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Smart Glove for Paralyzed Patient

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A B S T R A C T

There are 14.9 million males and 11.9 million females with disabilities in India – accounting for 56 and 44 per cent of the total population. Person with Disabilities often have lower education accomplishments, poorer health conditions, higher poverty rates and less economic engagement than other people. Physically challenged patients or bed-ridden patients often have to rely on others to operate switches for light, fan, TV etc. Remote controls do help such people. But certain illnesses will not permit the patient to operate even a remote controller, due to lack of flexibility in the movement of the hands. Paralytic patients are a typical example. The solution for these people, would be a gesture-controlled device, worn on their hands, wherein with a small movement of the finger. Differentially able people need support of smart assistive devices, of which visually impaired people need at most care. There are several wearable devices and mobile apps to assist them.

Keywords: IOT, Smart glove, Paralyzed patient, Sensors.

1. Introduction

HA smart glove is a wearable device that can be worn on the hand and is designed to help paralyzed patients. These gloves use advanced technologies like sensors, microcontrollers, and artificial intelligence algorithms to interpret the movements of the patient's hand and fingers. The smart glove can then translate those movements into commands that can be used to control a range of devices, such as computers, smartphones, and even prosthetic limbs. For paralyzed patients, a smart glove can be a game-changer as it can give them greater independence and help them carry out daily tasks that would otherwise be impossible. By simply moving their hand and fingers, they can control a range of devices, communicate with others, and interact with their environment in a meaningful way. One of the key benefits of smart gloves is that they can be customized to suit the needs of individual patients. The sensors in the glove can be calibrated to detect even the slightest movements. This means that each patient can have a personalized glove that is tailored to their specific needs and abilities. Overall, smart gloves offer an exciting new technology for paralyzed patients, giving them a new level of independence and helping them to overcome some of the challenges of their condition. As the technology continues to advance, we can expect to see even more innovative and exciting applications for these devices in the future.

2. Methodology

2.1 Architecture

The smart glove for paralyzed patients is a device that uses an Arduino microcontroller as its main board. This microcontroller has both analog and digital pins, which are used to connect various input and output devices to it.

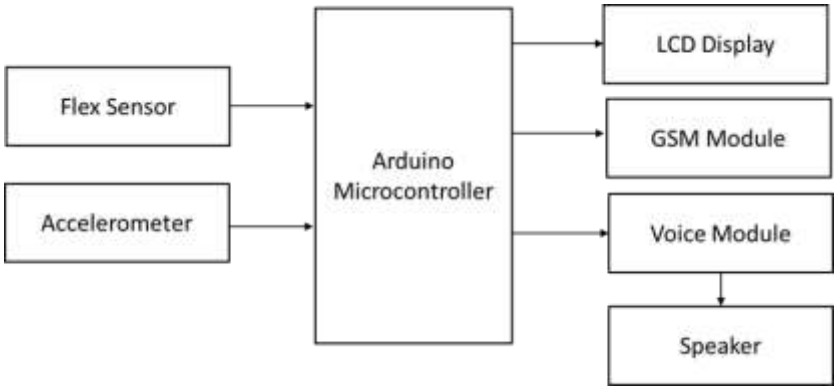

Fig 1: Methodology of Smart Glove

Fig 1 shows the architecture of Smart Glove. The glove is mounted with a flex sensor that can detect the movement of the fingers, allowing the patient to send input to the microcontroller by simply bending their finger. The smart glove also uses an accelerometer to recognize hand gestures and arm movements. This allows the device to perform predefined actions based on the input it receives from the sensors. For instance, if the patient falls, the accelerometer can detect the movement and send an alert message to the caretaker using a GSM module that is connected to the device.

The LCD display is another important component of the system that provides feedback to the user and displays the actions taken by the system. When the patient bends finger, for example, the LCD display can show a message confirming that the input has been detected and the corresponding action is being taken. Similarly, when an alert message is sent to a caretaker, the LCD display can show a message indicating that the message has been sent successful. The voice module and speaker are also useful components that can provide auditory feedback to the caretaker when an alert message is received. Overall, the smart glove system for paralyzed patients is a useful and innovative application of the Arduino microcontroller platform and various sensors and components.

2.2 Sequence Diagram

Sequence diagram defines the interactions and message flow between objects or components of a system.

