DE-40 (DC&SE)

YEAR 2022

NUST COLLEGE OF

ELECTRICAL AND MECHANICAL ENGINEERING

SMART BIKING GLOVES

A PROJECT REPORT

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Submitted by

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BACHELORS

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ACKNOWLEDGEMENTS

First, Alhamdulillah, that our FYP is finally made and all Thanks to Allah Almighty for giving us the strength and moral to keep pushing forward and helping us on each and every step of the way.

Secondly, we would like to offer heartily thanks our supervisors, Dr. Ali Hassan and Dr. Aqib Pervaiz, who helped us a lot, tremendously, on each and every single issue, who’s help, and guidance became a source of strong determination for us. Thank You, sir`s you played a great role in our lives, one that we can never forget.

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ABSTRACT

Two wheelers are very much part of our lives. In Pakistan, two wheelers are increasing day by day, more than 17.5 million were registered till 25th October 21. Difficulty in tracking each other while riding a bike is a big issue. Two wheelers are very much a part of our lives There are approx. 20.5 million two-wheel vehicles on roads of Pakistan, 45 thousand fatal and 60 thousand non-fatal accidents on yearly basis. Safety of the rider needs to enhance. Mostly, two wheelers are involved in major of accidents. Main reason of these accidents is low visibility of the rider which we focused on. Our project is to target the people who uses two wheelers and to provide them a device which can help them to see in dark and in case of any accident nearby hospital will be informed. Also, some two wheelers like to move in groups so with our product they will be able to know each other's location. Reducing the likelihood of an accident by increasing visibility of a rider and, in the event of one, providing prompt assistance to the rider

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Chapter 1: Introduction

1.1 Introduction

Cycling is on the rise in many major cities across the world. With this growing popularity and growing concerns about bicycle safety and infrastructure, government agencies often step on the line to meet the needs of two wheel riders and drivers and adapt safely and easily to both modes of transport on the road. Today, two wheel riders are still considered secondary road passengers, and there is a severe shortage of finished goods enough to understand the situation in front of them, a situation that can change rapidly in response to unexpected or unstable behavior by two wheel riders and drivers, where they share the road with others. There is no affordable, ready-to-use user-friendly twist signal product that is clearly visible to pedestrians, drivers, and two wheel riders traveling in different angles and directions. Consumer products have been developed to sell comfortable lights stitched in clothing such as gloves, jackets, and helmets, but these products are expensive, users need to wear supportive clothing, and users need to use effective additional controls that can be embedded in the garment or attached to the steering wheel. Some of these products have failed to significantly improve visibility. For example, the new Jackie Signal glove requires a button and press the button on the glove to illuminate itself with the LED lamp contained in the glove, and when the rider holds the steering wheel, these LED lamps become inactive and start turning to safely complete.

There are three main objectives that should be improved compared to traditional cycling gestures.

a) Visibility: In wide corner positions or low light, drivers and other two wheel riders cannot see gestures.

b) Mobility: If you need to put rider hand on the steering wheel, the gesture is impractical and not safe. Intersections reaching above, or below steep hills become targets along with bend and moving signals.

(c) Interest: Officially recognized break gesture signals are valid in some countries but are usually unsafe for use under normal circumstances. Therefore, there are no practical gestures to indicate the driver's braking, roll or dangerous conditions.

1.2 Motivation

Smart gloves aim to solve all these problems using inexpensive devices, consumer equipment ready for use with accelerometers and gyroscope sensors, energy-saving wireless BLE communication, providing gesture-controlled turn signals to two-wheel riders, and providing services other than turn signals. In addition to being able to signal turns, Smart gloves can provide custom animations for lighting and braking displays in neutral conditions. Rolling information and exposure comes in the form of increasingly sensitive lighting.

1.3 Scope

Using officially recognized bicycle gestures for rotation and parking, two wheel riders do not need to adapt to the new system – the only requirement for two wheel riders is to download mobile apps and smartwatches embedded in smartphones. In addition, the system provides guidance information and GPS location sensors, which significantly reduces the cost of the system by using a regular device that many people already own and wear every day, and can be compatible with any range of smartphones and wearable smart devices. Smart gloves can also replace the rear with commonly used headlights on bicycles in low-light conditions, enhancing them by adding automatic signs and aesthetic features at a lower price.

Figure 1: Graph of the cyclist's four major gestures. From left: Turn on the signal and break left, right, right, right..

1.4 Previous Work

Although not much research has yet been done in some areas of automated blinker processing, many consumer products have been prototyped or released for use as turn signals of two wheel riders.

a) Dora, Luma Helm: Two conceptual products that propose a comfortable LED helmet that tries to solve vision problems. Many marketing and laboratories have issued many other helmets offers, but they all have the same big problem with the huge auxiliary helmets and controls mounted on the steering wheel.

b) Zackees: A new compact LED glove product is introduced using the samples to complete the circuit between two metal nails. These gloves are marketed as solutions to low-light vision problems, but they cannot improve visibility in situations where the user must put his hand on the handle to ensure safety.

c) HelSTAR helmet: Another helmet is designed to communicate with the turn signals of a 12V motorcycle navigation system using an RF connection.

d) MIT laboratory research: integrated LED sensors and clouds. Major among all these products are consumer availability and accessibility issues, which hinder their widespread use on the streets. The introduction of new accessory fabrics with built-in sensors and LED lamps limits the global suitability of the product for users of different sizes, requiring users to perform unnecessary tasks in wearing, washing, and nurturing unique fabrics embedded in electronic devices. These tools also require additional user learning and additional user learning. A physical controller embedded in clothing or attached to the steering wheel. Finally, the expected and actual price range of all these devices is very high due to their modernity, with Jacques gloves selling for less than $80 and comfortable helmets for more than $180. All of the above are needlessly complex to meet other basic and simple needs: affordable, natural and easy-to-use turn signals for two wheel riders to integrate into their daily lives without distractions. More than 58 percent of American adults who own a smartphone and with a new wave of smartwatches and wearable devices on their fists, the fast, reliable turn-signal sensing technology is being adopted by most two wheel riders. The Smart gloves solution uses the current network of individual mobility sensors to provide a low-cost, efficient, and usable cycle rotation signal.

Accident impact is a condition in which nerve tissue is lost due to a reduction in blood supply to the brain or hemorrhage. It is Asia's fifth greatest cause of mortality, claiming the lives of almost 795,000 individuals each year Even though the incidence of accident impact has decreased gradually and dramatically over the last century, the death rate remains high, with about one out of every twenty accident impact survivors dying each year.

There are right presently more than 7 million mishap influence survivors, 66 per cent of whom

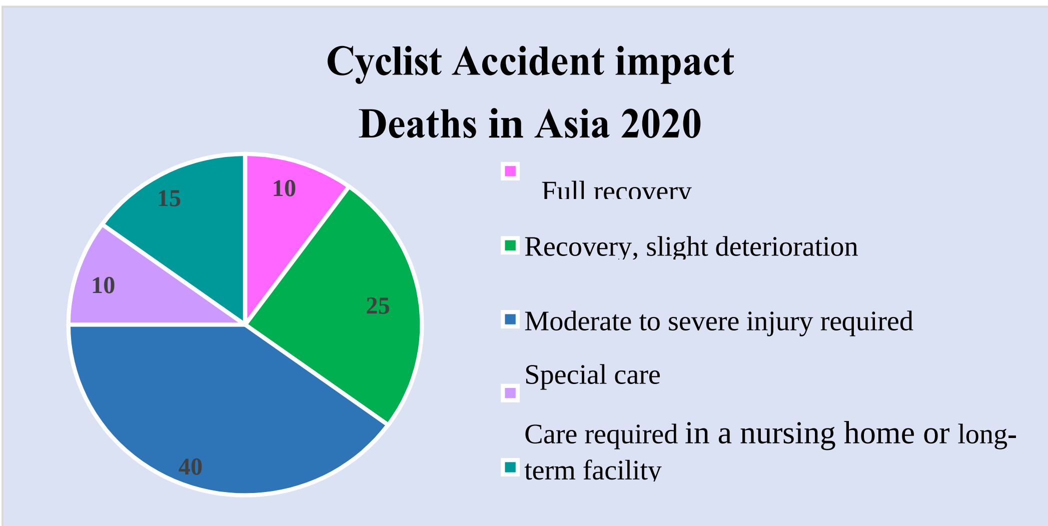


Figure 2: Accident impact deaths in 2020 (Go et al. 2020).

will persevere from long enduring versatility disarranges, costing Asia around Rs. 365 crore per year (Go et al. 2013). As of now, because it were treatment for accident influence is switch. The objective of recovery is to help accident influence survivors reach most prominent levels of adaptability and effectiveness, but recovery is outstandingly variable. In truth, recovery and recovery are profound established shapes and neurobiological foundations, and little is known around the criteria for compelling turn around trade. As life expectation increases for the common people, driving to a sharp increase inside the number of accident influence survivors inside the coming decades, it is getting to be continuously basic to find practical medicines.

