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SMART GLOVES FOR DISABLED PEOPLE

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Abstract- Each year, new technologies rise and fall, sometimes making an impact on our daily lives and other times barely leaving a trace. One category of emerging technologies that has the widest variety is the Internet of Things or IoT. IoT is regarded as hard-core for integrating various sensors, microcontrollers and all sorts of communication protocols and lays the foundation for futuristic communication standard i.e. Human-Things Interaction. Taking huge leaps in technologies with each passing year, the humans are making smart inventions every year to help themselves and for the ones who are affected by any disability.
Arduino is a microcontroller for building digital devices and interactive objects that can sense and control objects in the physical and digital world. Arduino board designs use a variety of microprocessors and controllers.
The proposed work aims to solve the daily challenges faced by the people, who are unable to speak (dumb) or one who has recently undergone an accident and is unable to speak. It can also be used by elderly people, who find difficulty in speaking. With this wearable smart glove, dumb people or patient can easily communicate by just tapping the points on the glove by their thumb that results in 12 different commands that are both audible audio and image on any Android smartphone via an app. This can also be used in automation of day to day things like home appliances and many more.

Keywords - Smart Gloves, Microcontroller, IoT, Arduino Nano, Mobile App

I. INTRODUCTION

The Internet of things (IoT) is the network of devices, vehicles, and home appliances that contain electronics, software, actuators, and connectivity which allows these things to connect, interact and exchange data. IoT involves extending Internet connectivity beyond standard devices, such as desktops, laptops, smartphones and tablets, to any range of traditionally dumb or non-internet-enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the Internet, and they can be remotely monitored and controlled.

One key application of IoT is to provide assistance for those with disabilities and elderly individuals. These smart systems use assistive technology to accommodate an owner's specific disabilities. Voice control can assist users with sight and mobility limitations while alert systems can be connected directly to cochlear implants worn by hearing impaired users. They can also be equipped with additional safety features. These features can include sensors that monitor for medical emergencies such as falls or seizures.

Arduino is a microcontroller for building digital devices and interactive objects that can sense and control objects in the physical and digital world. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project. As part of the development process, mobile user interface (UI) design is also essential in the creation of mobile apps. Mobile UI considers constraints, contexts, screen, input, and mobility as outlines for design. The user is often the focus of interaction with their device, and the interface entails components of both hardware and software. User input allows for the users to manipulate a system, and device's output allows the system to indicate the effects of the users' manipulation. Mobile UI design constraints include limited attention and form factors, such as a mobile device's screen size for a user's hand(s). Mobile UI contexts signal cues from user activity, such as location and scheduling that can be shown from user interactions within a mobile app. Overall, mobile UI design's goal is mainly for an understandable, user-friendly interface. The UI of

mobile apps should: consider users' limited attention, minimize keystrokes, and be task-oriented with a minimum set of functions. This functionality is supported by mobile enterprise application platforms or integrated development environments (IDEs).

All these technologies are the leading pioneer in a creating a smart society that makes everyday task simple for humans. Combining these three technologies can provide great services to the disabled people in the community.

The proposed system uses Arduino Nano based microcontroller as the core controlling component. The proposed system is a hand glove that comprises of Arduino Nano, Bluetooth module, conducting metal contacts and wires. With this wearable smart glove, dumb people or patient can easily communicate by just tapping the points on the glove by their thumb that results in 12 different commands that are both audible audio and image on any Android smartphone via an app.

The proposed system's objective is to solve the daily challenges faced by the people, who are unable to speak (dumb) or one who has recently undergone an accident and is unable to speak. It can also be used by elderly people, who find difficulty in speaking. Solves the issues of those people, who cannot learn or are unable to use 'sign language' to communicate with others by providing them a 'virtual voice'. This wearable glove is both affordable and feasible. It is easy to wear and customizable according to one's need. Can be used by people of any age group and also illiterate.

II. RELATED WORK

- **Automated Sign Language Interpreter**

Taking huge leaps in technologies with each passing year, the humans are making smart inventions every year to help themselves and for the ones who are affected by any disability. The project aims to make the communication for dumb people easy and hence proposing a sign interpreter, which automatically converts sign language into audio output. For the dumb people, sign language is the only way of communication. With the help of sign language, physically impaired people express their thoughts to the other people. It is difficult for common people to understand the specific sign language therefore communication becomes difficult. The sign language recognition has become an empirical task, as it consists of various movements and gesture of the hands and therefore getting the right accuracy at a low-cost is a mammoth task. Instrumented gloves with audio out are the solution to this problem. The gloves attached with various sensors are worn for sign interpretation. Hence, the proposed system solves the problem and helps the dumb people in communication with the rest of the world at low cost.

