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Multi- Purpose Sensory Glove: A Wireless Gesture based System using Android App

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Abstract: As the giant market demand has been pushing for its growth for a long time, Human Machine Interfaces are about to become an integral part of the future society, offering a low-cost self-powered human machine interface to many different applications. The inability to vision things around exerts psychological and social impacts on the affected person due to the lack of proper communication. Multiple research articles have been published with new inventions and research to overcome the disability and communication in the field of hand gesture recognition using technology, combining those ideas and innovating something new is the main outcome of this paper, which would be thoroughly discussed in this research study, a device is developed which is represented by a glove powered by micro controller and various sensors, these sensors help in recording the movements of hand in a desired direction which ultimately controls RC car, and many more of these sensors are used for the Blind man application and for Mouse cursor control.

Thus, a system is proposed namely, Multi-Purpose Sensory glove which aims to control multiple applications just through gestures and an Android App. This paper would help new researchers to know the benefits of the device and will also get provided with valuable insights to understand and contribute to this field of technology. The working and need of the system are briefly described in this paper.

Keywords: glove; microcontroller; sensor; gesture recognition; pattern recognition; Human machine interface (HMI); classification etc.

I. INTRODUCTION

Humans interact with the physical world using five of their senses. However, Hand gestures are the most common means of communication used in the world. Performing hand gestures is the most regular thing that people do whenever frustrated to demonstrate the device what they want it to do. The term “Sensory Glove” is a wired glove or a “Data Glove” that works as an Input device through which the data is transmitted and after being processed, the data is received at the receiving end and the Output is generated. Sensory gloves are gaining popularity with time and are a very convenient method through which people can control anything in accordance with the application attached to them, the process is effortless and preferable for the users, especially the ones who are Visually Impaired, Deaf, and those having walking difficulties. Thus, the Glove is the most important and essential part of the whole project as it consists of all hardware components which will send the appropriate input and generate the output according to the application being used, the control of specific application takes place through an Android App. The significance of the device is to make the world a better place for everyone to live in as the device controls multiple applications just through the use of one single glove. The Multi- Purpose Sensory Glove makes use of various sensors to capture gestures and conclude them as inputs, as the input signals produced are analog in nature, they are converted into digital signals and processed using Microcontroller. The Glove comprises of a Microcontroller that takes all the input processed by the sensors and then transmits the data through Bluetooth modules and RF wireless transmissions. Different conventional gesture recognition algorithms are used to evaluate the data collected from the sensors corresponding to various hand movements.

The inspiration behind the model comes from many research works done in the past, but the drawbacks to the past research were that the gloves were only capable to control one application control and didn’t go beyond. As, when gesture recognition systems control an individual application: they do not need many components or sensors to be attached to the glove. But when it comes to controlling two or more applications through a single smart glove, the number of components needed is exceeded due to which the glove becomes heavier and may come out to be uncomfortable at first Thus, the focus was to control multiple applications just through a single glove and to make the glove as light as possible for the user to feel comfortable after using the device. If users could attain a level of comfort and maturity with the

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equipment, as though using the equipment is no more than using an extension of their own self or bodies, perhaps they could get to a point where they thought of themselves as the ones performing the action (Raheja et al., 2010)- (Solanki and Desai, 2011). It will probably take years to achieve that level of comfort (3). This may sound rather unsettling, but this is where Multi-purpose Sensory Glove comes into the picture.

The Prime Focus of the paper and the model is to control three main applications that are stated below:

- RC car (Robot Controlled Car)
- For People with Vision Impairment (Blind) &
- For Mouse Cursor Control (Gaming)

All the above applications along with the proposed design and circuitry will be explained in detail and are controlled individually using an Android App.

II. METHODOLOGY

All the applications are divided individually to give a sense of information or knowledge for the researchers, if the work is only limited to one application. The basic outline of all the applications with regards to the hardware components is divided into three main units: INPUT, PROCESSING UNIT, and OUTPUT.