Outrider's reverse program could be a great elective to more costly hospitalization programs. In any case, the costs related with outward switch program are tall and frequently surpass what wellbeing protections covers. A consider was conducted at the College of Texas Center for Wellbeing Sciences to capture the coordinate taken a toll of switch and medicate administrations for 54 to begin with mischance affect survivors in 2001-2005 (Godwin et al., 2011). The results showed that travelers caused critical costs within the to begin with 12 months after clearing out the hospital's invert environment. The average fetched of reestablishing an outside rider and a sedate within the to begin with year after exit was Rs. 17,081. Of these, the normal yearly fetched of drugs and invert is estimated at Rs.5,392 and Rs.11,689.

Chapter 2: Research Goals

The reason of this ponder is to create keen gloves that can be utilized as associates and give criticism when families and healing centers react to mischance recuperation. The most inquire about situation is to develop a framework which can help the analysts go forward for the unused information which is able offer assistance in creating modern prospects in driving Wheelers Measured clench hand expansion and fingers are utilized to degree hand movements. The gloves connect wirelessly to the ricomputersuter or smartphone and are detachable.

It can be modified to supply perceptions approximately the precise developments that happen amid the interaction in each arrangement. A beat flex sensor connected to the glove can be utilized to degree the fist-finger association and alter the affectability to suit each rider's special needs. The notice records the number of fist-finger associations and the sum of time passed amid the session for measurement. strength.

2.1 Research Importance

The glove design components have been carefully selected to meet the low-cost requirements for the best work. Currently, finger and fist stretch performed during the interaction with the accident do not count within the tracking points visited. Providing feedback on the level of execution helps therapists and cyclists gradually increase frequency and intensity during the response. The device is also expected to improve participant performance through continuous training with feedback. In addition, this system allows handlers and riders to see if the two-wheeled vehicle is doing the required exercise.

2.2 Theoretical Framework

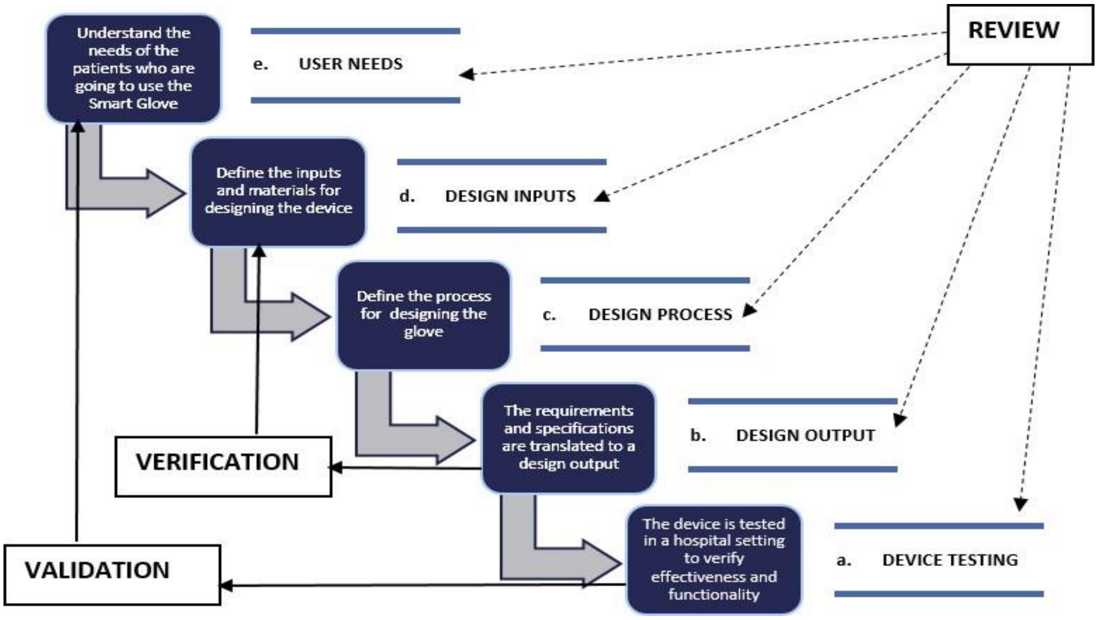


Figure 3: Theoretical framework for smart glove design

Figure 3 appears to be taken after when making and testing a keen glove. The plan measures are reliable with the FDA's proposed standard waterfall demonstrate for wellbeing gadget plan (Wellbeing and Radiation Gadget Center).

2.3 Design Review

The design review is performed at a critical point in the device design cycle. Make sure the step completes properly and the next step can be started.

2.4 User Requirements and Final Device Authentication

The design review includes additional functional evaluation and design review to verify that the device meets user requirements.

Chapter 3: Equipment Design

3.1 Understanding Customer Needs

Users are the pioneers of input design, so it is important to meet their needs during the two-wheel driver phase of a project. Design inputs capture measurable details and design goals for the device. Therefore, it is important to clearly set user requirements. When determining user requirements, the following important questions should be addressed:

3.2 Main issues to address

The main issues to address when determining user needs are:

3.2.1 Who is the primary user of this device?

As clearly stated in the purpose of document, smart gloves are used by riders who are experiencing a rehabilitation reaction to recover from fist and hand cramps.

3.2.2 How do Two-wheel riders interact with this device?

Two-wheel drivers respond intelligently when wearing gloves with reliable sensors. The glove records the number of connections made and the duration of the session. This information is gathered using a slide attached to a fist and transmitted wirelessly to a computer that can generate a report at the end of the ride.

3.2.3 What components does the device use?

The microcontroller on the chip is used to detect the time spent during various types of communication and response sessions. The software is written on a microcontroller that runs an algorithm that determines the initiation of a connection by measuring changes in sensor readings.

3.2.4 What environment does the device use?

This device is designed for use in appropriate settings and provides feedback to researchers and motorcycle drivers. Equipment evaluated at the Swan Tracking Point and the Good Samaritan Banner Point. However, the device is designed for use at home by two-wheel riders and caregivers.

3.2.5 Is the device safe and effective?

This device is designed for use in appropriate settings and provides feedback to researchers and motorcycle drivers. Equipment evaluated at the Swan Tracking Point and the Good Samaritan Banner Point. However, the device is designed for use at home by two-wheel riders and caregivers.

3.2.6 Are there any explicit requirements for device users to consider?

Since this device is used by cyclists with limited hand movement, it must be designed so that it does not increase the difficulty in performing fist and finger movements during the reaction

3.2.7 Are there any restrictions and requirements for the cost of equipment?

This device should provide meaningful input to bikers at a minimal cost. Because one of the goals of this paper is to develop a low-cost, portable design for treating upper extremity spasticity. This can be done by carefully selecting design components that do not compromise the device's efficiency.

3.3 Design Reference Definition

3.3.1 Glove Material

Polyester suitable for glove material. Polyester gloves are widely used in industry and in everyday life and are available on the market in a variety of sizes and colors.

Polyester is a low-cost polymer due to its ease of production. Polyester gloves are thick and flexible, as well as offering market benefits. On a firm basis, assembles easily embroidered circuit pieces in gloves. It also keeps the user's hands from coming into contact with the circuit, which can cause irritation, itching, and redness. Due to the variety of materials used, it has good elasticity and shrinkage, ensuring a comfortable fit. Permeable polyester fibers offer for enhanced hand ventilation and a more comfortable fit. It has excellent sweat-wicking properties, making it ideal for long-term reactions. Because riders use them, cycling gloves must be easy to put on and take off. It should allow for appropriate airflow as well as enhanced finger and fist openness for unrestricted movement. Polyester circular fingerless gloves are used to meet these requirements. The glove has a wide base that can be adjusted for a specific fit using a Velcro strap. The part of the glove that covers the finger is made of breathable porous synthetic rubber. Additional Velcro straps can be easily stitched into the general pattern for customized patterns. The gloves also have hand fillers to aid absorption, which is especially crucial for long-term reactions.