- **Smart gloves for hand gesture recognition: Sign language to speech conversion system**

The idea proposed in this paper is a smart glove which can convert sign language to speech output. The glove is embedded with flex sensors and an Inertial Measurement Unit (IMU) to recognize the gesture. A novel method of State Estimation has been developed to track the motion of hand in three dimensional spaces. The prototype was tested for its feasibility in converting Indian Sign Language to voice output. Though the glove is intended for sign language to speech conversion, it is a multipurpose glove and finds its applications in gaming, robotics and medical field.

- **Smart glove for Sign Language communications**

Human beings have a natural ability to see, listen and interact with their external environment. Unfortunately, there are some people who are differently abled and do not have the ability to use their senses to the best extent possible. Such people depend on other means of communication like sign language. This presents a major roadblock for people in the deaf and dumb communities when they try to engage in interaction with others, especially in their educational, social and professional environments. Therefore, it is necessary to have an advance gesture recognition or sign language detection system to bridge this communication gap. Here an effort has been made to develop a smart glove using Intel Galileo Gen 2 IoT kit for real-time gesture recognition. The objective is to create a device which helps the hearing or speech impaired persons to communicate with others.

- **Smart glove with gesture recognition ability for the hearing and speech impaired**

The primary goal of this paper is to design and implement a low cost wired interactive glove, interfaced with a computer running MATLAB or Octave, with a high degree of accuracy for gesture recognition. The glove maps the orientation of the hand and fingers with the help of bend sensors, Hall Effect sensors and an accelerometer. The data is then transmitted to a computer using automatic repeat request (ARQ) as an error controlling scheme. The system is modeled for the differently abled section of the society to help convert sign language to a more human understandable form such as textual messages.

III. PROPOSED WORK

The proposed system aims to solve the daily challenges faced by the people, who are unable to speak (dumb) or one who has recently undergone an accident and is unable to speak. It can also be used by

elderly people, who find difficulty in speaking. Solves the issues of those people, who cannot learn or are unable to use 'sign language' to communicate with others by providing them a 'virtual voice'. This wearable glove is both affordable and feasible. It is easy to wear and customizable according to one's need. Can be used by people of any age group and also illiterate.

The idea comprises of a wearable glove along with a microcontroller (Arduino Nano), Bluetooth module HC-05, some connecting wires, zero board and some metal contacts. The whole setup works with Android app via Bluetooth.

The proposed work has two main modules, the hardware module and the software module. The hardware module is further divided into three modules, input signal generation, Arduino processing, data transfer through bluetooth. The software module is divided into three modules, bluetooth connection, selection process, output display.

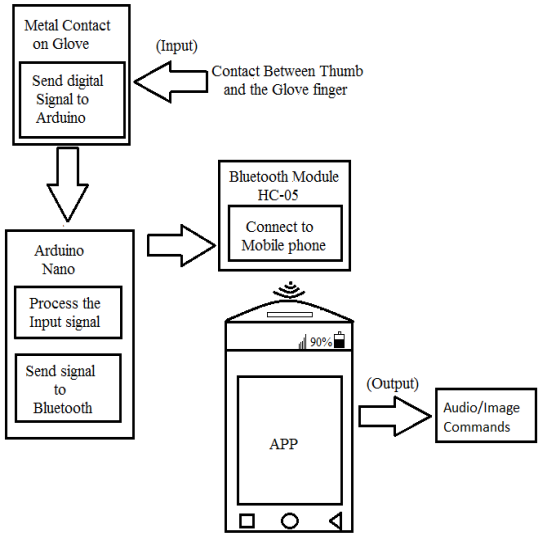

Fig. 1. Architecture diagram of the smart gloves for disabled people

As Figure 1 represents the primary input for the system is in the form of a simple touch. It is not complicated and requires only the thumb finger and the other finger with the required command (metal contact) to connect. Once This signal is sent to the microcontroller Arduino Nano there are two process that takes in the microcontroller.

The first process that takes place in the microcontroller once the microcontroller receives the signal is to determine the point of contact, i.e., determining which metal contact was touched to generate the signal.

The second process in the Arduino Nano microcontroller is to generate an appropriate data to be sent to the mobile application via the bluetooth module. For this the microcontroller has to identify the point of contact and then generate an appropriate signal or data and the send them to the bluetooth module.

Once these processes are completed the data is sent to the bluetooth module which is connected to the microcontroller. The bluetooth module has a transmitter and a receiver built in it. The bluetooth module thus send the information to the application via the connection established with mobile phone.

The mobile phone contains various ways with it can create a connection with another device but in this system the mobile phone uses the bluetooth facility to establish a connection with the device.

The application on the mobile device that connected with the device via bluetooth. The application receives the data from the microcontroller and uses this data to decide the command to be displayed.

