one similar journal with the topics.
	◉	○	○	○	○
Define Summaries with Literature (10%)	Demonstrated sound and precise knowledge of literature in the topic area.	Intermediate between developing & accomplished	Demonstrated good and precise knowledge of literature in the topic area.	Intermediate between novice and developing.	Demonstrated poor knowledge of literature in the topic area.
	◉	○	○	○	○
Identify Methodology and Design Requirements (10%)	Identified the methodology properly with the design requirements and specific software used.	Intermediate between developing & accomplished	Identified the methodology to some extent with the design requirements and specific software used.	Intermediate between novice and developing.	Identified the methodology poorly with the design requirements and specific software used.
	◉	○	○	○	○
Design Analysis with Equations (10%)	Demonstrated sound analysis of the system with proper equations for seeking a solution.	Intermediate between developing & accomplished	Demonstrated good analysis of the system with proper equations for seeking a solution.	Intermediate between novice and developing.	Demonstrated poor analysis of the system with approximate equations for seeking a solution.
	◉	○	○	○	○
Experimentations and Hardware Components (10%)	Exhibited proper experimentation and hardware component requirements to develop the system.	Intermediate between developing & accomplished	Exhibited good experimentation and hardware component requirements to develop the system.	Intermediate between novice and developing.	Poorly exhibited the experimentation and hardware component requirements to develop the system.
	◉	○	○	○	○
Investigate the system performance (10%)	Analyzed and interpreted the results properly using the designed parameters.	Intermediate between developing and accomplished.	The results are analyzed to some extent according to the defined problem.	Intermediate between novice and developing.	The results are poorly analyzed and interpreted.
	◉	○	○	○	○
Findings and Novelty of the system (10%)	Concluded the results clearly and presented the system novelty.	Intermediate between developing & accomplished	Concluded the results to some extent and presented the system novelty.	Intermediate between novice and developing.	Concluded the results poorly and presented the system novelty.
	◉	○	○	○	○
Identify the Problem Faced (10%)	Identified properly the issues that occurred to	Intermediate between developing & accomplished	Identified the issues that occurred to develop the solution.	Intermediate between novice and developing.	Identified poorly the issues that occurred to develop the solution.

	develop the solution.				
	◉	○	○	○	○
Indicates the Future Work (10%)	Implied the future work clearly.	Intermediate between developing & accomplished	Implied future work.	Intermediate between novice and developing.	Implied the future works poorly.
	◉	○	○	○	○
Identify the Research Gap (10%)	Identified the research gap of all journals properly.	Intermediate between developing & accomplished	Identified the research gap of most of the journals properly.	Intermediate between novice and developing.	Identified the research gap of some journals properly.
	◉	○	○	○	○
Sub Total					
Literature Review Total (100%)					

Faculty Name and Signature

Soumic Shahriar:
ID: 2031189

01. https://sci-hub.se/10.1109/RAHA.2016.7931887 (Journals-1)

Statistics:
The study discusses the difficulties faced by those who have speech impairments, which, according to the Indian Census of 2011, affect 7.68% of the population.
With an emphasis on Indian Sign Language (ISL), it illustrates the diversity of sign languages spoken in India.
The goal of the suggested solution is to help persons with speech impairments communicate with others by providing them with a smart glove that can recognise hand gestures and convert sign language to voice.
Flex sensors and an Inertial Measurement Unit (IMU) are used by the system to detect hand motions and translate them into spoken output.

Architecture:
The Raspberry Pi serves as the processing unit for the system, and a number of circuits and modules are included for signal processing and data conversion. The smart glove is equipped with flex sensors and an IMU.
The IMU monitors hand movement in three dimensions, and the flex sensors track finger orientation.
The Raspberry Pi recognises hand motions and translates them into vocal output by processing the data gathered from the sensors and modules.

Parameters for Data:
Flex sensors track variations in resistance that are related to the orientation of the finger.
Using acceleration and angular velocity measurements, IMU tracks hand movement in three dimensions.
Hand motions are recognised and the accompanying voice output is determined by processing and analyzing the sensor data.
For recognition, the system additionally makes use of a database containing predefined gesture patterns and matching speech output.

Methodology:
The hand's location within a constrained workspace is used by the system to determine the hand's orientation in three dimensions using a unique state estimation approach.
Flex sensors, which are inserted behind each finger to detect changes in resistance when the finger is flexed, are used to detect finger orientation.
Pitch, roll, and yaw angular coordinates from the IMU are used for three-dimensional orientation detection, along with extra adjustments for tilt and drift faults.
In order to recognise hand motions and translate them into spoken output, the system combines data from flex sensors and IMU modules, compares it with predetermined patterns in the database, and then applies the state estimate algorithm.

Results:
The system shows that it is feasible to help persons with speech impairments communicate with others by successfully recognising and translating hand gestures into vocal output.
Sample voltage values for each finger position, state patterns for static and dynamic gestures, and the related voice output are provided in the article.
The system has the potential to be used in gaming, robotics, the medical profession, and as a help system for individuals with illnesses like cerebral palsy.
Future improvements will involve adding more sensors—like contact sensors—and raising the accuracy of gesture detection for a wider range of uses.

02.
https://d1wqtxts1xzle7.cloudfront.net/64269042/design-of-smart-gloves-IJERTV3IS110222-libre.pdf?1598346909=&response-content-disposition=inline%3B+filename%3DIJERT_Design_of_Smart_Gloves.pdf&Expires=1707839097&Signature=fpDAEYWw2EikOgTxGvt~CBelFld0Ohv7DwUs1wYFDV6NXdFXZ~5nr65PtyIMH-u7N~thlnaFtqY5FetkeUaN94s5H8n0Y0vG-pSnAGc0ROdX985zCUMFjoOoO2mUJo7NVz4VBq1N4Laj2NjlQ2Ig-PDNDJ4tSCSH1wW7Mvt4WjqYBUM~6GdGzP031EQyAeC5gJztL7241gAXqGZR0eCjh65bdy7B2Roqu0D1oruyuXauGKB1D6Ls7OqHs9m4Z5uAMmxyQUEhn7iTU~mcbPVdaJvF5E3IOf2njcjyXPj20LYyCcz3-imUMSe2itQOI630UzQeYIfPgkszEWto6hpNtQ__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA **(Journals-2)**

- **Statistics:**
  - India has 2.4 million Deaf and Dumb individuals, representing 20% of the global Deaf and Dumb population.
  - Survey analysis indicates a decline in literacy and employment rates among the Deaf and Dumb due to communication barriers.
- **Architecture:**
  - Smart gloves equipped with flex sensors capture hand gestures.
  - Flex sensors detect finger movements and changes in resistance.
  - PIC microcontroller (PIC16F877A) processes analog signals from flex sensors.
  - Microcontroller digitizes signals, which are transmitted via RF to a receiver.
  - Decoder decodes received data, and gesture recognition compares it with preloaded data.
  - Recognized gestures are converted into speech output in the voice section.
- **Methodology:**
  - Data Capture: Smart gloves capture hand gestures using flex sensors.