- *INPUT UNIT:*

Consists of acquired data using sensors like flex sensors, contact sensors and inertial measurement unit (IMU), Ultrasonic Sensors, Vibrator, Gyro sensors. Flex sensor also known as bend sensors is a kind of sensor used to measure the amount of bending or the deflection. This sensor is generally designed using plastic and carbon and is arranged on a plastic strip in such a manner that whenever it is turned aside, the sensor's resistance changes, so it is usually used to sense changes in linearity.

- *PROCESSING UNIT:*

It's the Intermediate device which processes the sensors data using a microcontroller board.

- *OUTPUT UNIT:*

Displays the gestures to control the RC car, IR Appliances like computer monitor, speaker or smartphone. All the three main units mentioned above are used in gesture recognition systems to control as many applications as possible but as the review focuses more on the three main applications consisting of: Smart glove for RC car control, Mouse control or IR remote glove and lastly for the blind. The detailed materials and methodology for each of them will be meticulously described ahead.

III. PROPOSED SYSTEM

The Proposed prototype mainly consists of three parts: The Glove consisting of sensors, the controller unit and the slave device (RC car in one of the applications).

1) THE GLOVE

The glove consists of all the hardware components consisting of Flex Sensors, Ultrasonic Sensors, Gyro Sensors, Accelerometer, Ultrasonic sensors are attached on the Knuckles of the hand, so that it can be used to calculate the distance from the obstacle. Gyroscope and accelerometers are sewn to the wrist, which accepts connections from all the sensors and the cable from the control unit.

2) THE CONTROL UNIT

The control unit consists of the main Microcontroller, in this case an Arduino Micro. Which is the main controller through which all the applications are processed**.**

3) SLAVE DEVICE (RC Car, For one Application)

The slave device is controlled using RF transmitter and its inner system consists of an Arduino Nano, L293D motor controller and a RF transmitter. L293D motor driver is used for acceleration purposes and for turning the motors that are installed on the chassis.

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- **COMPONENTS REQUIRED:**

A) *HARDWARE*

1) *Microcontroller:* The ATmega32U4-based Arduino Pro Micro is a lightweight, full, and breadboard-friendly board. It is an Open-source microcontroller board which is based on microchip ATmega32U4 running at 5V/16MHz, this board is fixed with 4 X 10-bit ADC pins and 12 digital I/O pins (5 PWM pins) and is programmable with Arduino IDE which can be used with various other boards and circuits.

Figure 1. Arduino Pro Micro

2) *Flex Sensors:* It's a long sensor with electrical properties that change when it's bent. The analog output has two output pins, one for ground and the other for analog output. The resistance varies around the terminals as the sensor flexes. That is, it grows and shrinks. While the sensor is flat, it provides standard resistance; when it bends to 45 degrees, resistance increases; when it bends to 90 degrees, resistance increases. This flex sensor will be used to turn on and off our Spinel Crux in this project.

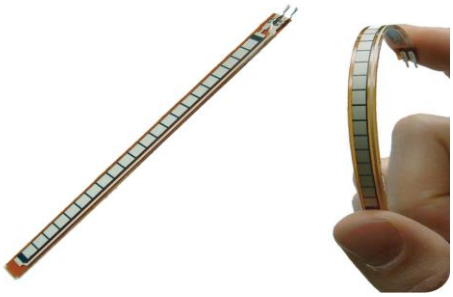

Figure 2. Flex sensor

3) *Ultrasonic Sensors (HC- SR04)*: Ultrasonic sensors HC-SR04 are used for the detection of obstacles in front of the user with a range of approximately 2cm to 4cm. These sensors include a control unit, a transmitter and a receiver for the detection of obstacles. The sensor is triggered by a pulse of 10 microseconds and the module also sends eight 40khz signals for obstacle detection by testing.

4) *Buzzer:* A piezo buzzer is a device that emits a tone or beep to alert the user. This type of buzzer can be used as an alarm system to provide some kind of notification or warning.