The output generated is in two forms. The command selected is first displayed in image format and the same command is played as an audio using the media player of the mobile application.

The proposed system brings together microcontroller, bluetooth module and mobile application together to form an effective system to help the disabled people.

3.1 Hardware module

There are various components involved in the making of the hardware module of the proposed work. The following are the hardware requirements for the proposed work

- Wearable glove (any glove can be used either of rubber or cloth material)
- Microcontroller (Arduino Uno/Nano): It is going to be brain of the setup and will handle all task of processing the point of contacts and forwarding the signal to be send to Bluetooth module.
- Bluetooth module (HC-05): Will send the signal to the android device.
- Connecting wires and conducting metal contacts.
- Zero board for assembling all the component on a single board.

3.1.1 Input signal generation

The subject(dumb/patient) needs to wear this glove on his hand, the glove is compatible to any hand right or left. The user touches the metal contacts in the gloved finger when they want to communicate. There will be some conducting contacts on the fingers, one on the thumb and rest twelve on the other fingers i.e. three contacts on each of the other fingers. These contacts are connected to the input of the Arduino.

The metal contacts are any conducting metal that are able to conduct current. The metal contacts are used to close the circuit which sends a signal to the Arduino Nano microcontroller. There are 13 metal contacts used in the system. Twelve of the contacts are placed on the glove fingers, three per finger and the remaining one contact is placed on the thumb.

Once the thumb metal contact touches another metal contact in any finger the circuit will be closed.
The metal contact in the thumb of the glove is connected to this +5v pin. Rest of the metal contacts in other glove fingers are connected to the digital input pins respectively (D2-D13). When the metal contact in the thumb finger connects with the other metal contact in any other finger then the circuit is closed and a digital signal is sent to the digital input pin.

3.1.2 Arduino processing

The Arduino Nano is the brain of the system. Arduino Nano is a microcontroller that is used to control the entire circuit.

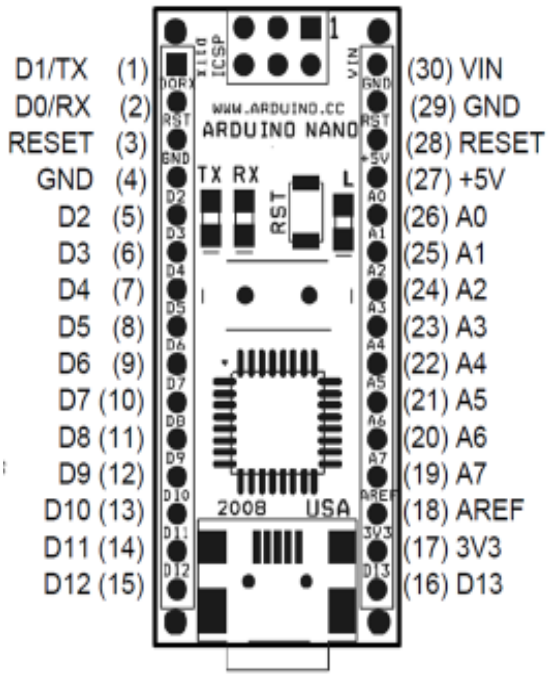

Fig. 2. Arduino Nano pin Diagram

Figure 2 shows the pin diagram of Arduino Nano. The Arduino Nano consists of 14 digital input pins namely, D0-D13. The pins, D0 and D1 are used as receiver and transmitter to enable communication between the microcontroller and the computer system. The pins D2-D13 are used for receiving input signals.

The microcontroller has a +5v pin that is used to transfer pulse. The metal contact in the thumb of the glove is connected to this +5v pin. Rest of the metal contacts in other glove fingers are connected to the digital input pins respectively (D2-D13). When the metal contact in the thumb finger connects with the other metal contact in any other finger then the circuit is closed and a pulse is sent to the digital input pin.

The controller is programmed such that if there is a touch between the thumb's contact and any one of the other contacts then a particular command is decoded corresponding to that particular contact.

3.1.3 Data transfer through bluetooth

Once the controller receives the pulse it decodes the respective signal and sends the signal to bluetooth module.

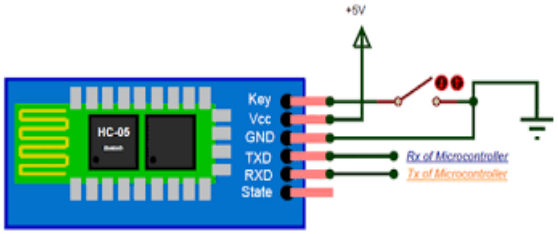

Fig. 3. Bluetooth module HC-05 pin diagram

Figure 3 shows the pin diagram of the bluetooth module HC-05. The bluetooth module has two main pins that are required to connect it with the Arduino Nano microcontroller, TXD and RXD pins. The transmitter and receiver pins are connected to the microcontroller so that the signals can be sent from the microcontroller to the bluetooth module. Once the bluetooth is connected to the application the signal can be sent from the microcontroller to the application via the bluetooth module.