3.3.2 Sensor type

A sensor must be able to log events and must be able to measure itself and provide an appropriate output that is meaningful or convertible to another measurable output format.

The pulse bend sensor fits the bill. These are tape sensors whose pulses vary in proportion to the degree of bending. The tape is made of carbon polyethylene with copper chips bonded on one side for flexibility in bending. This design includes Spark fun's FS7548 model with a 4.5" sensor. The length of the sensor is suitable for installation on gloves of various sizes. In addition, the sensor is thin and flexible and fits the connector. As the pulse increases with the curvature of the transducer, the pulse continuously decreases over a period to detect the start of the connection. The sensitivity of the sensor is limited by the bending impact range (60 K to 110 K ohms). Also, the tapes are cheap in the market because they are made of cheap materials. This design combines two bar sensors to independently detect the two types of communication.

3.3.3 Automation and Control

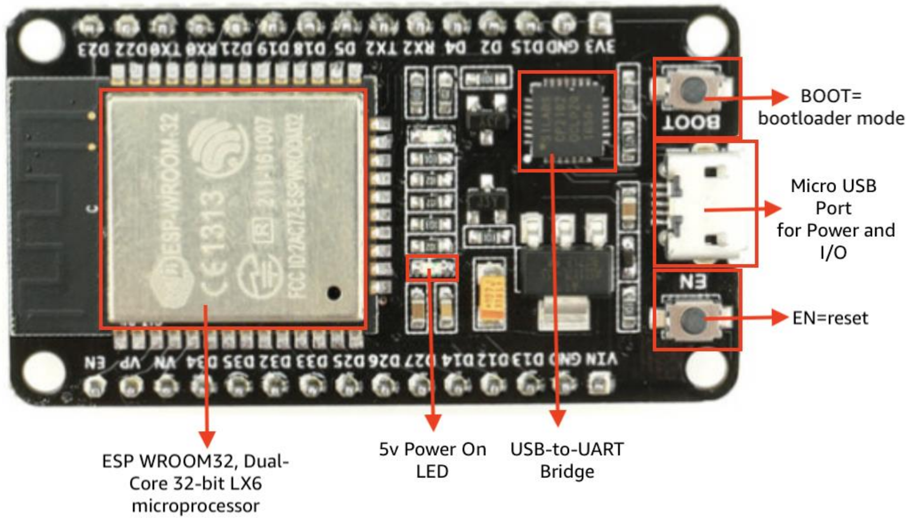


Figure 4: ESP-32 Microcontroller: Smart Glove Handling Unit

That processing block must be able to collect sensor data and convert it to usable digital output data for use in a programmed. The software then implements the logic for detecting the connection. Microcontrollers are integrated circuits that include processing units, memory, and I/O, making them an excellent choice for controllers with lesser throughput and more hardware-software interfaces. The console should be compact and light enough to be attached to the first console without limiting interaction.

I utilized a Punch Through Plan ESP32 microcontroller as a cleverly glove controller. Typically, a microcontroller mounted on an electrical board to which a punctured board is connected. A circuit component is required to change over the resistance esteem created by the sensor into a advanced constrain esteem that can be interpreted by computer program. Circuit components can be welded to the working board. Scoreboard focuses are electrically disconnected from each other. In this way, circuit components can be welded concurring to basic circuits. Prepared with a low-power Bluetooth module, it can be connected to a computer or portable phone. You'll moreover download the code utilizing the Bluetooth association convention. This disposes of the require for extra remote modules and execution boards, frequently making it troublesome to guarantee compatibility between gadgets of diverse designs..

It also increases the size of the entire circuit, making it unsuitable for fist mounting. The compact unit greatly reduces the number of wires in the circuit, making it easy to maintain unlimited arm movement during the interaction.

3.3.4 ESP-32 MCU Programming

The ESP32 microcontroller is an integrated ESP32 panel. The Esp32 development board was initially installed and integrated with open-source hardware and software. The ESP32 integrated development environment is used for programming. The program is written in C. Libraries are called cables, which makes working with input and output very easy in the IDE. I/O commands are very easy to use, and their syntax is simple. The software used in my article was written and compiled using ESP32 1.6.4, the latest IDE installed on my Laptop with Windows 11. After assembly, the program creates a hexagon file. It is written on the microcontroller using the built-in programmer along with another program called ESPIDF. ESPIDF can connect to the ESP32 using a plugin and is equipped with a serial screen that displays a log of response sessions.

3.3.5 The Interface controller for the display device

It connects to the computer using the Bluetooth 4.0 low energy protocol. It makes mobile devices and processors small and surprisingly powerful. The session log is displayed on the PC on a serial screen connected to the ESP-IDE.

3.3.6 Advanced Design

Design To create an advanced system of the Smart Glove System can be met. The data collection device consists of a resistive sensor mounted on a smart glove. The sensor's pulse depends on how much it stretches when rider fist and finger are connected. The pulse change is converted to a measurable voltage using a data conversion device. The block consists of a voltage divider circuit with a resistor and a constant power supply. Dimensional voltage is the input to the ESP32 MCU console. Beans are coming. It takes analog forces and converts them to digital values using a precision controller.

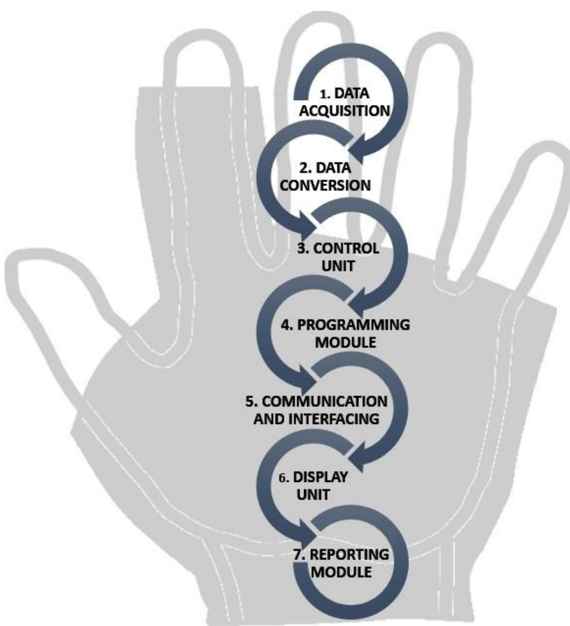


Figure 5: High-end smart glove design

I used ESP32 to program on my personal phone. A connection and interface between a programming device and a wireless console that implements the Bluetooth connection protocol.

The display module is ESPIDF software. Whenever a connection is found, it is displayed on my phone with a serial screen connected to the program. Additionally, upon completion of the response session, a summary is produced that includes the number of fist and finger stretches made and the time taken during the session. You can export sequential screen summaries to a text file. This includes reporting units.

3.4 Data Acquisition Unit

Inserts the tape sensor into the stitch pocket of the glove. The design has two sensors. One detects the flexion of the finger. To detect finger flex, place the sensor on rider index finger,

.

Figure 6: Touch sensor mounted on gloves with stitched pockets

The belt sensor has a very fragile contact pin. Therefore, these nails are welded to thick copper wire. Contact pins also tend to slip off the impulse bar when bent excessively. To prevent this, the connector connecting the nail and the tape impulse is wrapped with a foam pad and held in place with an electrical rod. Attach Velcro fasteners to the back of the sponge to prevent the resistance sensor from sliding out of rider pocket. A small Velcro strip is sewn into the Tay glove to which you can attach the sensor.

Figure 7: Bicycle gloves with module

3.5 Data Conversion Unit

Band Pickup Changes in pulses are transformed to measurable voltages using a voltage divider circuit. A voltage divider circuit converts the power supply into a reduced force across a resistor connected to the power supply. The voltage is divided into smaller components based on the pulse value. The isolation circuit in the design devices a 10KΩ resistor in series with the resistive sensor. The output force is measured by the load transducer. As the sensor expands, the pulses decrease, reducing the voltage across the sensor. This dilatation is detected by reducing this momentum over time. The circuit is powered by the ESP32 MCU 3V DC pin.