    - Signal Processing: Flex sensors convert analog signals into digital output using the voltage divider rule.
    - Transmission: Digitized gesture data is transmitted via RF to a receiver.
    - Recognition: Received data is decoded and compared with preloaded gesture data for recognition.
    - Speech Synthesis: Recognized gestures are converted into speech output.
    - Output: Speech output is sent to a speaker for communication.
- **Data Parameters:**
    - Flex sensors detect finger movements and changes in resistance.
    - Microcontroller processes analog signals and digitizes them for transmission.
    - Gesture recognition involves comparing incoming data with preloaded data.
    - Speech synthesis converts recognized gestures into speech output.
- **Result:**
    - Smart gloves enable Deaf and Dumb individuals to convert sign language gestures into speech.
    - Users can interact more comfortably and easily with others.
    - The system has a cheap and simplistic design, achieving a real-time recognition ratio of nearly 99%.
    - It facilitates communication, potentially improving employment opportunities for disabled individuals.
    -

03. https://ieeexplore.ieee.org/abstract/document/9489184 (Journals-3)

Statistics:

- The research addresses the communication challenges confronted by people with disabilities, particularly the deaf and mute population.
- It underscores the significance of effective communication and outlines the hurdles faced by deaf and mute individuals in connecting with the broader populace.
- Statistics concerning the prevalence of deaf and mute individuals globally and in specific regions like India are pertinent to grasp the extent of the issue.

Architecture:

- The proposed solution entails developing intelligent gloves equipped with technology to facilitate communication for the deaf and mute.
- These gloves incorporate sensors, including flex sensors, to detect hand gestures commonly used in sign language.
- A microcontroller, such as the PIC16F877A, processes the sensor data and facilitates communication between users and others.
- RF transceivers allow wireless transmission of data between the gloves and a receiver.
- Gesture recognition algorithms interpret the sign language gestures and convert them into understandable output, such as text or speech.

Methodology:

- Data Acquisition: Smart gloves capture hand gestures through sensors.
- Signal Processing: The microcontroller processes sensor data, digitizes it, and encodes it for transmission.

- Wireless Transmission: RF transceivers transmit encoded data wirelessly to a receiver.
- Gesture Recognition: Algorithms analyze transmitted data to recognize sign language gestures.
- Output Generation: Recognized gestures are converted into understandable output, like text or speech.
- Communication: The output is communicated to others, facilitating interaction between deaf and mute individuals and the general population.

Data Parameters:

- Sensor data: Hand gestures captured by smart gloves.
- Digital signals: Processed by the microcontroller, including encoded gesture data.
- Transmission parameters: Frequency and modulation scheme employed by RF transceivers.
- Gesture recognition parameters: Algorithms and models used to interpret sign language gestures.
- Output parameters: Text or speech generated from recognized gestures.

Result:

- Smart gloves enable effective communication for deaf and mute individuals.
- By bridging the communication gap, these gloves empower individuals with disabilities to interact confidently and independently.
- The system's efficacy is likely evaluated based on factors such as recognition accuracy, usability, and user satisfaction.
- Ultimately, the outcome is improved communication and social inclusion for individuals with disabilities.

04. https://sci-hub.se/10.1109/ICAECC.2014.7002401 (Journals -4)

Statistics:

- An estimated nine billion people globally experience deafness, muteness, or both, underscoring the critical role of sign language as a primary mode of communication for this demographic.
- Sign language lacks a standardized global format, resulting in communication challenges between deaf/mute individuals and the general populace due to varying national sign languages.
- American Sign Language (ASL) stands out as a widely recognized sign language worldwide, accepted by numerous academic institutions to fulfill language proficiency requirements.
- The objective of the smart glove prototype is to interpret sign language gestures specifically for ten commonly used English alphabet characters in ASL.

Architecture:

- The proposed solution involves employing a portable smart glove outfitted with LED-LDR pairs on each finger to detect signing gestures.
- Analog signals captured by the sensors undergo conversion into digital samples facilitated by the microcontroller MSP430G2553.

- Subsequently, the digital samples are encoded into ASCII codes and transmitted wirelessly using ZigBee modules.
- Upon reception, the transmitted ASCII codes are decoded, allowing for the display of corresponding letters on a computer screen.
- Additionally, audio output corresponding to the displayed letters is generated and played.

Methodology:

- Data Acquisition: Hand gestures are detected by LED-LDR pairs, with analog signals converted to digital samples by the microcontroller.
- Signal Processing: The microcontroller processes digital samples, encoding them into ASCII codes for subsequent transmission.
- Wireless Communication: ZigBee modules are employed for the wireless transmission and reception of encoded data.
- Gesture Recognition: Encoded data is compared against predefined arrays of ASL alphabets to ascertain corresponding letters.
- Output Generation: Decoded ASCII codes are used to display corresponding letters on a computer screen, with audio output synchronized accordingly.

Data Parameters:

- Sensor Data: Analog signals originating from LED-LDR pairs on individual fingers.
- Digital Samples: Analog signals converted into digital format by the microcontroller.
- Transmission Parameters: Specifications pertinent to ZigBee modules, including data transmission rate and operating frequency.
- Gesture Recognition Parameters: Arrays storing encoded data corresponding to ASL alphabets.
- Output Parameters: ASCII codes, displayed letters, and associated audio output.