3.2 Software module

The app made can convey the message sent by the glove in both audible and image with about 12 different expression of the expresser. It is very easy to use and connects with the glove easily via Bluetooth. Once connected it can work unaltered as long as the phone is in the range of the Bluetooth and it also provide feature of customizing according to the need of the subject. Since, the app is the basic app and does not require any extra effort and paid resources so, it can be distributed under free and fair license. Thus, the app can be freely available to anyone.

3.2.1 Bluetooth connection

The app has to make use of the connection made to the glove using Bluetooth. Using this connection, the application can draw all the information or signal it requires as input from the glove. The only source of input for the application is through the Bluetooth connection established between the application and the glove's Bluetooth module.

3.2.2 Selection process

Once the application receives the signal from the glove through Bluetooth connection it has to take the necessary decision. The application has to take the input acquired from the Bluetooth module and process it. It has to use a logic, preferably switch case, to determine the command that has been invoked. Once the suitable command is found it has to proceed to the next module. The logic used in the

mobile application for selecting the appropriate command is described in Figure 4

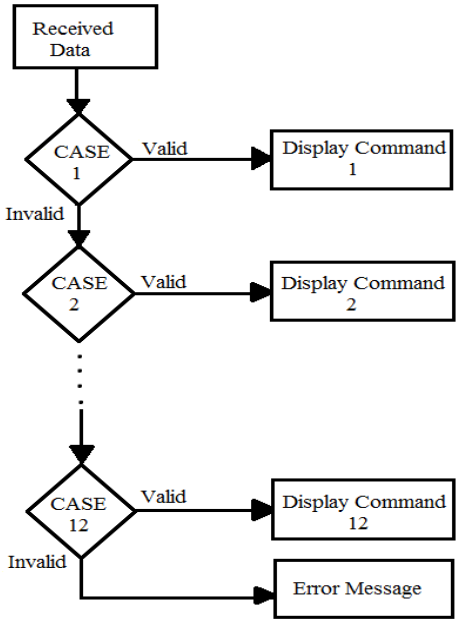

Fig. 4. Decision logic using switch case

According to Figure 4 the data received by the mobile application is fed to the switch case as an expression and it compares the input with various cases to find the appropriate command.

The data received by the mobile application is an integer data hence, it will be compared with integer case values. Once a match is found the command that has been coded for that case will be displayed as the output. For example, the received input data matches with the case value 3, Then the command to be displayed will be, "Can I get some water" or if the case value is 7, then the command displayed is "Switch on the fan please" and so on.

3.2.3 Output display

The main part of the application is to display the command chosen by the user in image format and in audio format. In this module the screen has to display the appropriate image corresponding to the command selected and they playback the audio which elaborates the said command.

The application plays a major role in this system as it helps in conveying the thoughts between the user and their caretaker

Once the input matches a case value the respective command will be chosen and the corresponding image will be displayed and the audio playback will be played through the application's inbuilt media player.

IV. RESULT AND CONCLUSION

The proposed system can solve the daily difficulties suffered by the people, who are cannot speak(dumb) or one who has recently undergone an accident and is not in a condition to speak about this health to the doctor or express his feeling to his family. It can also be used by elderly people, who find difficulty in talking due to their bad heath conditions. It can also be integrated in the field of automation where one can automate things without getting in direct contact of the machines/appliances that are to be automated or controlled. It has wide application in defence sector and war equipment, where solider will not put their life in danger and can control the artillery or explosive without coming in direct contact of it from a safe distant zone.

The smart glove can also work as a controller for Wheel chair and stuffs that are wheeled and needs to be controlled by gestures in some critical or required situation. So, this glove can easily communicate by just tapping the points on the glove by their thumb that results in twelve different expressions/commands in text, image and audio format on any android smartphone via an app. But its application possibilities are more in different fields. Thus, the smart wearable glove will solve many issues related to different fields like healthcare, defence sector, automation, public safety, control systems and many more. Once, it comes in public domain then it will truly change the life of many and will encourage such innovative projects and ideas so that more and more similar product is introduced for the benefit of the society.

FUTURE ENHANCEMENT

Instead of using Bluetooth protocol to communicate between the gloves and the app, we can use Wi-Fi that can provide us a greater range compared to Bluetooth, we can connect more than one receiver (phone) for the same glove. With the involvement of the Wi-Fi, this also be integrated to the field of IOT (Internet of things), where we can store the data on a cloud for further assessment or can communicate from anywhere on the globe via internet.

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