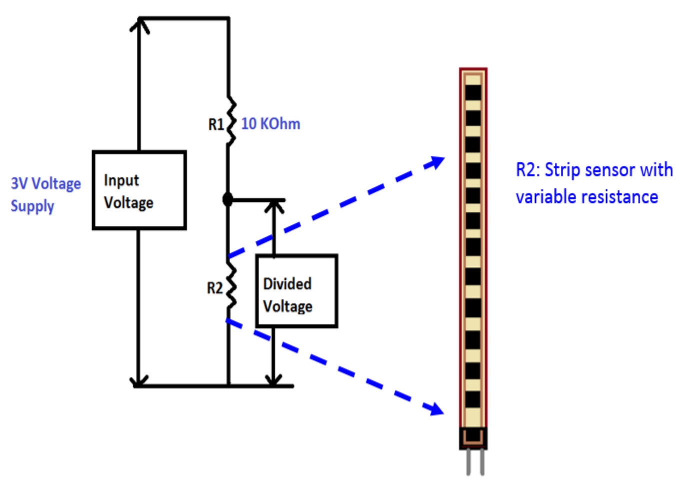


Figure 8: Circuit Voltage Divider for Data Conversion

3.6 Console

ESP32 MCU console is a device console. This is a low-power ESP32 Bluetooth panel with a 328p AT Mega microcontroller and various peripherals that interface with exterior hardware and software. However, the smart glove only uses analog pins, digital output pins, floor pins, and ESP32 microcontroller power pins. It has 6 A/D 10-bit adapters, 2 analog pins, 6 digital input/output pins, 1 3V power pin, and 2 ground pins. .

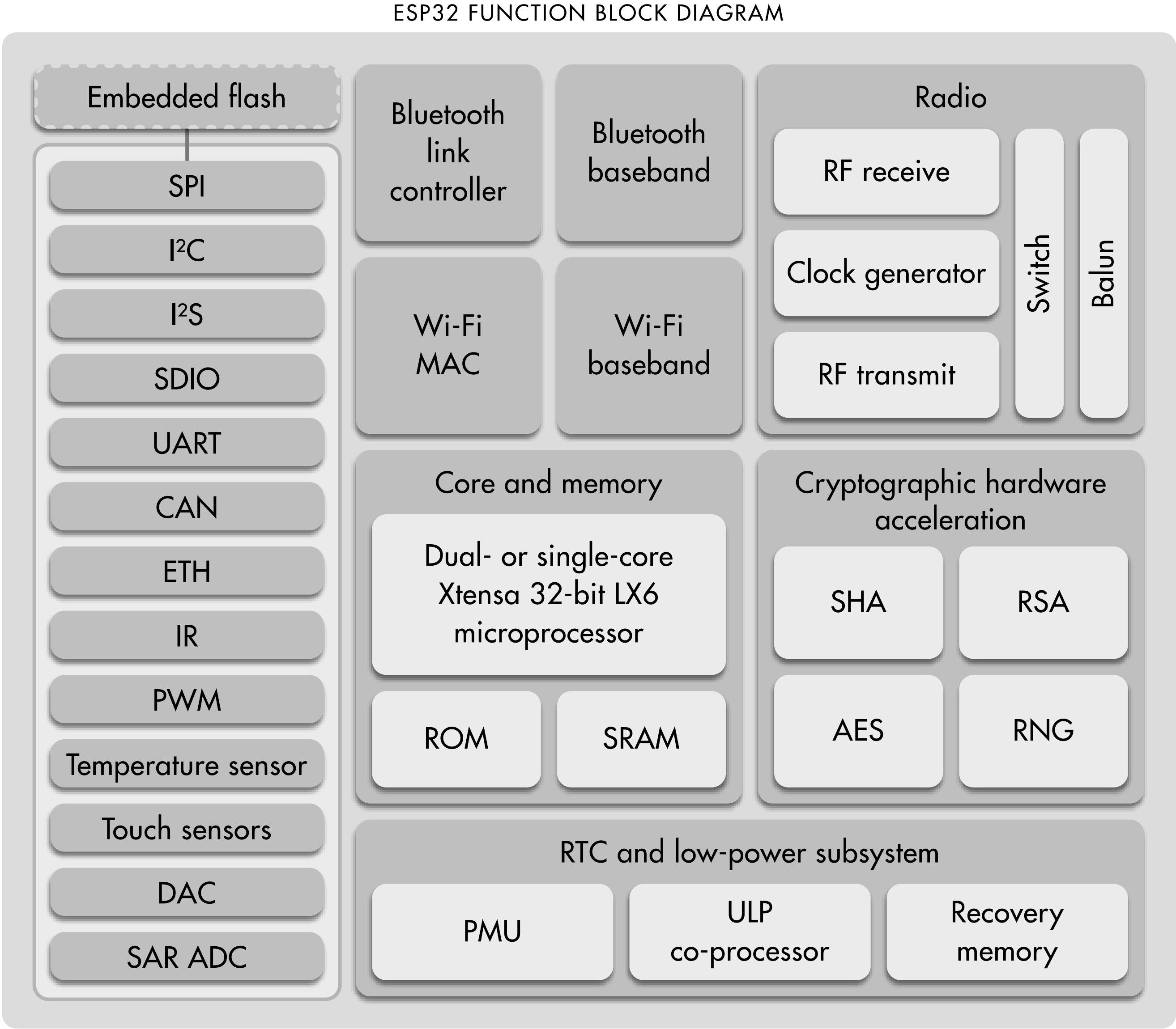


Figure 9: Esp-32 MCU and terminal pins are used to design smart gloves

The pins are used to design the smart glove and the nut is also connected to the dashboard where the circuit can be welded to receive and transform data. The dashboard has 34 individual points to which you can connect circuit components. The operating voltage is 3 volts and is powered by a battery.

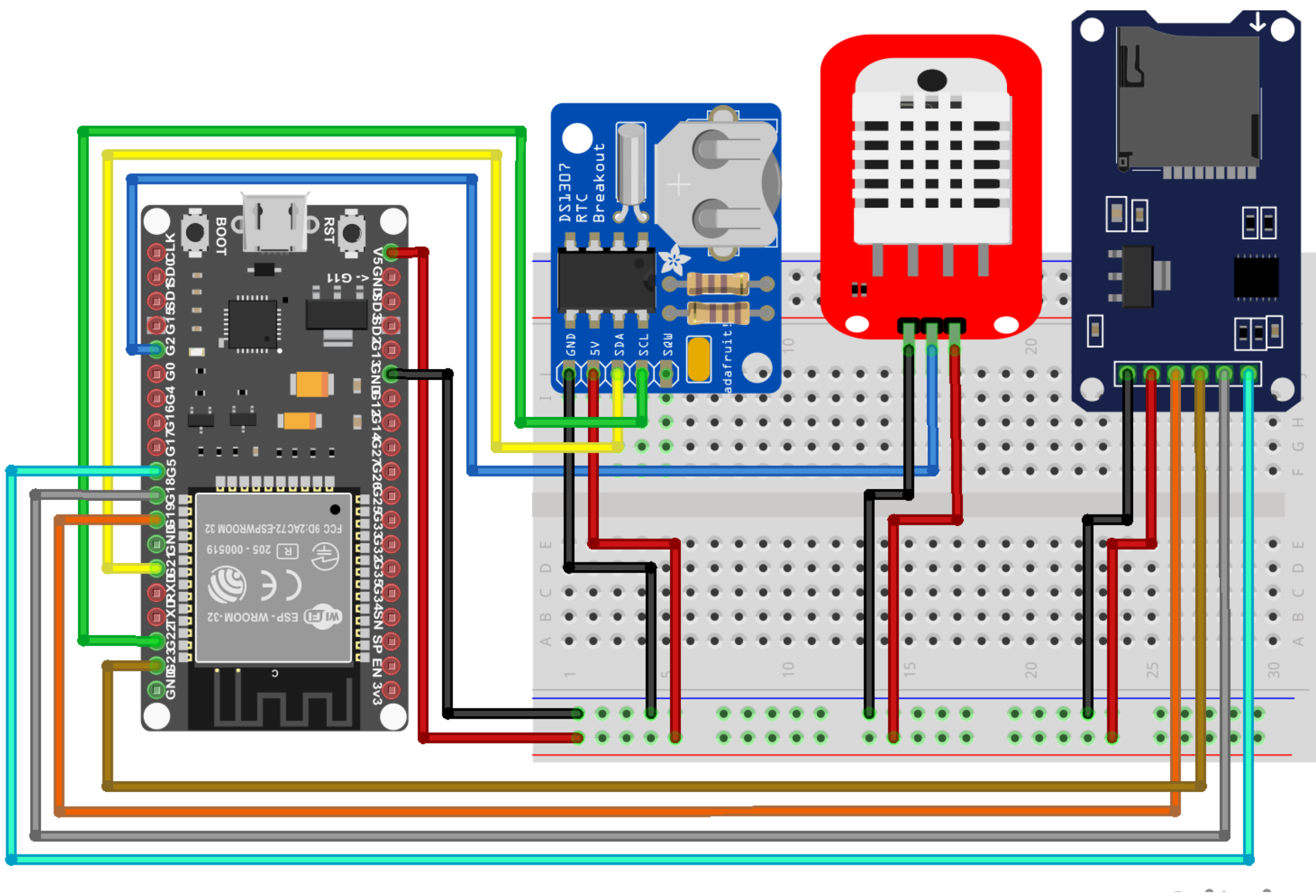


Figure 10: ESP-32 microcontroller with data acquisition

Both sensors are connected via analog and floor contacts. Adaptable multi-fiber cables are used for welding. This cable is connected to a thick copper wire connected to the sensor contacts.