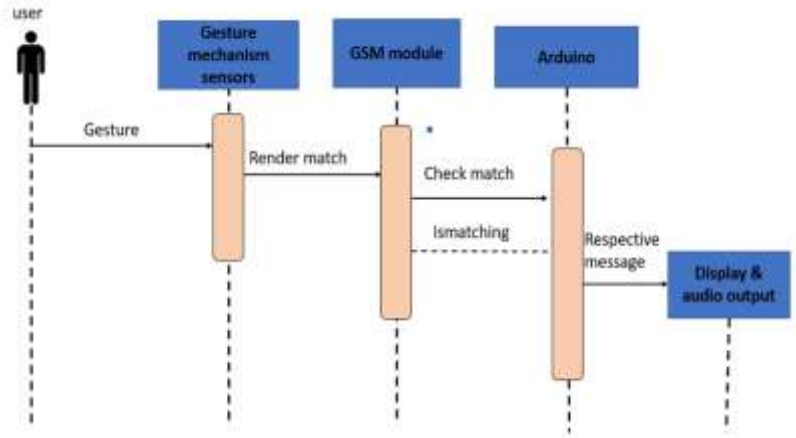

Fig 2 – Sequence diagram

The sequence diagram for our project is shown in Fig. 3.3. A sequence diagram is an interaction diagram that demonstrates the relationship and sequential order of processes. In the case of smart gloves for paralyzed patients, the sequence diagram can show the interaction between the user The smart gloves use sensors to detect the user's hand movements and send the data to the microcontroller and processes the data which renders the match and GSM module is mainly used for sending the SMS to pre fetched mobile number where it matches the pre stored data which is already stored in the microcontroller and then sends the output as a display and audio output.

2.3 Utilities

- **Arduino UNO :** The Arduino microcontroller is a popular platform used for building electronic devices and projects. It has many analog and digital pins that can be used to connect various input and output devices such as sensors, motors, LEDs, and more. The microcontroller is programmed using a special language and software that allows it to process inputs and generate outputs based on predefined rules or lgorithms. In the context of the smart glove for paralyzed patients, the microcontroller is the main board that controls the various components of the system.
- **Flex sensor:** A flex sensor is a type of sensor that changes its resistance when it is bent or flexed. It consists of a thin strip of material with conductive elements, which change their distance and orientation when the sensor is bent. This change in distance and orientation alters the resistance of the conductive elements, providing a measure of the degree of bend. Flex sensors are commonly used in wearable devices, such as smart gloves, to detect the movement of fingers or other body parts and to control electronic devices or prosthetic limbs..
- **GSM Module:** A GSM module is a type of device that enables communication over a GSM network. GSM stands for Global System for Mobile communications and is the most widely used mobile communication standard in the world. A GSM module typically consists of a SIM card slot, a radio module, and an interface to connect to other devices. With a GSM module, it is possible to send and receive SMS messages, make and receive phone calls, and access the internet using a mobile data connection. GSM modules are commonly used in a wide range of applications, such as remote monitoring, tracking, and control.
- **Accelerometer:** An accelerometer is a type of sensor that measures acceleration, which is the rate of change of velocity over time. Accelerometers can be used to measure linear acceleration, such as the acceleration of a vehicle, or angular acceleration, such as the rotation of an object around an axis. An accelerometer typically consists of a sensing element, which responds to changes in acceleration, and an

electronic circuit, which converts the sensor output into a measurable signal. Accelerometers are commonly used in a wide range of applications, such as motion sensing, vibration analysis, and inertial navigation systems. In the context of a smart glove, an accelerometer can be used to detect the movement of the hand and the arm, enabling gesture recognition and fall detection.

- **LCD Display:** An LCD display is a type of electronic display that uses liquid crystals to modulate the light passing through them. LCD displays are commonly used in a wide range of devices, such as calculators, watches, and televisions. An LCD display typically consists of a layer of liquid crystals sandwiched between two polarizing filters, with electrodes at the edges of the layers. When an electric field is applied to the electrodes, the liquid crystals align themselves and change the polarization of the light passing through them, producing the desired image or text. In the context of a smart glove, an LCD display can be used to show the actions taken by the system, such as the recognition of a gesture or the sending of an alert message.
- **Voice module:** A voice module is an electronic device that allows a microcontroller or other digital device to produce and playback pre-recorded sounds, voices or music. It typically includes a built-in amplifier, speaker and memory chip or storage device for storing the recorded audio files. The voice module can be programmed to play specific audio files in response to certain triggers or inputs, such as button presses, sensor readings or other events. Voice modules are often used in electronic devices where pre-recorded audio feedback or prompts are required, such as in alarm systems, toys, musical instruments, and home automation systems.