5) *Gyro Sensors*: The GY-87 is a 3-axis gyroscope and 3-axis accelerometer on the same chip, with an on-board Digital Motion Processor (DMP) that can handle complex 9-axis Motion Fusion algorithms. We may Use these Algorithms if necessary. The parts' integrated 9-axis Motion Fusion algorithms use an auxiliary master I2C bus to access external

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magnetometers or other sensors, enabling them to collect a complete collection of sensor data without the need for interference from the system processor.

6) *IR Sensors*: Since it is so simple to use, infrared communication is one of the most common ways of wireless communication. When we click a button on your TV remote, an LED on the remote switches on and off repeatedly, sending a modulated infrared signal from the remote to your TV. After the signal has been demodulated, the order will be executed. To transmit IR signals, IR receiver modules are used.

7) *Motor Driver IC (L293D:* The L293D is a 16-pin motor driver IC that is widely used. It's mostly used to power motors. A single L293D IC can drive two DC motors at the same time, and the two motors' directions can be operated independently.

8) *RF Transmitter Receiver:* The frequency of the transmitter/receiver (Tx/Rx) pair is 434 MHz, An RF transmitter receives serial data and wirelessly transmits it using RF through its antenna connected to pin4. The transmission speed is between 1 and 10 kilobits per second. The data is received by an RF receiver working at the same frequency as the transmitter. The RF module is often used in conjunction with a pair of encoders and decoders. The encoder encodes parallel data for transmission feed, while the decoder decodes reception.

9) *Bluetooth Modules (HC-05):* Bluetooth modules can configure as either Master or slave. The Frequency is around 2.4 GHz ISM band with an emission power of ≤4dBm, Class 2 and Speed; Asynchronous: 2.1Mbps (Max) / 160 kbps, Synchronous: 1Mbps/1Mbps. It is used as Industrial control, GPS receiver and in MCU projects.

B) SOFTWARE

1) *Arduino IDE*

The Arduino Integrated Development Environment (IDE) is a cross-platform program written in C and C++ functions. It's used to write and upload programs to Arduino-compatible boards, as well as other manufacturer development boards with the support of third-party cores.

Below shown is the Block Diagram representation of the “MULTI-PURPOSE GLOVE”.