.

3.7 Programming Block

The microcontroller is manipulated using the ESP32 1.6.4 IDE. Pulses from the tape sensor are converted into force. An analog voltage is converted to a digital value between 0 and 1023. The software monitors this digital value of both sensors for 250 milliseconds.

The initiation of communication can be determined by a continuous decrease in the digital voltage value, and both the fist and the fingers remain counted.

The program is only started when the chip key is actuated, which can be determined by the high state of digital pin 2. Since then, logic has been implemented to detect different types of bends in the loop until the moment the slider key is turned off. I have a low digital case with 2 pins.

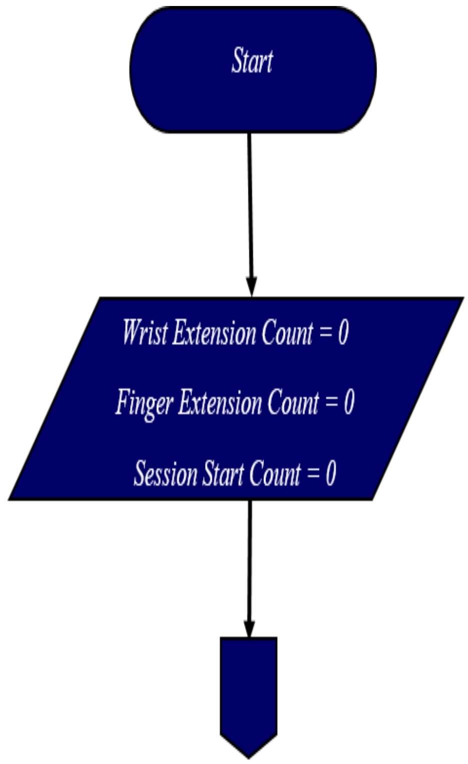


Figure 11: Make a precise control flow process to detect wrist and finger connections

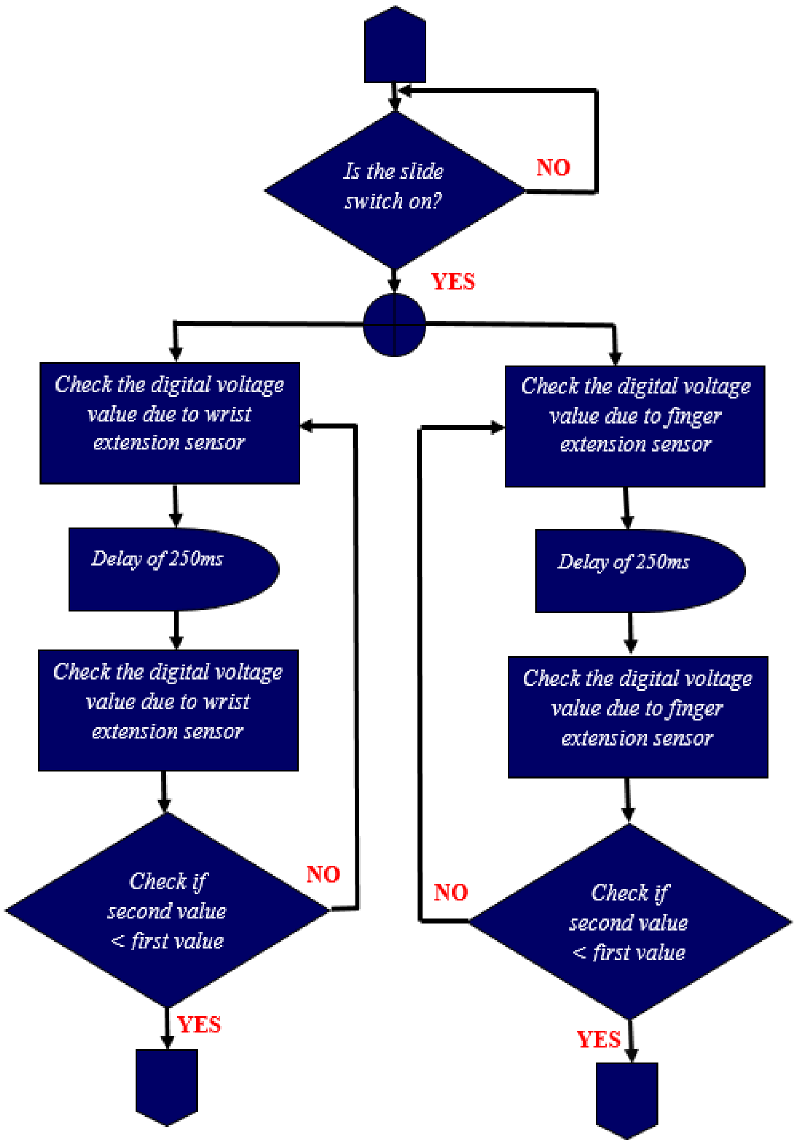


Figure 12: Precise control programming flow to detect wrist and finger connections (child 1)