2.4 Software tools used

- **Arduino IDE:** The Arduino Integrated Development Environment (IDE) is a software application used to write, compile, and upload code to Arduino microcontroller boards. The Arduino IDE provides an easy-to-use interface for programming Arduino boards, and it is available for Windows, Mac OS X, and Linux operating systems. The IDE is based on the Processing programming language and includes a code editor, a compiler, a linker, and a serial monitor. It also includes a library manager, which allows users to easily add third-party libraries to their projects. The Arduino IDE supports a simplified version of the C++ programming language, which is easy to learn even for beginners with no programming experience. The code is uploaded to the Arduino board through a USB port or another type of serial connection. The Arduino IDE is an open-source project, and its source code is available on GitHub for anyone to modify and contribute to. The Arduino community has created a vast number of libraries and examples, which can be accessed through the Arduino IDE's Library Manager.
- **Embedded C Programming:** Embedded C language can be used for programming Arduino boards using the Arduino IDE. It involves working with the hardware resources of the board, such as digital and analog input/output pins, timers, and interrupts. To interact with these hardware resources, you can use the Arduino language and library functions, which provide an abstraction layer over the low-level hardware details. However, if you want to work directly with the hardware resources of the Arduino board, you can use embedded C code to interact with the hardware at a lower level. This requires an understanding of the specific hardware architecture of the Arduino board being used, as well as the C programming language and the specific libraries and functions provided by the Arduino IDE. Overall, Embedded C language can be used for programming Arduino boards, but it requires a strong understanding of the hardware and software being used. There are many resources available online for learning embedded C programming for Arduino boards, including tutorials, books, and online courses.

3. Results

Snap shots of the project

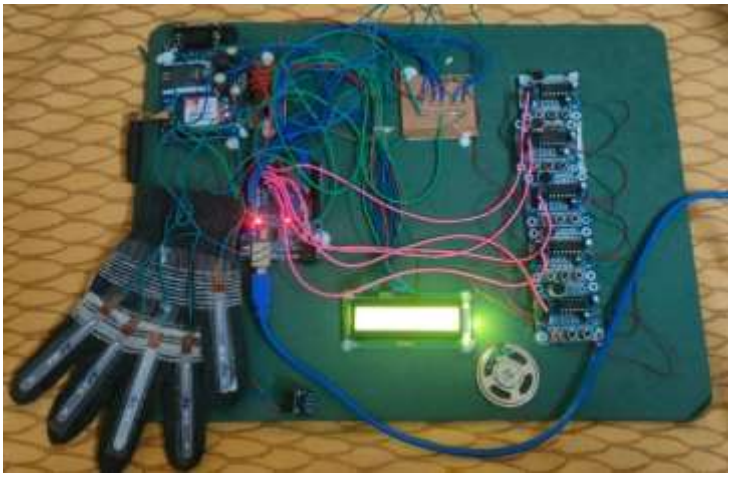

Fig 6.1 Smart glove Project

Fig 6.1 shows the project smart glove where all the components are mounted on a Board.