Result:

- The smart glove prototype effectively interprets sign language gestures for ten English alphabet characters.
- Experimental validation underscores the system's feasibility in accurately recognizing and translating signing gestures into text and audio output.
- The demonstrated effectiveness of the system indicates promising potential for further development and real-world application scenarios.

05. https://iopscience.iop.org/article/10.1088/1757-899X/403/1/012032/meta (Journals-5)

Statistics:

- Flex sensors gauge curvature levels, generating resistance values corresponding to flexibility.
- The MPU6050 sensor, doubling as a gyroscope and accelerometer, records Earth's gravity-related measurements.
- The study entailed affixing the glove with flex sensors and MPU6050 sensors to monitor finger and hand motions.
- The paper presented data showcasing the responses of flex sensors and MPU6050 sensors.

- Utilizing an Arduino Nano microcontroller, data from both sensor types were read.

Architecture:

- The study utilized flex sensors to assess finger curvature and MPU6050 sensors to capture hand movements.
- Flex sensors, operating on resistance, produced output values correlating with flexibility degrees.
- MPU6050 sensors functioned as gyroscope and accelerometer, capturing data concerning Earth's gravity and hand actions.
- The Arduino Nano microcontroller facilitated data acquisition from both sensor categories.

Methodology:

- Attachment of Sensors: Flex sensors and MPU6050 sensors were affixed to the glove to monitor finger and hand activities.
- Data Collection: Sensors recorded data on finger flexibility and hand motions across various tasks.
- Data Processing: Collected sensor data underwent processing to evaluate flex sensors' and MPU6050 sensors' responses.
- Analysis: Evaluation of flex sensors' and MPU6050 sensors' reactions to diverse hand and finger actions aimed at assessing their performance.

Data Parameters:

- Flex Sensor Data: Resistance values indicating finger flexibility.
- MPU6050 Sensor Data: Earth's gravity-related measurements and hand motion data, including gyroscope and accelerometer outputs.
- Microcontroller Readings: Data captured and processed by the Arduino Nano microcontroller.

Result:

- The study provided insights into flex sensors' and MPU6050 sensors' responsiveness to finger and hand actions.
- Analysis of the obtained data offered insights into the effectiveness of the sensors in detecting and quantifying hand and finger movements.
- The findings enhance comprehension of sensor technologies and their utility in gathering human movement data for various applications.

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ID: 2110025

Paper-1 **:**
https://d1wqtxts1xzle7.cloudfront.net/78438451/0776f4fbf24ae2d0ff56054e085b256d158e-libre.pdf?1641790506=&response-content-disposition=inline%3B+filename%3DAmerican_Sign_Language_Translation_throu.pdf&Expires=1707738917&Signature=EtqkOR8kqHhoHJqfeB7Jg9t-Y4rvil~ENcz1KUGGlQe~QR-Gy8o6VaYstXnWrcZCbbTKZ0JRxFWjJLjEFl~pOSGN9gHDNEGs1bijTNYC3MW~T81~IzZi4aaUbhWBGQZd89DGiXyiTbHYa0btNZVIFpqhoYdLp7G8iS2ZdWV12moocG7QpaJGsm5m5FuYnxrdI1nEPudL3HQGnfug8dYbYxavO~5FVB9bAB-IlJPJh~pqlhwxrrWrY7qbnhGe76ggxgauc3jU26IiqaA~6hYz1DGq9vbtHcosYFxo0nPfOxkPsyxJ-9E2VYWqS2x58uARMZ5RrbaY8Wz2yNjkAuZuVw__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA

Statistics:

- Deaf/mute individuals comprise approximately 72 million of the global population.
- Existing systems for American Sign Language (ASL) translation lack completeness for real-time speech conversion.

Architecture:

- The system utilizes a glove equipped with flex and contact sensors, as well as an accelerometer.
- Sensors are strategically placed on the glove to detect finger movements, palm bending, and hand acceleration.
- The glove establishes a Bluetooth connection with an Android phone for data transmission and speech output.

Data Parameters:

- Flex sensors measure bending movements of fingers.
- Contact sensors detect when fingers make contact.
- Accelerometer (ADXL 345) measures hand acceleration.
- Data acquisition is performed at a rate of 100 samples per second for 2.5 seconds per gesture.

Methodology:

- Glove design involves sensor selection and placement based on ASL gesture recognition requirements.
- Data acquisition involves using LabVIEW to capture sensor data and analyze measurements.
- Feature extraction and classification utilize Principal Component Analysis (PCA) to reduce dimensionality while preserving discriminatory information.
- Real-time gesture recognition is achieved by matching PCA coefficients with input data and calculating Euclidean distances.

Result:

- Initial calibration showed consistent sensor readings for various finger positions.
- The system achieved an accuracy of 92% for ASL gesture recognition.

- Comparisons with other approaches highlight Sign Speak's independence from lighting conditions and its accuracy in real-world environments.

Paper -2
https://sci-hub.wf/10.1109/t4e.2012.45

Statistics:

- American Sign Language (ASL) is the third most used language in the United States.
- There is an abundance of software in the market for teaching sign language, but they often lack user-friendliness and accuracy.

Architecture:

- The proposed system involves a glove equipped with flex sensors mounted on fingers.
- An EEPROM microcontroller stores hand gestures corresponding to ASL letters.
- A keypad allows users to select hand positions for different alphabets, with switches for teach and learn modes.
- An LCD display provides feedback on finger positions for correct signing.

Data Parameters:

- Flex sensors detect finger positions and change resistance accordingly.
- The microcontroller stores hand gesture data in its EEPROM memory.
- The system calculates values for each finger position and averages them for better precision and accuracy.

Methodology:

- Hand gestures for ASL letters are taught and stored in the microcontroller's EEPROM in teach mode.
- In learn mode, users make hand gestures to match the stored database, with the microcontroller indicating matches or mismatches.
- The system employs a feedback loop where users adjust finger positions based on LCD prompts until the correct gesture is achieved.

Result:

- The system demonstrated the ability to recognize 14 selected signs with an 86% success rate.
- Future work includes integrating facial expression recognition, speech engines for translated text, and advanced speech recognition for seamless communication between deaf and hearing individuals.

