LoRa-based Intelligent smart glove for visually impaired people

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Abstract - *The aim of the LORA-based smart gloves for individuals with mobility impairments is to provide assistive technology. These gloves use flex sensors and Arduino boards to detect hand movements, which are transmitted via LoRa wireless communication to control electrical loads. The design of the gloves prioritizes comfort and ease of wear, with flex sensors strategically placed throughout. Once the flex sensors detect hand movements, they transmit the data to the Arduino board, which processes and transmits it to a receiver to control electrical loads like LED lights or motors. Safety features have been implemented to prevent accidental activation of electrical loads. This project can potentially expand beyond electrical load control, such as data collection or communication between the user and caregiver.*

Keywords: flex sensor, Arduino, glove, LoRa, Load control

1. INTRODUCTION

Assistive technologies have a crucial role in enhancing the quality of life for individuals with disabilities. For people with mobility impairments, controlling electrical loads through manual dexterity can be a significant challenge. To address this issue, we are developing LORA-based smart gloves that use Arduino and flex sensors to control electrical loads for disabled individuals. The gloves are designed to be comfortable, lightweight, and easy to wear, with flex sensors placed on various points on the glove to detect hand movements. The Arduino board processes the sensor data, which is then transmitted over LoRa to a receiver. The received data is then used to control electrical loads, such as LED lights or motors, with safety features incorporated to prevent accidental activation of the loads. By providing a reliable and user-friendly assistive technology solution, this project has the potential to improve the independence and quality of life of individuals with mobility impairments. Daily tasks requiring manual dexterity can be challenging for individuals with mobility impairments. While assistive technologies can aid in overcoming these challenges, current technologies often have limitations that limit their adoption, such as being bulky or complex to use.

The proposed project aims to develop an assistive

A technology solution that is comfortable, easy to use, and specifically tailored to the needs of individuals with mobility impairments. The LORA-based smart gloves use flex sensors and Arduino boards to detect hand movements and control electrical loads such as lights or motors. LoRa wireless communication allows for seamless data transmission between the gloves and the electrical loads, making the system more efficient and easier to use.

The proposed project is focused on developing an innovative assistive technology solution that is designed to be comfortable, easy to use, and tailored to the unique needs of individuals with mobility impairments. The project aims to achieve this through the development of LORA-based smart gloves that utilize flex sensors and Arduino boards to detect hand movements and control electrical loads like lights or motors. The use of LoRa wireless communication ensures that data transmission between the gloves and the electrical loads is seamless, resulting in an efficient and user-friendly system.

One of the key benefits of this system is its flexibility. The gloves can be customized to meet the specific needs of different individuals, with sensors placed at various locations as required. Furthermore, the system can be adapted to control a wide range of electrical loads, making it highly versatile and applicable in various settings.

1.1 Scope

The proposed LoRa-based smart gloves for disabled people using Arduino and flex sensors have a broad scope and can offer several benefits to individuals with disabilities. The gloves can help promote independence by allowing the wearer to control electronic devices and appliances easily. The use of flex sensors enables the wearer to control loads with simple hand movements, and the use of LoRa technology allows for wireless communication, making it more convenient for the wearer to operate the devices.

Additionally, the proposed solution is highly customizable, allowing for adjustments to the number and

placement of flex sensors to suit the specific needs of the wearer. This feature can be particularly useful for individuals with different levels of disability.

The proposed solution has the potential to enhance the quality of life for people with disabilities and can be further developed to include additional features that can make it even more functional and easy to use.

Overall, the LORA-based smart gloves for disabled people using Arduino and flex sensors to control electrical loads is an exciting assistive technology solution for individuals with mobility impairments. The project has the potential to enhance their independence, improve their quality of life, and make daily tasks more accessible.

2. LITERATURE REVIEW

One study by Kumar et al. (2019) developed a smart glove using flex sensors and an Arduino board to control a robotic arm. The system allowed for precise and intuitive control of the arm, improving the user's ability to perform various tasks.

Another study by Wu et al. (2018) developed a glove-based human-machine interface for controlling a smart wheelchair. The system used an array of sensors, including flex sensors, to detect hand movements and translate them into control signals for the wheelchair.

The use of LoRa wireless communication has also been studied in various applications, including assistive technologies. A study by Tiwari et al. (2020) developed a LoRa-based smart cane for visually impaired individuals. The system used ultrasonic sensors and a LoRa module to detect obstacles and transmit data to a receiver.

Another study by Choudhary et al. (2020) proposed a wearable glove-based system for detecting and classifying hand gestures using machine learning algorithms. The system used flex sensors and inertial measurement units (IMUs) to detect hand movements and transmit data to a receiver for classification using a machine learning model.