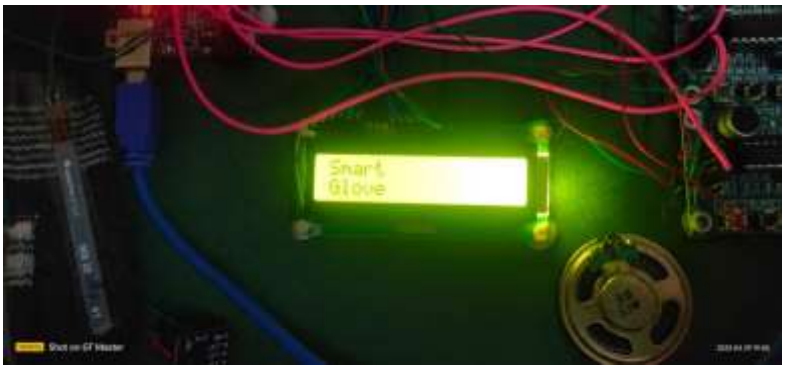

Fig 6.2 LCD Output

Fig 6.2 shows the lcd display, where all the instructions will be displayed

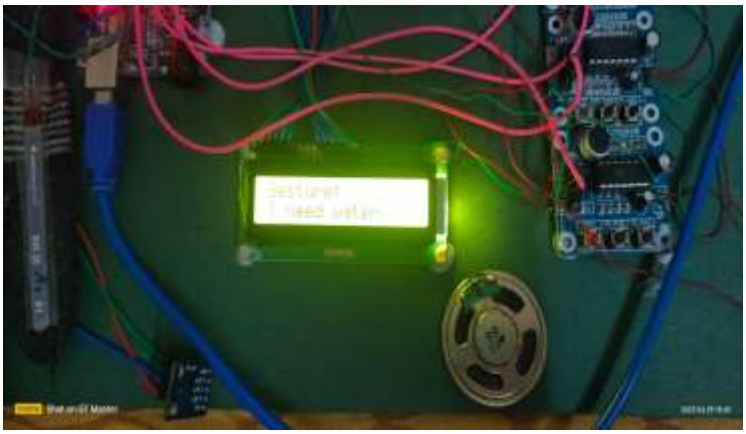

Fig 6.3 LCD Output Instruction 1

Fig 6.3 shows the output instruction ‘I need water’ on lcd when the patient bends thumb finger.

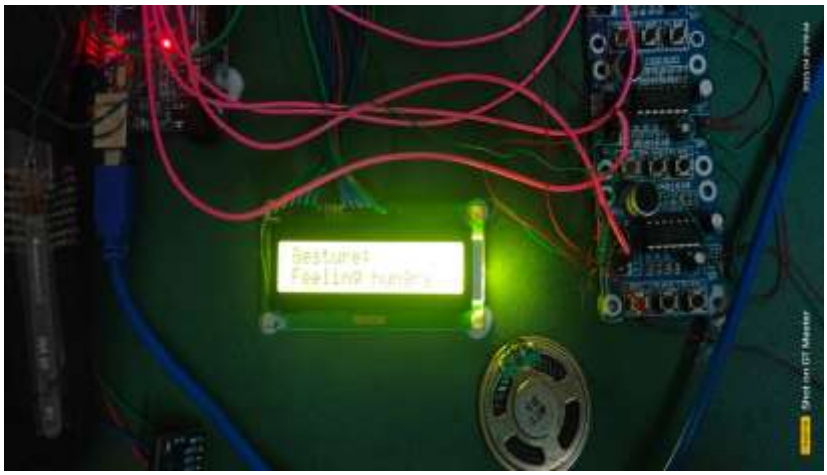

Fig 6.4 LCD Output Instruction 2

Fig 6.4 shows the output instruction ‘Feeling Hungry’ on lcd when the patient bends index finger.

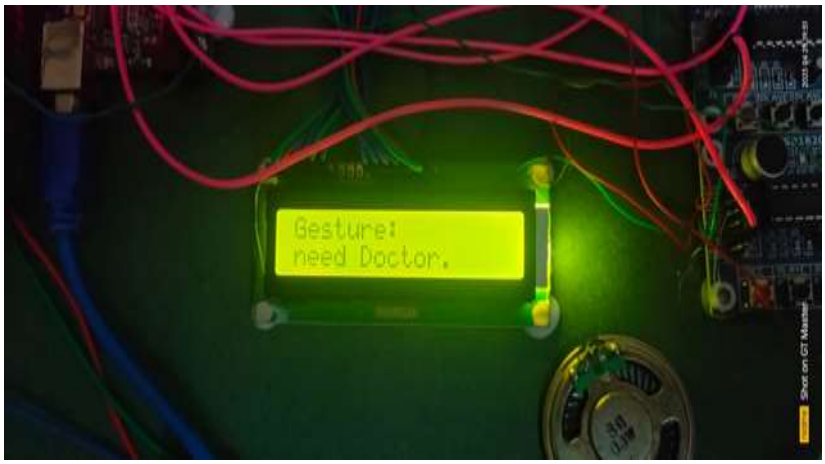

Fig 6.5 LCD Output Instruction 3

Fig 6.5 shows the output instruction ‘Need Doctor’ on lcd when the patient bends middle finger.