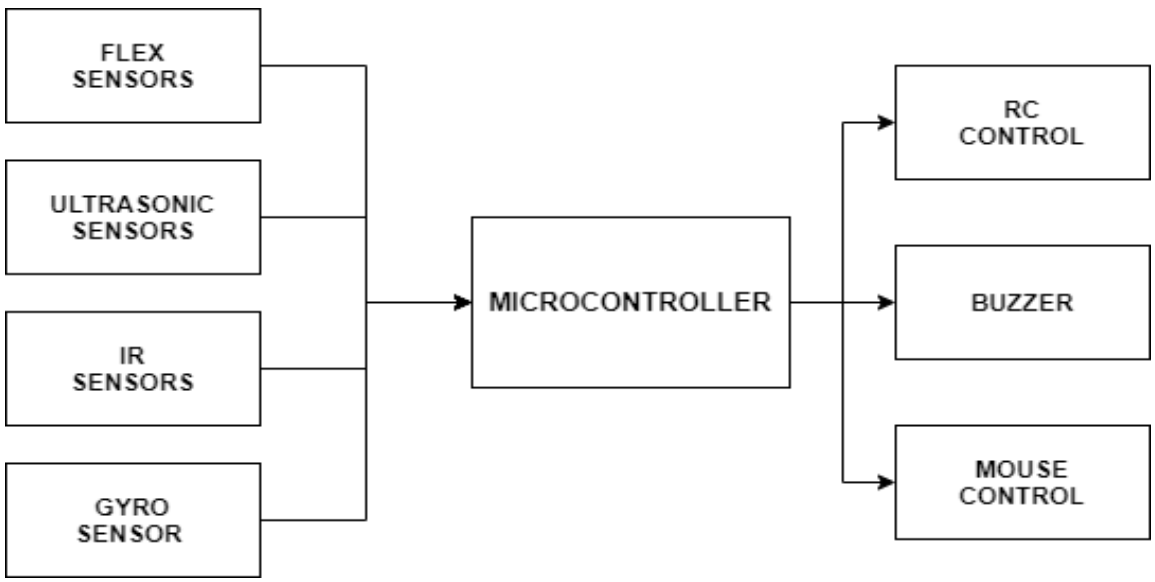

Figure 3. Functional Block Diagram of the System

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IV. CONTROL MECHANISM

The control mechanism focuses on Four main parts: The three main applications that are being controlled and the fourth part on the Android App, through which the proposed device selects the appropriate modes. All the four control mechanisms will be individually described below:

A) **RC CAR CONTROL**

In this application, the appropriate sensors will start working depending on this selected mode, the sensors would be Flex sensors, and Accelerometer Gyro sensors which are connected to the main control unit, in this case Arduino Micro. The first part of the control involves getting the data from the Accelerometer Gyro Sensor by the Arduino. The data is continuously acquired by the Arduino from the Accelerometer and based on the parameters; the Arduino sends a data to the RF transmitter. The Second part is the Wireless Communication between the RF transmitter & the RF receiver. After receiving the data from the Arduino, the RF transmitter transmits it through the RF communication to the RF Receiver. The Third part is where the received data is decoded by the RF Receiver, through which the appropriate signals are sent to the Motor Driver IC, which activates the wheel motors of the Robot. This application has an external Robot Chassis which is connected to elements like Microcontroller (Arduino Nano), L293D Motor Driver & RF Receiver. L293D motor driver is used for acceleration purposes and for turning the motors that are installed on the chassis.

B) **BLIND PEOPLE CONTROL**

This proposed Application is divided into two parts: Controller and Obstacle Detection Unit.

The Controller: the microcontroller is the most important part of any embedded system it works as a heart for the overall system, most of the proposed uses Arduino micro-controller but some of the systems also use different controllers such as PIC or ARM micro-controller depending upon various sensors to be interfaced and having best possible compatibility the controller is selected. This module receives instructions and commands from the remote guided system and sensors and carries out issued commands accordingly.

Obstacle detection Unit: These are basically used to detect different kinds of obstacles in front of the blind person and help him move freely. The most used technique is the use of infrared or ultrasonic sensors which have a range between 2cm and 4m of contactless measurement and have ultrasonic transmitter and receivers as control units. Thus, the basic components used in the glove after the activation of this mode are Two Ultrasonic Sensors, to cover more degree of angle and IR sensors as seen in the Block Diagram mentioned above. The ultrasonic sensors work on electrical- mechanical transformation to receive the distance between the sensor and the detected object. The transmitter generates high-frequency pulses at small intervals of time and if these pulses collide with the obstacle and are received by the receiver then the control system estimates the distance between the object and sensor using some equation and then the user is informed through a buzzer and a vibration motor. Thus, the Output processed through this application is in the form of a Buzzer and vibration motor, which produces beeps to alert the user.

C) **MOUSE CURSOR CONTROL**

This system uses an ATmega32U4 microcontroller which is embedded in an Arduino pro Microchip. The ATmega32u4 is comparable to the Arduino Leonardo in that it has built-in USB connectivity, without the need for a separate CPU. This causes the Micro to appear as a mouse and keyboard as well as a simulated (CDC) serial / COM port to a linked device.

Sensors: Any movement produces some amount of acceleration. This acceleration can be in one, two or three dimensions. The motion of the hand also produces some acceleration. This acceleration is in all three axes. The acceleration is measured using an accelerometer. A system that produces voltages proportional to acceleration is known as an accelerometer. We get acceleration readings in all three dimensions when our hand travels in three dimensions. The microcontroller then converts this 3D motion to 2D motion. Motion detection is achieved on the transmitter side by calculating the acceleration of the hand in all three axes. The basic strategy for implementing this project is to use a microcontroller, accelerometer, and a wireless channel to get the mouse into contact with the screen without using a monitor or other optical equipment. The mouse movement would be synchronized with the hand motion, making for smooth mouse activity.