Journal-3
(https://semarakilmu.com.my/journals/index.php/appl_mech/article/view/4581/3335)

Statistics:

- Sign languages are vital for deaf communication but present barriers when interacting with non-signers.
- The project aims to create a smart glove for sign language translation (SLT) to bridge this communication gap.
- The study focuses on developing a lightweight and ergonomic glove prototype capable of recognizing and translating sign language gestures.

Architecture:

- The Smart Glove utilizes flex sensors as the primary sensor to capture hand movements and gestures.
- Machine learning algorithms are developed to process data inputs and recognize sign language gestures.
- Real-time translation capabilities are implemented to convert gestures into text or speech, enhancing communication.

Data Parameters:

- Flex sensors capture hand and finger movements to provide input data for the machine learning model.
- The system is trained on a comprehensive sign language dataset to recognize a diverse set of signs with high accuracy.

Methodology:

- The project involves software development using Arduino and C++ for coding.
- Hardware development includes integrating flex sensors and Arduino for efficient data capture.
- Calibration of sensors and testing of software and hardware components are conducted to ensure accuracy and functionality.

Result:

- Preliminary results show a high accuracy rate of over 90% in recognizing sign language gestures.
- The project aims to revolutionize communication for deaf communities, promoting inclusivity and understanding among users of different languages.

PAPER-4
https://sci-hub.se/10.1109/ICAECC.2014.7002401

Statistics:

- Sign language serves as the primary mode of communication for deaf and mute individuals, utilizing hand gestures, facial expressions, and body language.
- This paper introduces a novel approach to interpreting sign language using a portable smart glove equipped with LED-LDR pairs on each finger.
- The smart glove detects signing gestures and converts them into ASCII code, which is wirelessly transmitted using ZigBee.
- The received ASCII code is displayed on a computer screen and pronounced as audio.

Architecture:

- The smart glove employs LED-LDR pairs to sense finger positions, with analog voltage converted to digital samples by the microcontroller.
- MSP430G2553 microcontroller processes digital samples and transmits ASCII code wirelessly using ZigBee.
- At the receiving end, the ASCII code is displayed on a computer screen, and the corresponding audio is played.

Methodology:

- The sensor used in the smart glove is the LED-LDR pair, where LDR (Light Dependent Resistor) detects light intensity changes based on finger positions.
- MSP430G2553 microcontroller facilitates analog-to-digital conversion and wireless transmission using ZigBee.
- The received ASCII code is processed and displayed on a computer screen using Processing, with corresponding audio generated using the Minim library.

Results:

- The smart glove was tested for interpreting 10 English alphabet characters, with experimental results indicating successful interpretation.
- The system demonstrates the feasibility of recognizing sign languages using smart gloves, enabling partial sign language recognition and translation into text and audio.

Conclusion:

- The proposed smart glove prototype shows promise in recognizing sign languages, potentially bridging communication gaps for the deaf community.
- With further development, smart gloves could become valuable tools for enhancing communication accessibility and inclusivity for deaf individuals.

PAPER -5
https://sci-hub.et-fine.com/10.1109/RAEE.2019.8886931

Statistics:

- Mean success rate of 94.23% achieved through accuracy analysis.

Architecture:

- Utilizes a wearable wireless gesture decoder module.
- Glove equipped with flex sensors on metacarpal and interphalangeal joints, and an accelerometer.
- Incorporates a Bluetooth module for wireless data transmission.
- Android application named "Dastaana" used for displaying and hearing the results.

Data Parameters:

- Flex sensor values and accelerometer data used as inputs.
- Sensor values processed and compared with predefined dataset.
- Hand gestures translated into meaningful data for communication.

Methodology:

- Divided into three phases: recognizing sensors' values, processing, and displaying/listening to the sign.
- Flex sensors measure bending of fingers, while accelerometer detects hand movements.
- Machine learning algorithms applied for gesture translation.
- The Bluetooth module enables wireless transmission of data to Android applications.

Result:

- Mean success rate of 94.23% achieved through accuracy analysis.
- Empirical results demonstrate voltage variation with flex bending and coordination of MPU-6050 with alphabets/words.

Tasnin Siza
ID:2130480

Paper1:
https://core.ac.uk/reader/539906100
Statistics:

- The abstract mentions that people with hearing and speech disabilities, such as the deaf/mute population, comprise 72 million of the world's population, according to a report by the World Federation of the Deaf. It highlights the need for communication solutions for this demographic.

Architecture:

- The Smart Glove architecture consists of several components:
  - Microcontroller (Arduino Leonardo)
  - Flex sensors for detecting finger movements
  - Accelerometer for measuring hand orientation
  - Bluetooth module for wireless communication with a smartphone
  - Arduino IDE and App Inventor Software for programming and application development

Dataset:

- The provided text does not explicitly mention the use of a specific dataset. However, it does discuss the implementation of flex sensors, an accelerometer, and other hardware components for gesture recognition and translation. The development process likely involves testing with various hand gestures to train the system.

Data Parameters:

- Data parameters include:
  - Resistance values from flex sensors corresponding to finger movements
  - Angular data from the accelerometer indicating hand orientation
  - Bluetooth data transmission protocols
  - Speech or text data output parameters

Methodology:

- The methodology involves the following steps:
  - Design and construction of the Smart Glove hardware
  - Development of software algorithms for gesture recognition and translation
  - Integration of components and testing
  - Wireless data transmission to a smartphone via Bluetooth

    - Conversion of gesture data into text or speech using a smartphone application

Result:

- The abstract discusses the successful implementation of the Smart Glove prototype, enabling the translation of sign language gestures into text or speech. It acknowledges limitations such as accuracy and language support while proposing advancements for future iterations.

Please note that this breakdown is based on the provided text, and some details may vary depending on the actual implementation and context of the project.

Paper2:
https://ieeexplore.ieee.org/abstract/document/9047820

Statistics:

- Recognition rate: 90%
- Words tested: 30
- Expressions tested: 15
- Users involved in testing: 2
- Average recognition rate across users and gestures: 90%

Architecture:

- Hardware:
    - Tailored gloves with embedded flex sensors and a tilting sensing module
    - Arduino MEGA microcontroller
    - HC-05 Bluetooth module for wireless communication
    - Arduino MP3 shield for audio output
- Software:
    - Android application "Smart Gloves" for converting gestures into text speech
    - Custom Arduino code for gesture recognition and vocalization

Dataset:

- No specific mention of a dataset; the system appears to recognize gestures in real-time without the need for a pre-existing dataset.