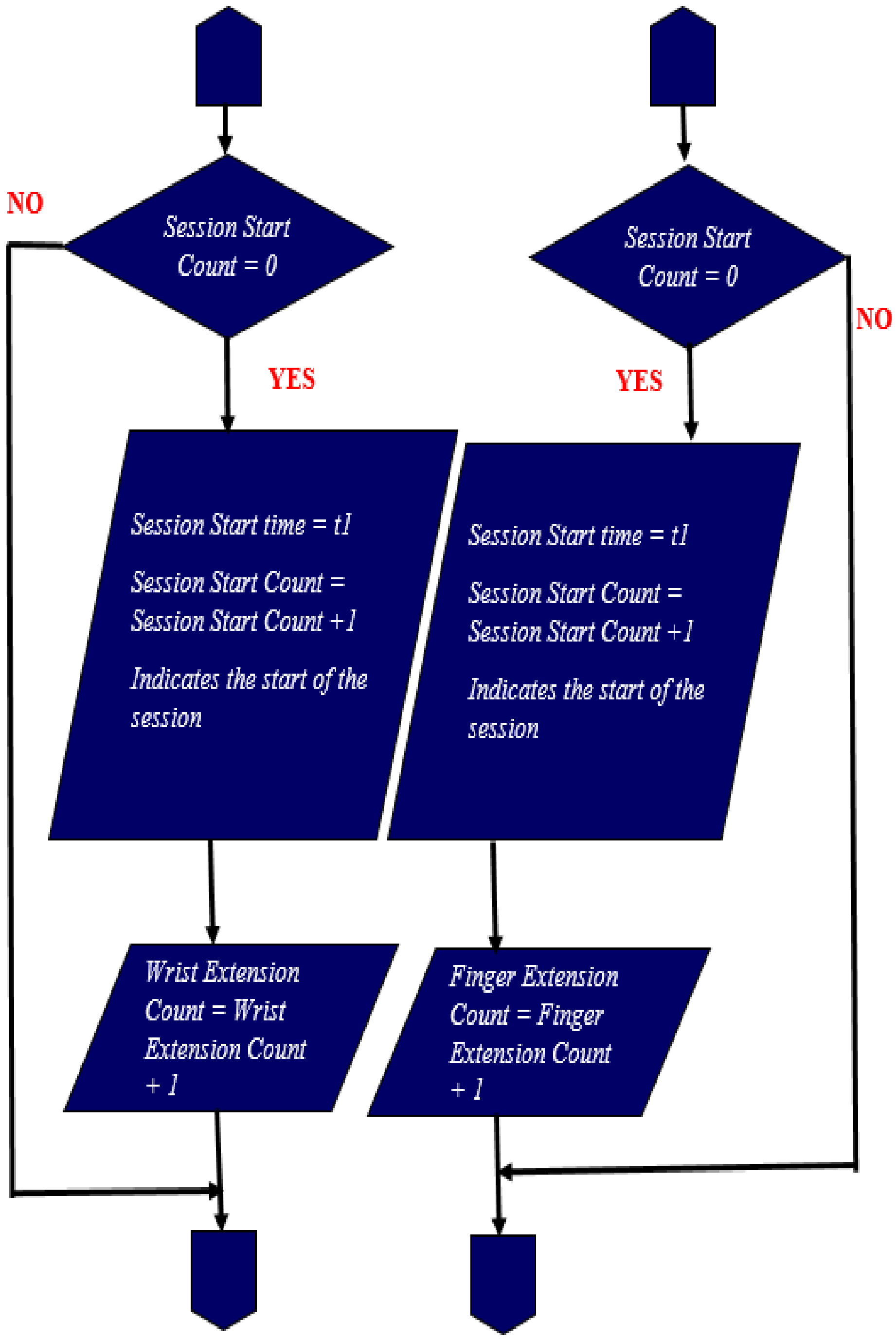


Figure 13: Microcontroller programming for the detection of wrist and finger links (follow 2)

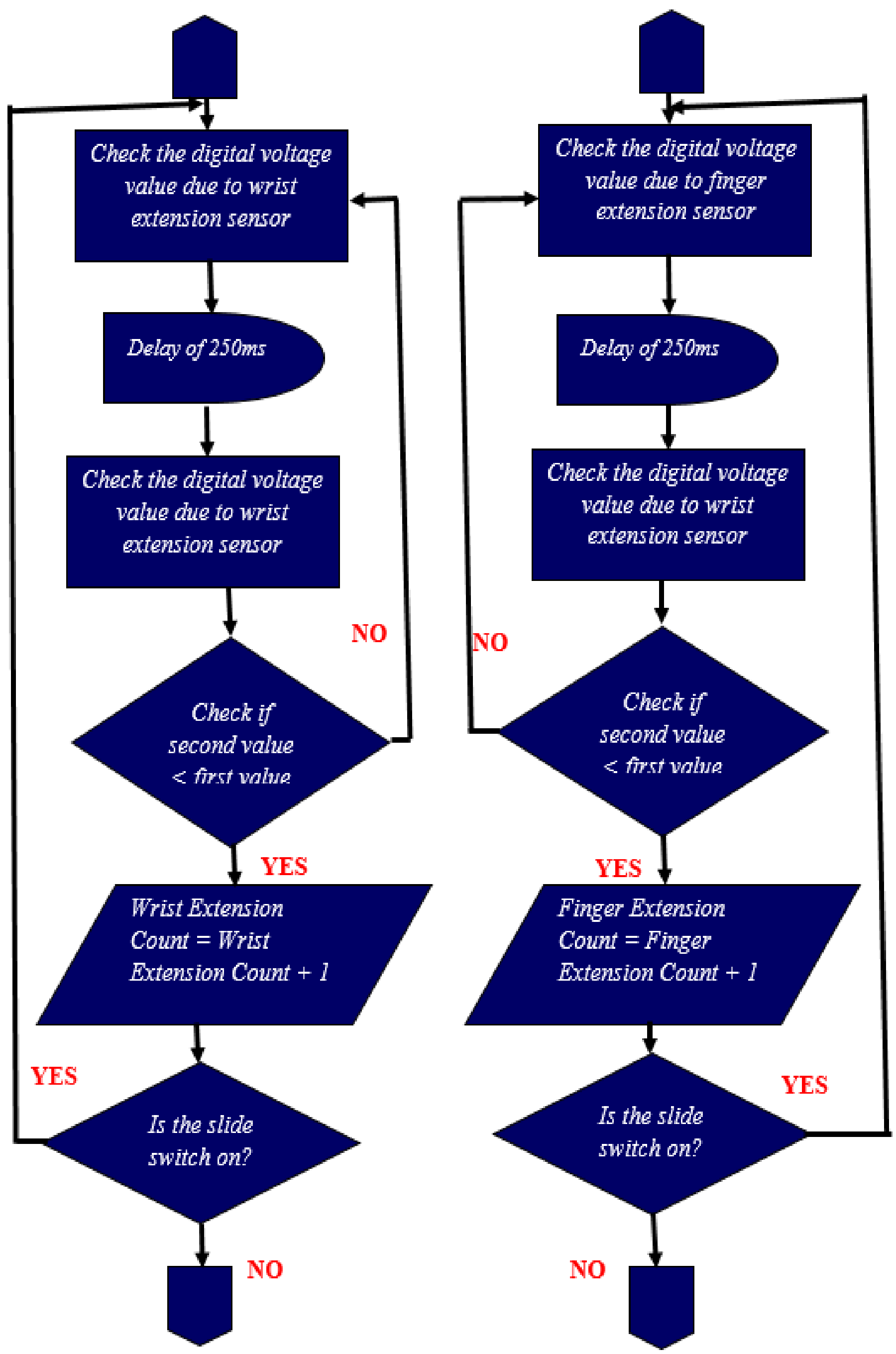


Figure 14: Microcontroller programming for wrist and finger communication detection (follow 3)

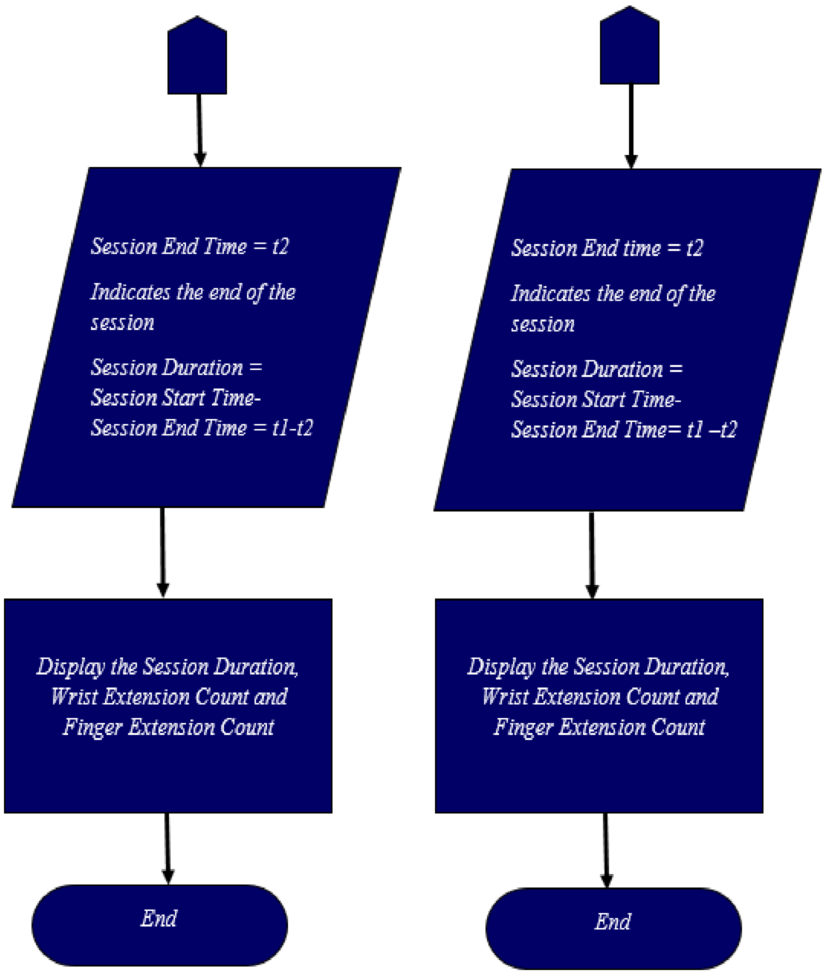


Figure 15: Perform the operation for a precise control to detect wrist and finger connections (follow 4)

You can modify the sensor sensitivity in the program. , Fist sensitivity can be adjusted, and finger bending can be adjusted for each rider

3.8 Communications and interfaces

The ESP32 microcontroller is equipped with a lbm313. The device must support the Bluetooth 4.0 connection protocols and must have a Android, Mac or Windows. These external devices can be phones, tablets, or phones.