The wireless aspect of the mouse depends on the connection strength of the module with the receiver. Testing of the working of mouse cursor via serial cable by sending the values through a Cable was done. The HW-290 gives the gyroscope and accelerometer values which help in interpretation of the hand coordinates into 2D. These values are used in the code to move the mouse or the RC car accordingly.

D) **THE APPLICATION CONTROL (ANDROID APP)**

The control parameters of the system are divided into three phases to control the specific sensors and generate the required output through the glove, depending upon the application being used. Thus, to control specific applications needed at the

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time, Android App is made so as to control all the applications individually according to the appropriate mode selection. The sole purpose of the App is to switch from one Application mode to another. The three modes are as follows:

1) RC CAR Control
2) BLIND MAN Control (for people with Vision Impairment)
3) MOUSE Control

The Android App consists of options to select the appropriate mode needed as per the requirement. Whenever the mode is selected, the app will send the input data of the selected option to the glove via Bluetooth and according to the option selected the Arduino will receive the data and act on the selected option, thus sending data to the relevant sensors and further operations are activated and starts working.

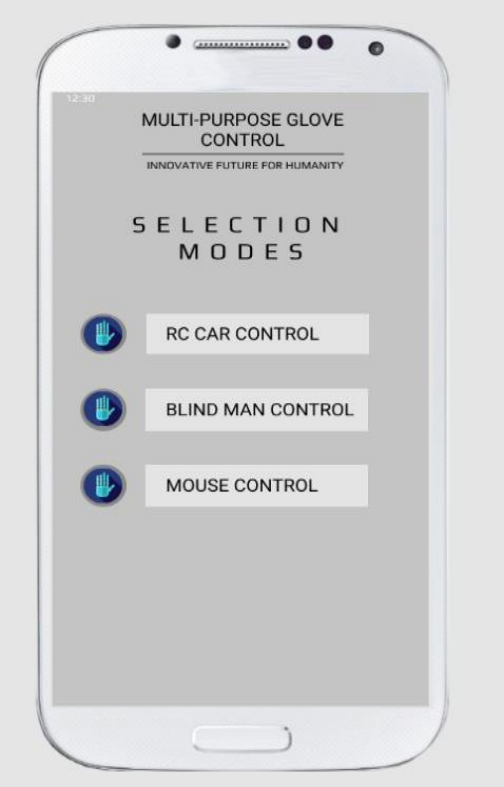

Figure 4. Application Selection modes

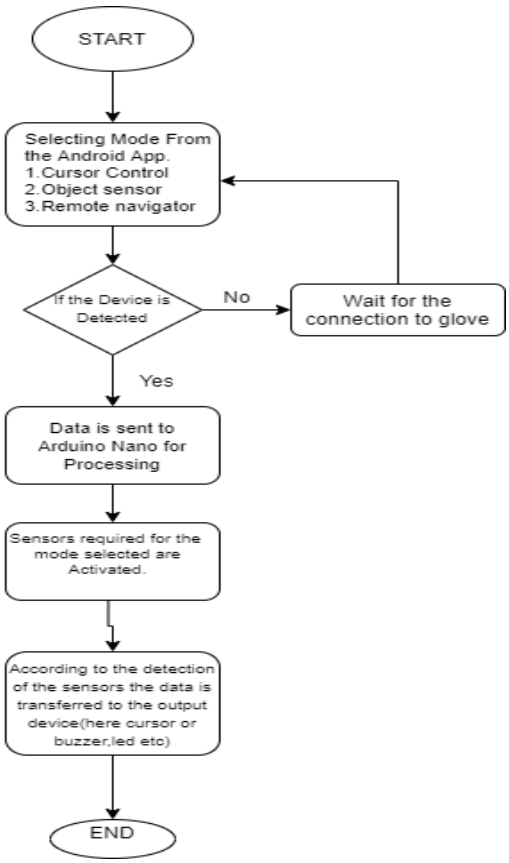

Figure 5. Flowchart of the System

From Figure 4, It is evident that once, any one of the buttons are pressed by the user, the glove will perform the selected mode and the required sensors applicable for the selected ones will only be in the operating mode and will be activated while others won't work. The working can also be seen through a flowchart as described below in Figure 5.