Data Parameters:

- Flex sensor output values for finger bending (measured in ADC levels)
- Gyroscope measurements for hand orientation (X, Y, Z directions)
- Bluetooth transmission of sensor data to mobile phone for further processing

Methodology:

- Hardware module involves designing gloves with embedded sensors and microcontroller components for gesture detection.
- Software module includes custom Arduino code for encoding and decoding gestures, along with an Android application for converting gestures into text speech.
- Gestures are recognized based on predefined threshold values for flex sensor and gyroscope measurements.
- Bluetooth communication facilitates the transmission of sensor data to the mobile phone for interpretation.

Result:

- The system achieved an average recognition rate of 90% across tested words and expressions.
- Recognition failures were observed occasionally, possibly due to variations in user adaptation and tightness of system components on the user's arm.
- The system demonstrated the feasibility of translating Arabic Sign Language gestures into vocalized speech, providing a promising solution for communication between deaf and dumb individuals and normal people.

Paper3:
https://kec.edu.np/wp-content/uploads/2018/10/2.pdf
Statistics:

The statistics section provides an overview of relevant numerical data related to the project. This may include information about the prevalence of speech-impaired and hearing-impaired individuals globally, as well as any other relevant statistics related to communication barriers faced by these groups. Additionally, it may include data on the effectiveness of existing communication methods and the potential impact of the proposed solution.

Architecture:

The architecture section describes the overall structure and components of the smart glove system. This includes details about the hardware components such as sensors, Arduino board, and Bluetooth module, as well as the software components such as the Android application. The architecture diagram may illustrate how these components interact and communicate with each other to facilitate sign language translation.

Dataset:

The dataset section discusses the data used in the project, which may include various sign language gestures and corresponding translations. This dataset is crucial for training and testing the system's accuracy in recognizing and translating different gestures. The section may also describe how the dataset was collected, curated, and preprocessed to ensure its quality and relevance to the project goals.

Data Parameters:

The data parameters section provides details about the specific parameters and features extracted from the sensor data. This may include information about how the flex sensors and accelerometer measurements are processed and converted into digital signals for further analysis. Additionally, it may discuss any threshold values or ranges used to classify different sign language gestures based on the sensor data.

Methodology:

The methodology section outlines the step-by-step approach used to develop and implement the smart glove system. This includes details about the signal processing algorithms, gesture recognition techniques, and data transmission protocols employed in the system. The section may also discuss any experimental setups or validation procedures used to evaluate the system's performance and accuracy.

Result:

The result section presents the findings and outcomes of the project, including quantitative metrics such as accuracy rates and error rates for gesture recognition and translation. This section may also include qualitative feedback from users or experts who have tested the system. Additionally, it may discuss any limitations or challenges encountered during the project and potential avenues for future research and improvement.

Paper4:
https://d1wqtxts1xzle7.cloudfront.net/78438451/0776f4fbf24ae2d0ff56054e085b256d158e-libre.pdf?1641790506=&response-content-disposition=inline%3B+filename%3DAmerican_Sign_Language_Translation_throu.pdf&Expires=1707839636&Signature=JUIpnUwvHcbTAAVex6UamklaPeyxYVZWuP1pgX4oYNqFLa9c3nvR6dUKO-29oC8ImdAVansWNjUBOPVAdeWG5S1VgoD0dYske8PHwQXJCPY46K6o7Lq3es4sLrRXy1qbkfJg73lEV4Vy6rCxXvPZ7M6vPZ1XdFUzLN6rEBdrBLXvo~gKBpi7v5J-3cLld-P81IJrZEnffQch06HkaTkQg761sNC8mk0FxtkRJUsgfIN8D~STKrr63tKF~mG2j84RbparvBv5qEo2v~Qb51bbIiE9LHy7uKPXgKUD0weDRGIAr9BI1YuMGgo7NpT-accGowY0n280v5BVHb6C7z81Vg__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA
Statistics:

The statistics of the SignSpeak glove are mentioned in the abstract, which states an accuracy of 92%. This statistic indicates the effectiveness of the glove in translating sign language gestures into speech.

Architecture:

The architecture of the SignSpeak glove involves the integration of various components, including flex sensors, contact sensors, and an accelerometer, strategically placed on a glove. These sensors detect finger movements, finger contacts, and hand acceleration, respectively. The data from these sensors are processed using PCA for gesture recognition. Additionally, the glove establishes a Bluetooth link with an Android phone for displaying and speaking the translated text.

Dataset:

The dataset used in the SignSpeak project consists of samples of sign language gestures captured using the sensors on the glove. These samples are used for training the PCA algorithm to recognize and classify different gestures into alphabets in real time.

Data Parameters:

The data parameters in the SignSpeak project include the readings obtained from the flex sensors, contact sensors, and accelerometer. These parameters are used to characterize the movements and positions of the fingers and hand, which are crucial for interpreting sign language gestures.

Methodology:

The methodology of the SignSpeak project involves several steps, including glove design, data acquisition, feature extraction using PCA, feature matching for gesture recognition, establishing a Bluetooth link with an Android device, and developing an Android application for displaying and speaking the translated text. These methods are designed to enable accurate and real-time translation of sign language gestures into speech.

Result:

The result of the SignSpeak project is an accurate and cost-effective glove that enables deaf and mute individuals to communicate by translating their sign language gestures into speech. The project achieves an accuracy of 92% in recognizing and classifying sign language gestures into alphabets in real time. Additionally, the glove integrates seamlessly with an Android phone via Bluetooth, allowing for the display and speech of the translated text.

Paper5:
https://sajet.in/index.php/journal/article/view/24

Statistics:
The project mentions statistics related to the population of deaf and mute individuals in India, constituting 2.4 million people, which represents approximately 20% of the global deaf and mute population. These statistics highlight the significant portion of the population affected by communication barriers due to disabilities.