3.9 Display Units

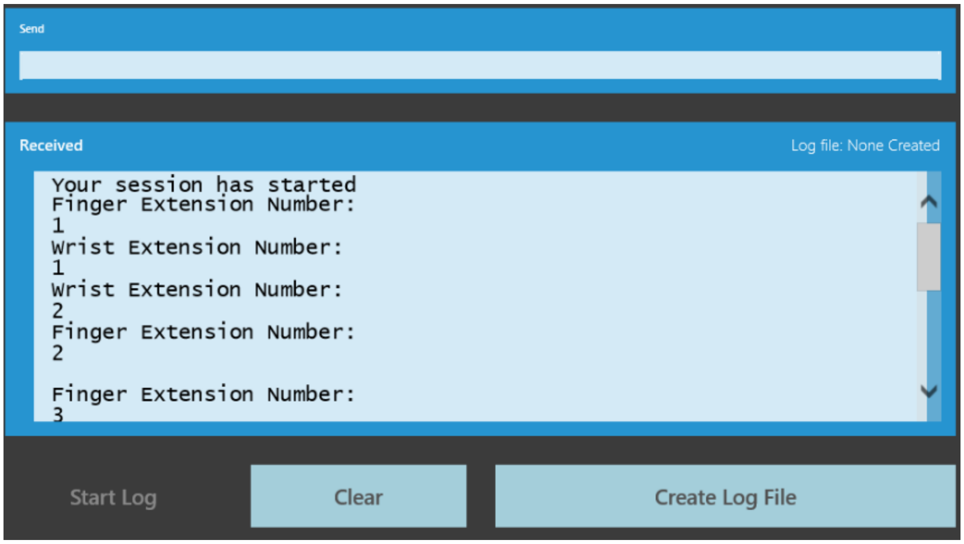
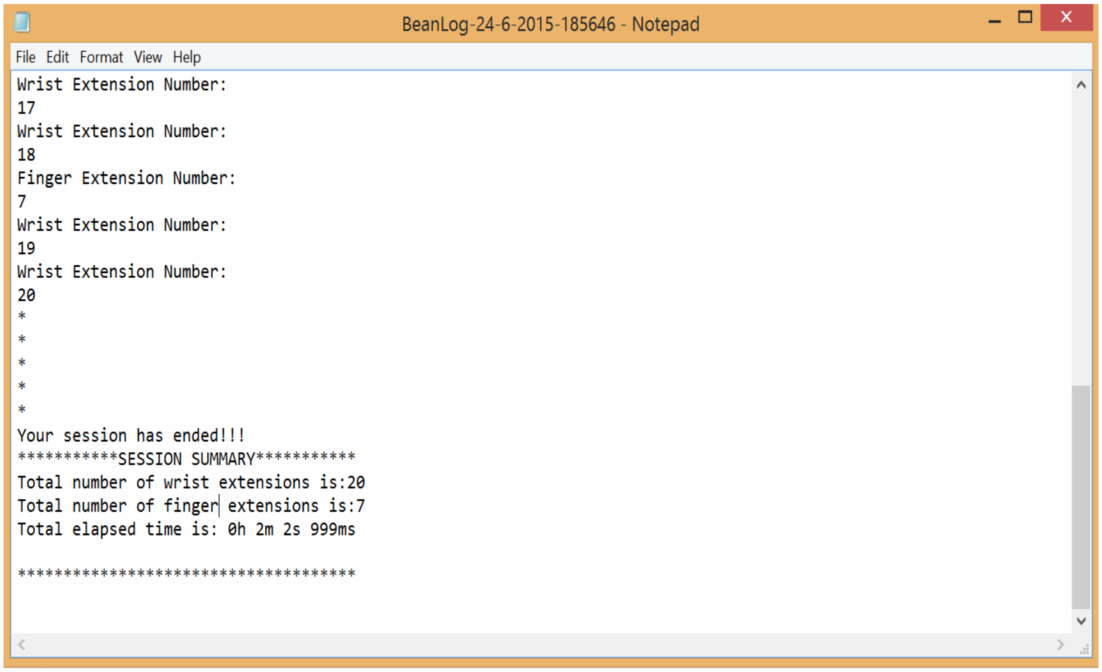


Figure 16: ESP-IDF serial monitor displays connectivity when detected

The ESP-IDE serial port monitor will show a connection if is found. Each turn is displayed on rider phone screen by the ESPIDF software. The software has a built-in serial screen that displays the microcontroller's program output. The software and the nut reconnect via Bluetooth.

3.10 Reporting Unit

ESP-IDE can be exported to a text file using the Serial Monitor plug-in. Information on the number of fist and finger extensions and time spent during the session. This text file can be used as a reference later to keep track of how riders perform over time.




```
Wrist Extension Number:
17
Wrist Extension Number:
18
Finger Extension Number:
7
Wrist Extension Number:
19
Wrist Extension Number:
20
*
*
*
*
*
Your session has ended!!!
***********SESSION SUMMARY***********
Total number of wrist extensions is:20
Total number of finger extensions is:7
Total elapsed time is: 0h 2m 2s 999ms

*************************************
```

Figure 17: Records forms created at the end of the overview response session on the integrated system

Single blocks are combined to realize a complete system. Security Design ensures continuity of relationships between blocks by checking. The data acquisition device is connected and converted to a console that transmits data to the display device via a Bluetooth connection protocol. If the system works only when the slider key is active, the system works properly and displays the number of fist and finger links on the moving screen when noticed.

Figure 18: Integrated Smart Glove System

Smart Glove Integration When the system is switched off, it should generate a session summary that can be transferred to a text file. The system works end-to-end and measures its effectiveness with gloves on incident response.

Chapter 4: Circuit Elements

4.1 ESP 32 microcontroller:

Esp32 was created by Espressif Systems, a low-cost, low-power chip system (SoC) with dual-mode Wi-Fi and Bluetooth capabilities. The ESP32 family includes ESP32-D0WDQ6 (AND ESP32-D0WD), ESP32-D2WD, ESP32-S0WD chipsets and systems in the ESP32-PICO-D4 (SiP) package. In between, there is a dual-core or single-core Butic Xtensa LX6 microprocessor at speeds of up to 240 MHz per hour. ESP32 with built-in antenna keys, RF balans, power amplifiers, highly compact low speakers, acceptance amplifiers, filters, and power management units. Designed for mobile devices, wearable electronics and IoT applications, ESP32 delivers extremely low energy consumption with energy-saving features such as precise clock resolution, multiple power modes and dynamic power regulation.

Specifications

- **Healer:**
    - Main processor: Butika Xtensa LX6 32-bit microprocessor
        - **Basic:** 2 or 1 (depending on the difference).

With the exception of the single-core ESP32-S0WD chip, all ESP32 family segments are dual-core.

- - - **Hourly frequency:** up to 240 MHz
        - **Performance:** Up to 600 DMIPS
    - **Ultra-low power setting processor:** Allows you to make ADC conversions, calculations, and level thresholds during deep sleep.
- **Wireless connection:**
    - **Wi-Fi: 802.11** b/g/n/e/i (802.11n @ 2.4 GHz up to 150 Mbps).
    - **Bluetooth:** BR/EDR v4.2 and Low Power Bluetooth (BLE).
- **Memory:**
    - **Internal memory:**
        - **Read-only memory:** 448 KB

for boot and key functions.

- - - **Fixed memory:** 520 KB

for data and descriptions.

- - - **PSTN Fast Still Memory:** 8 KB

It is used to store data and boot RtC to the current core CPU from deep sleep mode.

- - - **RTC Slow Still Memory:** KiB 8

Access to the unified processor in deep sleep mode.

- **eFuse:** 1 Kibbit

Of these, 256-bit system (MAC address and chip configuration) are used, and the remaining 768 bits are reserved for client applications, including flash encryption and chip IDs.

- **Built-in lightning:**

Internally portable memory is connected via IO16, IO17, SD_CMD, SD_CLK and SD_DATA_0 SD_DATA_1 in ESP32-D2WD and ESP32-PICO-D4.

  - 0 Mbps (ESP32-D0WDQ6, ESP32-D0WD and ESP32-S0WD chips)
  - 2 Mbps (ESP32-D2WD chip)
  - 4 Mbps (ESP32-PICO-D4 SiC unit)

- **External Flash and SRAM:** Esp32 supports up to four external QSPI flash with 16 Mbps and SRAM with AES-based hardware encryption to protect developer software and data. Esp32 can access external QSPI and SRAM flash memory via cache.
  - External flash memory allocates up to 16 Mbps of CPU code space and supports access to 8, 16 and 32 bits. Supports code execution.
  - Up to 8 Mbps of external flash/SRAM memory is allocated to CPU data space and supports access to 8, 16 and 32 bits. Support data reading for flash memory and SRAM. Data writing supports SRAM.