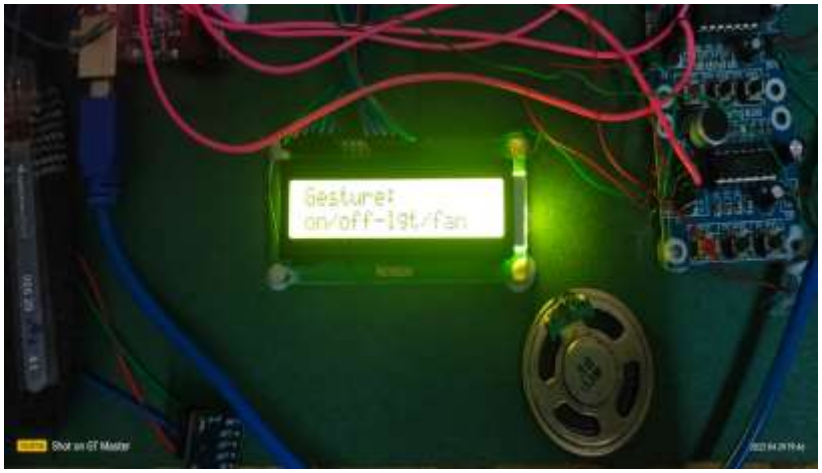

Fig 6.6 LCD Output Instruction 4

Fig 6.6 shows the output instruction ‘On/off-light/fan’ on lcd when the patient bends ring finger.

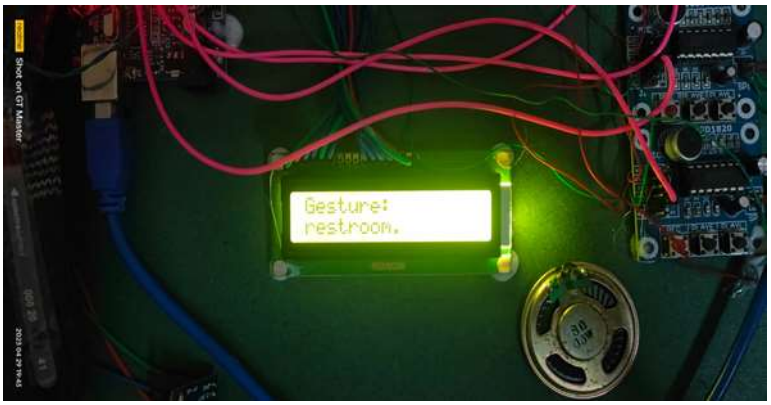

Fig 6.7 LCD Output Instruction 5

Fig 6.7 shows the output instruction ‘Restroom’ on lcd when the patient bends little finger.

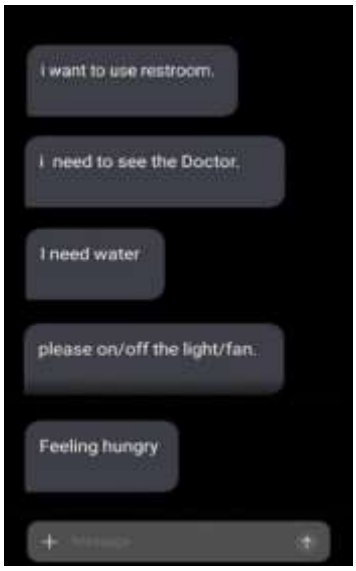

Fig 6.8 Output of Instruction through SMS 1

Fig 6.8 shows the output of all instruction on caretaker phone through sms.

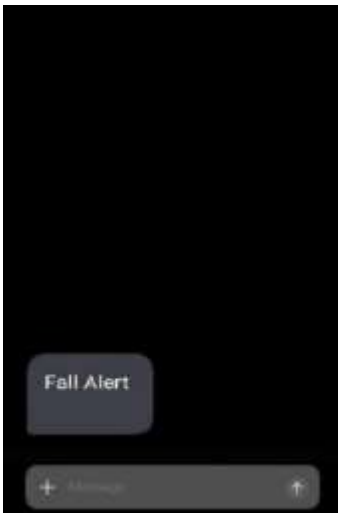

Fig 6.9 Output of Instruction through SMS 2

Fig 6.9 shows the output for accelerometer sensor which sends fall alert to caretaker when there is a sudden movement from patient.

4. Conclusion

In conclusion, a smart glove for paralysed people can have a significant positive impact on their quality of life and rehabilitation. A smart glove can assist patients in enhancing their range of motion, grip strength, and other functional abilities by tracking hand and finger movements, delivering rehabilitative exercise advice, monitoring vital signs, providing real-time feedback, and enabling configurable settings. Additionally, the remote control feature can allow therapists to change settings while working remotely, and data tracking and analysis can be used to monitor a patient's development over time. Overall, a paralysed patient's quality of life can be greatly enhanced by a smart glove, which has the potential to be an important instrument in the rehabilitation process.

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