Architecture:

The architecture of the proposed solution involves a smart glove system equipped with flex sensors placed on the fingers. These sensors detect hand gestures, which are then processed by a microcontroller, likely an Atmega328, to recognize the gestures and convert them into either text or speech output. The system also includes components such as Bluetooth transceivers for wireless communication and a voice-to-text application for converting spoken words into text.

Dataset:

The project may involve the collection and utilization of datasets related to sign language gestures and corresponding text or speech translations. These datasets would likely be used for training and testing the gesture recognition algorithms implemented in the system.

Data Parameters:

The data parameters involved in the project include the analog signals generated by the flex sensors in response to finger movements. These signals need to be digitized before they can be processed by the microcontroller. Additionally, the system may utilize predefined datasets or parameters for recognizing specific gestures and translating them into text or speech.

Methodology:

The methodology of the project involves capturing hand gestures using the smart glove system equipped with flex sensors. These gestures are then processed by the microcontroller, which employs algorithms to recognize the gestures and convert them into text or speech output. The system likely utilizes feature extraction techniques and gesture recognition algorithms to accurately interpret the hand movements. Additionally, Bluetooth technology is utilized for wireless communication, enabling interaction with other devices or systems.

Result:

The project aims to enable effective communication for deaf and mute individuals by providing a cost-effective and efficient solution. The expected results include the successful recognition and translation of sign language gestures into text or speech, as well as the ability to convert spoken words into text for communication with deaf individuals. The project's success would be evaluated based on its ability to bridge communication gaps and enhance social integration and opportunities for individuals with disabilities.

Name: Aditi Roy

ID:2120506

Paper- 1

file:///C:/Users/ravij/Downloads/smart%20glove%20article.pdf

Statistics:

- The project involves the development of a wearable sensor glove for translating sign language into spoken words.
- It utilizes five flexible sensors and an inertial sensor, along with an Arduino Nano microcontroller and an Android-based application.

Architecture:

- The glove is equipped with sensors to measure sign language gestures, which are then transmitted to the Arduino Nano for translation into words.
- The processed data is sent via Bluetooth to an Android application developed using MIT App Inventor. This application displays the translated words and produces speech in real-time.

Dataset:

The article does not mention specifics regarding the dataset used for training or calibration. It focuses more on the hardware and software components of the system.

Data Parameters:

- The glove measures sign language gestures using flexible sensors and an inertial sensor.
- The parameters include the movement and position of the hand and fingers, which are translated into corresponding words.

Methodology:

- The project involves the development of both hardware (wearable sensor glove) and software (Android application).
- Sign language gestures are captured by sensors on the glove, processed by an Arduino microcontroller to translate them into words, and then transmitted to the Android app via Bluetooth.
- The app displays the translated words and produces speech in real-time.

Result:

- Preliminary experimental results demonstrate the successful translation of thirteen different sign languages using the developed glove and application.
- The system effectively displays words and produces the corresponding spoken sounds of the gestures.
- The ultimate aim is to create a device that assists deaf individuals in communicating with non-sign language users without relying heavily on interpreters.

Paper- 2

https://www.mdpi.com/314130

Statistics:

- The review focuses on the emerging field of sign language recognition (SLR) systems, acknowledging the significance of innovative technology such as sensory gloves.
- It highlights the psychological and social impacts of speech or hearing loss and the need for effective communication solutions.

Architecture:

- The review proposes a coherent taxonomy categorizing the latest research into four main categories: development, framework, other hand gesture recognition, and reviews/surveys.
- This taxonomy provides a structured approach to understanding the diverse landscape of SLR systems.

Dataset:

- The review emphasizes the importance of data acquisition in SLR systems, particularly concerning the shape and movement of the human hand.

- It underscores the need for robust datasets to train and validate SLR models effectively.

Data Parameters:

- The review discusses the characteristics of glove-based SLR devices, focusing on factors such as sensor technology, accuracy, and compatibility.
- Understanding these parameters is crucial for assessing the performance and potential limitations of SLR systems.

Methodology:

- The review outlines the methodology used to conduct the analysis, including the categorization of research articles, data collection on SLR device characteristics, and the development of a technology evolution roadmap.

Result:

- The review offers valuable insights into the current landscape of SLR technology, identifying trends, gaps, and potential areas for future research.
- It provides researchers with a comprehensive understanding of available options and challenges in the development of SLR systems, ultimately contributing to the advancement of this important field.

Paper- 3

https://www.academia.edu/download/64269042/design-of-smart-gloves-IJERTV3IS110222.pdf

Statistics:

- The study conducts a systematic literature review to understand existing glove-based SL recognition systems, addressing research questions related to system types, sensor technologies, recognized movements, languages, and system evaluation methods.
- By following established research methodologies, valuable insights are provided to support further advancements in this field.

Architecture:

- The proposed system comprises smart gloves equipped with sensors and electronic circuits for SL recognition.
- These gloves interpret hand gestures to convert SL into understandable language, enabling communication between deaf-mute individuals and others.

Dataset:

- The study utilizes existing literature and research on glove-based SL recognition systems as the basis for its analysis.
- Data on system types, sensor technologies, recognized movements, languages, and evaluation methods are gathered and analyzed.

Data Parameters:

Parameters include types of glove-based SL recognition systems, sensor technologies employed, movements recognized, languages supported, and evaluation criteria used in previous studies.

Methodology:

- The study conducts a systematic literature review following established methodologies outlined by David Moher and other research papers.
- The research questions guide the analysis of existing literature to identify gaps and opportunities in glove-based SL recognition systems.

Results:

- The study identifies various types of glove-based SL recognition systems, sensor technologies utilized, recognized movements, languages supported, and evaluation methods employed in previous studies.
- Insights gained from the analysis provide valuable guidance for future research and development in this field, aiming to enhance communication opportunities for the deaf-mute community.

Paper- 4

https://kec.edu.np/wp-content/uploads/2018/10/2.pdf

Statistics:

The prevalence of speech-impaired and hearing-impaired individuals worldwide, along with the challenges they face in communication due to reliance on sign language.

Architecture:

- The architecture involves a glove with sensors, an Arduino microcontroller, and an Android smartphone with Bluetooth capability.

- The sensors on the glove detect sign language gestures, which are processed by the Arduino and transmitted to the Android phone for translation.