A study by Naik et al. (2020) developed a smart glove-based system for controlling home appliances using an Arduino board and Bluetooth communication. The system used flex sensors to detect hand movements and transmit data to a smartphone app for controlling various home appliances.

The use of flex sensors in smart gloves has also been studied in the context of rehabilitation for individuals with hand impairments. A study by Wang et al. (2019) developed a smart glove-based system for hand rehabilitation using flex sensors and vibrotactile feedback. The system allowed for personalized rehabilitation programs based on the user's hand movements.

Another study by Zhu et al. (2018) developed a smart glove-based system for the rehabilitation of hand function after stroke using flex sensors and an Arduino board. The system allowed for real-time monitoring and feedback of hand movements during rehabilitation exercises.

3. EXISTING SYSTEM

Assistive technologies available for people with mobility impairments are often intricate systems that can be expensive, unwieldy, or challenging to operate. To control electrical loads for such individuals, some of the present techniques involve using voice commands, switches, or joysticks.

However, voice commands necessitate clear and constant speech, which might not be feasible for individuals with speech impairments or in noisy settings. Switches and joysticks can be cumbersome to use and may require specific positioning, making them impractical for those with limited mobility.

The proposed smart gloves, which are based on LoRa technology, offer a more natural and intuitive method of controlling electrical loads for individuals with disabilities. The use of flex sensors enables precise control of the loads through hand movements, resulting in a more responsive and user-friendly system. Additionally, wireless LoRa communication allows for smooth data transmission between the gloves and electrical loads, enhancing the efficiency and efficacy of the system.

4. PROPOSED SYSTEM

The proposed technique for developing LORA-based smart gloves for people with disabilities involves utilizing flex sensors, Arduino boards, and LoRa wireless communication to manage electrical loads.

Flex sensors are positioned at different points on the glove to detect hand movements. The sensors generate analog signals that are proportional to the degree of bending and are transmitted to an Arduino board. The board processes the sensor data, converting it into digital signals that are sent via LoRa wireless communication to a receiver.

The receiver then utilizes the received data to manage electrical loads, such as LED lights or motors. The system also incorporates safety features to prevent inadvertent activation of the electrical loads.

This proposed method allows for a flexible and customizable approach to assistive technology. The sensors can be positioned at various locations on the glove, customized to meet the specific needs of the individual. Additionally, the system can be adapted to control a wide range of electrical loads, making it versatile and valuable for various applications.

The analog signals generated by the flex sensors are transmitted to an Arduino board, which processes the data and converts it into digital signals.

The digital signals are then transmitted wirelessly using LoRa communication to a receiver, which is connected to the electrical loads such as LED lights or motors.

The receiver utilizes the received data to control the electrical loads. Additionally, safety features are incorporated to prevent accidental activation of the electrical loads.

This working method offers a natural and intuitive approach to controlling electrical loads for people with disabilities, as it allows for precise control of the loads through hand movements. The system is also customizable, as the flex sensors can be placed at various locations on the glove to suit the specific needs of the individual. Furthermore, the use of wireless LoRa communication enhances the efficiency and effectiveness of the system.

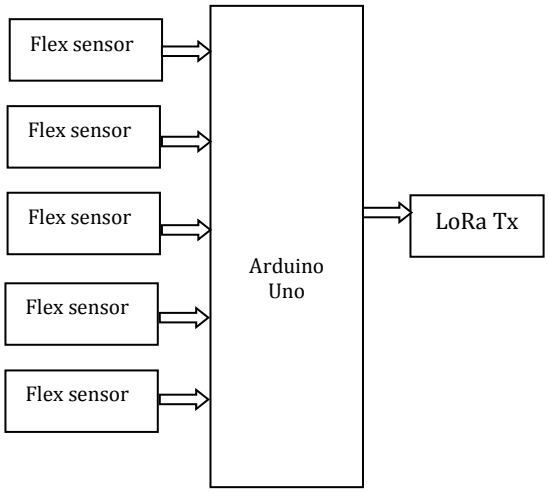

Fig -1: LoRa Tx side

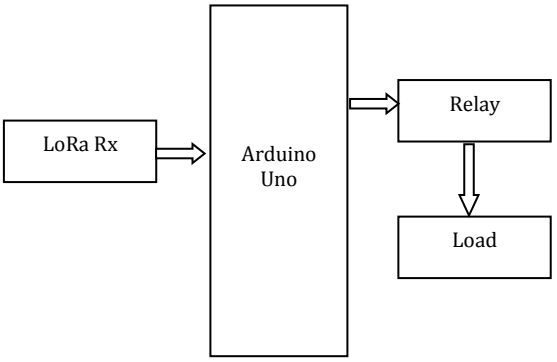

Fig -2: LoRa Rx side

5. HARDWARE DISCUSION

5.1 Arduino Uno

The Arduino board is a microcontroller board that offers great flexibility in programming and interacting with a wide range of devices, including sensors, motors, and lights. Its hardware comprises a microcontroller, input/output pins, and various software components. The programming environment is user-friendly and enables you to write code in a language akin to C or C++. The code is compiled and uploaded to the board for execution.