V. NEED OF THE SYSTEM

While communicating along with each other, human beings usually use speech and gestures rather than that they also have an amazing vision through which they can see the obstacles in front of them easily. Gestures are something through which almost everyone communicates thus to wirelessly control anything through gestures and by filling the gap between human-machine interface, this paper and research work came into existence. But in the case of Visually impaired people and blind people, they can only hear but not see. Due to which, if there's any obstacle in front, they won't be able to avoid it. The main motive behind the project was for the blind to have their senses intact even if they are unable to see the world, through the sensors connected to the glove they'll have their senses heightened and won't ever have to rely on others or the stick. Its vast application in controlling the RC (Robot Controlled) Car, if implemented on wheelchairs can even help the people to control the chair through their gestures. The control over three different applications makes it beneficial for the people and is a next step towards evolution in technology. Some of the benefits and motivations of Sensory Glove are demonstrated below:

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Figure 6. Benefits and Motivations of the System

VI. CONCLUSION AND FUTURE SCOPE

The Multi-Purpose sensory glove was developed, and the proposed system demonstrate the possibility of instinctive, uncomplicated, glove-based input general enough to be extended to added applications, including hardware and software. The system can perform a unique task just through the tip of our fingers; a liberating task that is particularly helpful in improving inter-communication and filling in the gap between human capabilities and machine interface in a very efficient way. The developed system is a lightweight wearable assistance of mobility which requires no training at all for users. The capabilities of all the components were put in use by taking advantage of the potential each component possessed. Through the use of a glove, the idea becomes significant in nature and deals with the future of technology and advocating for life changes are certain to be welcomed. Progress in gesture recognition offers the promise of convenience, mobility and adaptability

For the future scope, there are enhancements that can be made to allow for more functionality and more coverage. The findings of the controlled environment research and online questionnaire are useful and can be used in future projects. A provision also needs to be made for the functioning of the device when it comes to battery usage. An efficient way to recharge would be a solar-powered system. It should be durable for accidents and waterproof; while measures for reducing the cost must be made for it to be commercially available.

REFERENCES

[1] Raheja, J. L., Shyam, R., Kumar, U., & Prasad, P. B. (2010, February). Real-time robotic hand control using hand gestures. In *2010 Second International Conference on Machine Learning and Computing* (pp. 12-16). IEEE.

[2] Solanki, U. V., & Desai, N. H. (2011, December). Hand gesture based remote control for home appliances: Handmote. In *2011 World Congress on Information and Communication Technologies* (pp. 419-423). IEEE.

[3] Gesture Recognition, Wikipedia https://en.wikipedia.org/wiki/Gesture_recognition

[4] Dekate, A., Kamal, A., & Surekha, K. S. (2014, February). Magic Glove-wireless hand gesture hardware controller. In *2014 International Conference on Electronics and Communication Systems (ICECS)* (pp. 1-4). IEEE..

[5] Khairnar, D. P., Karad, R. B., Kapse, A., Kale, G., & Jadhav, P. (2020, April). Partha: A visually impaired assistance system. In *2020 3rd International Conference on Communication System, Computing and IT Applications (CSCITA)* (pp. 32-37). IEEE.

[6] Sabuj, B., Islam, M. J., & Rahaman, M. A. (2019, December). Human Robot Interaction Using Sensor Based Hand Gestures For Assisting Disable People. In *2019 International Conference on Sustainable Technologies for Industry 4.0 (STI)* (pp. 1-5). IEEE.

[7] https://www.indiamart.com/proddetail/arduino-pro-micro-board-16010180412.html

[8] https://learn.sparkfun.com/tutorials/flex-sensor-hookup-guide/all