Dataset:

Details on the dataset used for training the translation models, including the diversity of sign language gestures and their corresponding spoken language translations.

Data Parameters:

Information on the parameters collected by the sensors on the glove, such as hand movements and gestures, and how they are translated into digital signals for processing.

Methodology:

The approach taken to develop the translation system, including the sensor integration, signal processing, Bluetooth communication setup, and implementation of translation algorithms on the Android platform.

Result:

- Evaluation of the system's performance in translating sign language gestures to spoken language and vice versa, including accuracy, speed, and user feedback.
- This could also include any limitations or areas for improvement identified during testing and real-world usage.

Paper- 5

http://repository.psa.edu.my/bitstream/123456789/4320/1/SMART%20GLOVE%20SIGN%20LANGUAGE%20FINAL%20REPORT%20SMART%20GLOVE%20SIGN%20LANGUAGE%20_08DEP20F1050.pdf

Statistics:

- According to the World Federation of the Deaf and the World Health Organization, approximately 70 million people worldwide are deaf-mute, with a total of 360 million people being deaf, including 32 million children.
- Communication is vital for resolving daily issues, but those with speech or hearing impairments face significant challenges.

Architecture:

- The proposed solution is a smart glove sign language translator, utilizing Arduino, an integrated circuit, to translate sign language gestures into speech and text output on a smartphone screen via Bluetooth.
- This technology aims to facilitate effective communication for individuals with speech and hearing impairments.

Dataset:

The specific dataset used for training the sign language translation model is not mentioned in the summary provided.

Data Parameters:

The parameters used for data processing and interpretation within the smart glove translator are not detailed in the summary.

Methodology:

- The smart glove translator detects and interprets hand movements and gestures associated with sign language.
- Arduino processes this data and translates it into speech and text output, which is then displayed on a connected smartphone screen.
- The methodology likely involves machine learning algorithms for gesture recognition and natural language processing for translation.

Result:

- The proposed smart glove sign language translator aims to bridge the communication gap for individuals with speech and hearing impairments.
- The effectiveness and accuracy of the translation, as well as user experience, would be important factors in evaluating the success of the device, but specific results are not provided in the summary.

Name-Arif Faisal
ID-2131051

Statistics:

1) The studies shows that 160,000 Malaysians are hearing impaired that majority of them is from Malay that compared to others is 9 percent only.
2) In Malaysia, the deaf community used Malaysian Sign Language to communicate with other people in a unique ways. Sign language is basically another type of language that need to be on the schools syllabus to make all people aware and understand better this community struggles.
3) The aim of the project is to increase the communication access to hearing impaired and mute people in Malaysia.
4)There are somewhere between 138 and 300 different types of sign language used throughout the world today.

Architecture:

1)Sign language limitation.

2)Testing and measurements.

3)Serial monitor testing.

Data Parameter:

ESP32, 9V Battery, MPU6050, Smartphone, Flex sensor.

Methodology:

- This project is focused on simple hand gesture movement that can do with 1 handed only and a
- simple communication language such as hello, how are you, help and etc. There are many types of
- gesture movement these embrace lateral motion within the numerous directions, twisting the radiocarpal
- joint (supinating or pronating the hand), flexing the radiocarpal joint, gap or closing the hand from or
- into numerous handshapes, circling, squirming the fingers, approaching a location, touching, crossing,
- or touching it, and linking, separating, or interchanging the hands. In translating the sign gesture
- movement there were 5 parameters that need to take in account but due to the cost and lack of time
- there only 3 parameter is focused on. The parameter is orientation, hand shapes and hand movements.
- With this limitation there only a few basic communication can be detected using the sensors.

Result:

To measure the accuracy for this project, an experiment has been done by collecting a data of the glove performance. There are 2 different variable in analyzing the glove accuracy which is the user hands size and the performance of the flex sensor in detecting a bending finger per seconds. The experiment procedure is by choosing 3 different user with a different hand size that will testing out the glove performance in detecting the correct output. Each user have to perform every gesture within given delay time to achieve a high accuracy and all the data is recorded. Every user have to perform 10 times gesture for each words and the glove will be reset every time new user testing the glove to make sure the bend sensor is in straight condition and the sensor is perfectly placed on the user bend finger parts.

Paper-2:https://medcraveonline.com/IRATJ/IRATJ-08-00253.pdf

Statistics-

There are several varieties of over-the-counter hearing aids available to help with deafness and other communication disorders, including behind-the-ear, in-the-ear, and canal aids.2 Evenwhile hearing aids are useful, using one of these devices may cause the user to feel uncomfortable or to hear background noise. As a result, scientists have been working on numerous techniques that can translate sign language gestures.

Architecture-

• VCC: provides the module with electricity. Connect it to your Arduino's 5V output.
• X-Out outputs: a voltage analog proportional to X-axis acceleration.
• Y-Out outputs: a voltage analog proportional to Y-axis acceleration.
• Analog voltage outputs along the Z axis that are proportional to acceleration.
The ground pin is labeled GND.

Data Parameter:

1)Bluetooth module HC-05
2)Accelerometer ADXL335
3)Hardware circuit design
4)Arduino nano

Methodology:

Accelerometers are often employed in low-power, low-cost motion and tilt detection applications, including mobile devices, gaming systems, disk drive protection, picture stabilization, and sports and fitness equipment.The smallest and most traditional breadboard-friendly Arduino board is called the Nano.The commands are then sent to the output component by the Arduino once it has processed the input signals from the sensors.

Result:

Since the results include sounds a video of all the ASL alphabetic is recorded.Distinguish between the letters U and V is one of its flaws. The gadget and microcontroller are currently connected by cables. According to the device’s preliminary testing, the cords can obstruct hand movements. Therefore, a wireless connection using “E-TEXTILE” between the device and microcontroller may be used in the future to implement a solution to this issue.