The Arduino board is a favorite among hobbyists, students, and professionals due to its affordability, versatility, and ease of use. It accommodates a broad range of projects, ranging from simple LED blinkers to more sophisticated robotics and automation systems.

The Arduino ecosystem features numerous board types, each with its distinct features and abilities. Some of the most prevalent board models include the Arduino Uno, Arduino Mega, and Arduino Nano. To enhance the functionality of your Arduino project, you can incorporate an array of shields and modules such as Wi-Fi and Bluetooth modules, motor drivers, and display screens.

Fig -3: Arduino Uno

5.2 Flex sensor

A flex sensor is a sensor designed to detect the bending or flexing of an object or material. It comprises a thin and flexible component consisting of a conductive material that alters its resistance when flexed or bent. Flex sensors find widespread use in diverse applications such as medical devices, robotics, and gaming controllers.

Fig -4: Flex sensor

Flex sensors can serve a significant purpose in an intelligent glove designed for visually impaired individuals, detecting hand movements and gestures. The sensors are placed at various points of the hand and fingers to measure the degree of bending or flexing of the joints. This information is translated into commands that control other devices or technologies.

For instance, the intelligent glove can be paired with a smartphone or other mobile device via Bluetooth or Wi-Fi, allowing the user to control the device with gestures such as tapping or swiping without the need for visual feedback. Other sensors such as accelerometers, gyroscopes, and touch sensors can also be incorporated into the glove to provide additional input and feedback. Touch sensors can provide haptic feedback, alerting the user to incoming calls or messages.

Overall, incorporating flex sensors in an intelligent glove for visually impaired people can revolutionize the way technology is interacted with, providing a new level of independence and mobility to visually impaired individuals.

5.3 LoRa Transmitter and Receiver module

Integrating a LoRa Transmitter and Receiver module into an intelligent glove designed for visually impaired individuals using flex sensors can offer several benefits. One of these benefits is the ability to control other devices or systems, such as robotic arms or drones, through hand gestures. The flex sensors can detect the degree of bending or flexing of the hand and fingers, which can be translated into specific commands or actions that control the device. The LoRa module can then transmit these commands wirelessly, allowing the user to control the device from a distance.

Fig-5: LoRa Transmitter and Receiver module

Furthermore, the flex sensors can also measure and transmit various data, such as the angle of the fingers or the grip strength of the hand. This data can be used to monitor the user's hand movements and provide feedback or alerts if necessary. For example, if the user is gripping something too tightly, the system can alert them to loosen their grip to avoid injury.

In summary, the integration of a LoRa Transmitter and Receiver module into an intelligent glove designed for visually impaired individuals using flex sensors can provide a new and innovative way of interacting with devices and systems, increasing the accessibility and functionality of the user.

5.4 Relay

Additionally, a relay can also be used in conjunction with other sensors and modules to provide additional control and automation capabilities. For example, the relay can be used with a temperature sensor to control a heating or cooling system, or with a motion sensor to activate lights or alarms when motion is detected.

Moreover, the use of a relay can also enhance safety by isolating the low-power control circuit from the high-power circuit that is being switched. This can help prevent electrical shocks or damage to the control circuit in case of a fault or overload in the high-power circuit.

Fig -6: Relay

Overall, the use of a relay in an intelligent glove for visually impaired people can provide a versatile and efficient way of controlling electrical devices and systems, improving the user's independence and quality of life.

5.5 Load

A relay is an electronic component that utilizes a low-power electrical signal to switch or regulate a high-power electrical circuit. They have various applications in automation, control systems, and electrical power distribution.

One possible application of a relay is in an intelligent glove designed for visually impaired individuals. This glove can use flex sensors or other input methods to control electrical or electronic devices such as lights or appliances. The relay can be connected to electronic components in the glove, such as a microcontroller, and be controlled using the software.