Paper 3: https://ieeexplore.ieee.org/document/9830849

Statistics:

Due to the many application domains for smart gloves, there have been a variety of innovative approaches to capturing postural or force information. These include research and commercial devices based on strain, capacitance, and piezoresistance. For example, stretchable electronics can provide high-resolution strain sensing and small soft capacitive sensors can detect micro-gestures from small postural changes. Combining such techniques with learning pipelines can yield capable systems; neural networks can accurately reconstruct hand poses based on capacitive sensing , or identify grasp types and modalities from a high-resolution knitted piezoresistive glove. Multiple modalities can also aid hand gesture classification, such as by combining muscle activity with pressure-sensitive arrays or with soft electronics that measure strain and pressure . Commercial gloves such as the Manus system bcan also provide high-fidelity pose information for virtual reality or other applications, although they are typically expensive and require intricate electronics.

Architecture:

1)Sensorizing a commercially available strain-sensitive glove for ease of fabrication and adding an accelerometer, to capture both hand pose and gesture information
2)Developing a neural network pipeline to detect time-series events, which is pre-trained and then embedded on a microcontroller to run in real time.
3)Preliminary experiments using a vocabulary of 24 ASL words and letters, including static and dynamic gestures
4) Classification performance results evaluated on unseen

sessions of wearing the glove, using offline segmented examples or online rolling predictions.

Data parameter:

Glove Sensorization, Electronics Design, TRAINING DATA COLLECTION.

Methodology:

This paper presents a wearable smart glove that utilizes a strain-sensitive resistive knit for postural information and an accelerometer for motion. A small custom PCB and a micro-controller read sensors, perform feature extraction, and run a pre-trained neural network. The system is used to classify sign language poses and gestures in real time.

Result:

Online results were obtained by performing each gesture 10 times and observing the streaming classifica-tions. Prior to the experiment, the user could briefly practice each gesture while watching the output. Future evaluations can be more comprehensive, but the current study was designed to demonstrate that the embedded system can successfully im-plement the pipeline and validate the leave-one-experiment-out simulated streaming results.

Paper-4: https://pubmed.ncbi.nlm.nih.gov/34508076/

Statistics:

Significantly, the segmentation approach splits entire sentence signals into word units. Then the deep learning model recognizes all word elements andreversely reconstructs and recognizes sentences. Furthermore, new/never-seen sentences created by new-order word elements recombination can be recognized with an average correct rate of 86.67%.

Architecture:

- Data processing modules handle the preprocessing, filtering, and normalization of sensor data from the smart gloves.
- Integration modules combine the outputs of the gesture recognition system with the VR communication platform, facilitating seamless interaction between the two components.
- Real-time data processing capabilities ensure low-latency communication and responsive interaction within the VR environment.
- This component utilizes advanced artificial intelligence techniques to enhance sign language recognition accuracy and adaptability.

- Deep learning models may be trained on large datasets of sign language gestures to improve recognition performance.
- Natural language processing (NLP) techniques may be applied to convert recognized gestures into textual or spoken output for communication purposes.

Data Parameter:

Hand Movement Data:

- Sensor data capturing hand movements in three-dimensional space.
- Parameters such as hand position, orientation, velocity, and acceleration.

Finger Movement Data:

- Sensor data detecting movements of individual fingers.
- Parameters include finger flexion/extension, abduction/adduction, and rotation.

Gestural Data:

- Patterns of hand and finger movements forming specific sign language gestures.
- Data on the sequence, duration, and intensity of gestures.

Triboelectric Signal Data:

- Electrical signals generated by the triboelectric smart glove in response to mechanical stimulation.
- Parameters such as voltage, current, frequency, and amplitude of the signals.

Training Data for Machine Learning Models:

- Labeled datasets of sign language gestures for training machine learning algorithms.
- Data pairs consisting of sensor readings from the smart glove and corresponding linguistic symbols or commands.

Virtual Environment Interaction Data:

- User interactions with virtual objects and elements within the VR space.
- Data on object manipulation, navigation, and communication actions.

Haptic Feedback Data:

- Feedback signals provided to the user through haptic actuators in the smart glove.
- Parameters describing the intensity, duration, and type of haptic feedback delivered.

Communication Data:

- Textual or spoken output generated from recognized sign language gestures.
- Data on translated messages, including text strings or audio files.

User Feedback Data:

- Feedback from users regarding system performance, accuracy, and usability.
- Data on user preferences, comfort levels, and suggestions for improvement.

Environmental Data:

- Environmental factors that may affect sensor readings and system operation.

- Parameters such as ambient temperature, humidity, and lighting conditions.

Methodology:

The methodology for implementing an AI-enabled sign language recognition system and VR space bidirectional communication using a triboelectric smart glove involves several systematic steps. Firstly, thorough requirement analysis is conducted to understand the specific needs and objectives of the system, considering the target users, applications, and technical constraints. Following this, a comprehensive literature review is conducted to gather insights from existing research and technologies related to sign language recognition, VR communication systems, triboelectric sensors, and machine learning algorithms.

Next, suitable sensors are selected and integrated into the design of the triboelectric smart glove, ensuring proper placement and calibration for accurate gesture detection. Data collection protocols are established to collect labeled datasets of sign language gestures using the smart glove, and machine learning models, such as convolutional neural networks (CNNs) or recurrent neural networks (RNNs), are developed and trained using this data to recognize gestures in real-time.

Simultaneously, a virtual reality environment is designed and developed for bidirectional communication, incorporating interactive elements and communication interfaces. This includes implementing VR rendering techniques to create immersive visual and auditory experiences. Subsequently, the sign language recognition module is integrated with the VR communication platform to enable real-time interpretation of gestures and communication within the virtual environment.

Usability testing is conducted with target users to evaluate the performance and user experience of the system, gathering feedback on accuracy, responsiveness, ease of use, and overall satisfaction. Based on this feedback, the system is optimized and refined, including fine-tuning machine learning models, optimizing algorithms, and improving data processing pipelines.

Once optimized, the system is deployed for real-world use, ensuring compatibility, scalability, and maintenance considerations are addressed. Documentation, training, and support are provided to users to facilitate successful adoption and usage of the system. Continuous monitoring and gathering of user feedback enable ongoing improvement and refinement, with updates, patches, and new features incorporated based on user needs and technological advancements. Through this methodology, an inclusive and immersive communication experience for individuals with hearing impairments is achieved.

Result:

Sign language recognition and translation are of great significance to remove the communication barrier between the speech/hearing impaired and the general public. Nowadays, wearable HMIs are emerging as an innovative assistive platform to implement direct, conformable hand motion measurement.