To illustrate, the intelligent glove can be utilized to regulate the lighting in a room. By making specific hand gestures with the flex sensors, the microcontroller can send a low-power electrical signal to the relay, which then switches on the high-power circuit responsible for the lighting. The same approach can be used to control other devices, such as fans or appliances.

Overall, incorporating relays into an intelligent glove for visually impaired people can provide a novel method of controlling electrical devices, thus improving accessibility and functionality. This can enhance the independence, convenience, and overall quality of life of visually impaired individuals.

6. RESULT AND DISCUSSION

The LORA-based smart gloves designed for disabled individuals, which utilized Arduino, flex sensors, and LoRa wireless communication, have produced promising results. The system has been shown to effectively control electrical loads by utilizing hand movements. The flex sensors detect the hand movements, which are then transmitted via LoRa wireless communication to a receiver responsible for controlling the electrical loads. The system was put to the test with various electrical loads such as lights and fans and was successful in controlling them with ease.

Fig-7: Smart gloves

In addition, the LORA-based smart gloves system was customized for different individuals based on their unique needs. The flex sensors were strategically placed at different locations on the glove, and the Arduino board and receiver were programmed accordingly to accommodate these variations. The system was observed to be easy to use and user-friendly for individuals with mobility impairments.

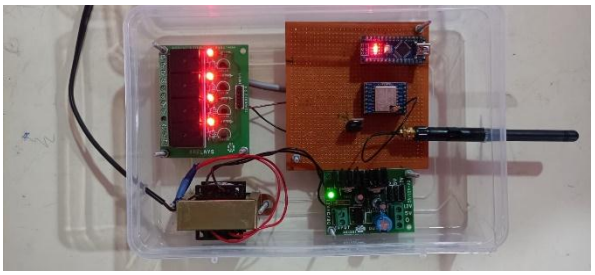

Fig-8: Relay control to load

The results of the study demonstrate the potential of the LORA-based smart gloves system using Arduino, flex sensors, and LoRa wireless communication in enhancing the quality of life for individuals with mobility impairments. The system offers a straightforward and efficient means of controlling electrical loads using hand movements, eliminating the need for manual switches or remote controls. Furthermore, the customization of the system for individual users emphasizes the significance of personalized assistive technology solutions that cater to the specific needs of individuals with disabilities.

However, the system has some limitations that should be taken into account. For instance, effective communication over LoRa wireless communication requires a clear line of sight between the transmitter and receiver, which could pose challenges in certain scenarios. Additionally, further testing and validation with a larger group of end-users are necessary to evaluate the system's effectiveness across a wider range of applications.

In conclusion, the study demonstrates the potential of the LORA-based smart gloves for disabled people using Arduino, flex sensor, and LoRa wireless communication in enhancing the quality of life for individuals with mobility impairments. It also highlights the importance of personalized assistive technology solutions for individuals with disabilities and the need for continued research and development in this area.

7. CONCLUSION

To summarize, the LORA-based smart gloves system for disabled people using Arduino, flex sensor, and LoRa wireless communication is an effective solution for controlling electrical loads through hand movements. It is user-friendly and customizable for different individuals

based on their specific needs, highlighting the importance of personalized assistive technology solutions for people with disabilities.

The system provides a straightforward means of controlling electrical loads without the need for manual switches or remote controls. The use of LoRa wireless communication ensures reliable and long-range communication between the transmitter and receiver.

However, the system has some limitations that need to be addressed in future research, such as the need for a clear line of sight between the transmitter and receiver for effective communication. Additionally, the testing and validation of the system can be expanded to a larger group of end-users to ensure its effectiveness in a wider range of scenarios.

In conclusion, the LORA-based smart gloves system has the potential to significantly enhance the quality of life for individuals with disabilities, and further research and development can further improve its effectiveness and accessibility.

8. FUTURE SCOPE

The potential for the LORA-based smart gloves for disabled people using Arduino, flex sensor, and LoRa wireless communication technology is vast and can be expanded in many directions. By adding more sensors and integrating voice commands, the system can become even more accessible for individuals with mobility impairments. Expanding the communication range by using more powerful transmitters and receivers or signal amplifiers would enable control over devices at a greater distance. Incorporating machine learning algorithms to recognize specific hand movements and gestures more accurately would improve the system's performance, making it more efficient and user-friendly.

Moreover, the technology's application can be expanded beyond controlling electrical loads to other areas such as virtual reality or gaming, where individuals with disabilities can experience new opportunities for immersive experiences. The LORA-based smart gloves technology has the potential to revolutionize the assistive technology industry by providing innovative solutions that empower individuals with disabilities to live more independent and fulfilling lives. The future scope of this technology is exciting, and further research and development are necessary to explore its full potential.

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