Esp32 chips with built-in flash memory do not support the assignment of addresses between external flash memory and peripherals.

- **Peripheral I/O**: Dynamic Mechanical Analysis (DMA) Terminal Interfaces including Snuff Touch, ADC (Analog-to-Digital Adapter), DAC (Digital to Analog Adapter), I²C (Integrated Integrated Circuit), UART (Asynchronous global receiver/transmitter), CAN 2.0 (console area network), SPI (serial terminal interface), I²S (built-in sound between IC), RMII (reduced media interface), PWM (pulse display adjustment), etc.

- **Secure:**
  - Supports all standard security features IEEE 802.11, including WFA, WPA/WPA2 and WAPI
  - Safe boot
  - Flash encryption
  - 1024 bit OTP, customers up to 768 bits

- Speeding up encryption devices: AES, SHA-2, RSA, elliptical curve encryption (ECC), random number generator (RNG)

Key features

Strong design

Esp32 works reliably in industrial environments from -40°C to +125°C. ESP32, backed by advanced calibration circuits, dynamically eliminates defects in external circuits and adapts to changes in external conditions.

Very low energy consumption

Designed for mobile devices, wearable electronics and IoT applications, esp32 delivers extremely low energy consumption by combining multiple types of proprietary software. ESP32 also includes advanced features such as micro watch slot, multiple power modes and dynamic power organization.

High level of integration

Esp32 is heavily integrated with built-in antenna keys, RF balloons, power amplifiers, low-noise speakers to receive speakers, filters, and power management units. ESP32 adds valuable functionality and flexibility to your app while meeting minimum printed circuit board (PCB) requirements.

A combination of Wi-Fi and Bluetooth chips

Esp32 can be used as a complete standalone system and a write-in for the host MCU, reducing the overhead of the communication stack on the main application processor. Esp32 can interact with other systems, providing Wi-Fi and Bluetooth capabilities through SPI/SDIO or I2C/UART interfaces.

4.2 List of Components

The components used in the circuit and the components that interact with ESP-32 are as follows:

- **TTP223 Touch Sensor**
- **VCNL4010 Proximity and Ambient Light Sensor**
- **Max30102 Pulse Oxygen meter Sensor**
- **LED layout**
- **GPS Module**
- **battery**
- **Switch**

4.3 TTP223 Touch Sensor

TTP223 features

- Operating voltage 2.0V ~5.5V
- handle @VDD = 3V, no download
- In a typical low power mode of 1.5uA, the maximum value is 3.0uA
- Maximum response time in low power mode is 220 mS @VDD = 3V
- Allergies can be adjusted using an external capacitor (0 to 50 pixels Fahrenheit).
- Stable detection of human communication replaces the traditional direct opening key
- Low power mode configuration
- Direct mode switch mode is provided according to the panel option (PIN TOG) and pin Q is cmos output
- All output modes can be selected via ahlb PIN for high or low activity
- There was a stability time of about 0.5 seconds after playback, when the keyboard was not touched and the function was deactivated.
- Automatic life calibration.
- In low power mode, the recalibration period is usually about 4.0 seconds,
- When you discover a key touch and edit the touch, it will be automatically calibrated about 16 seconds after the key is released.
- TTP223N-BA6 sensitivity is better than TTP223-BA6 sensitivity. However, the stability of TTP223N-BA6 is worse than that of TTP223-BA6.

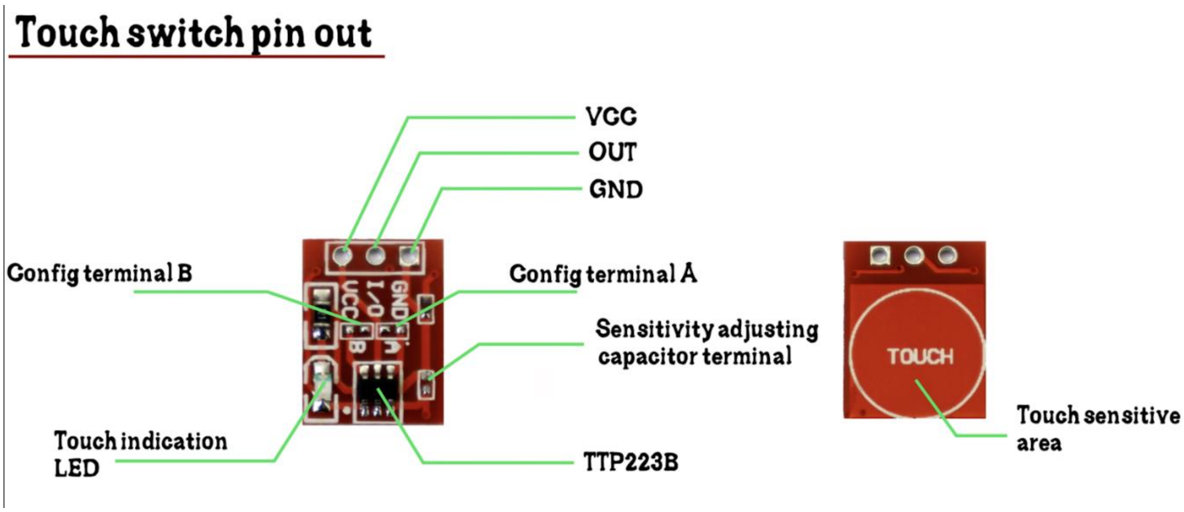


Figure 19: Click on the Settings switch

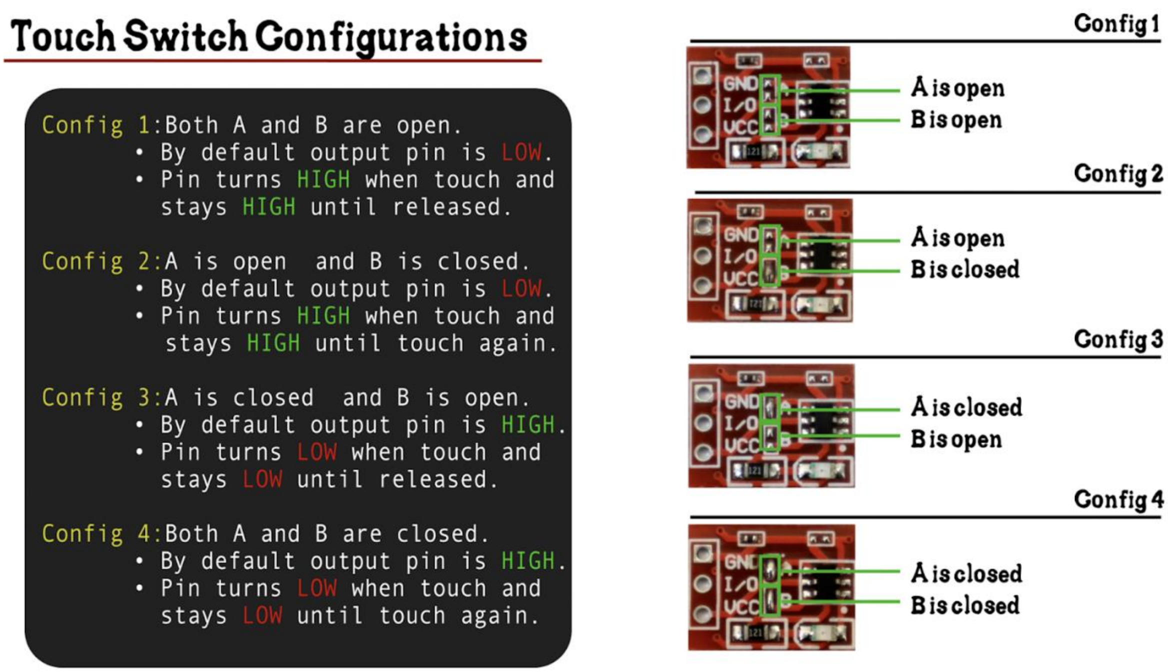


Figure 20: This touch key has four different settings, which are described in more detail below.

Configuration 1:

- To get a configuration, both parties A and B must be in open mode.
- The default output state will be low
- Changes status (to high) when you detect a touch function, and returns to the default state when you edit the touch function

Configuration 2:

- To get the settings, one must be turned on and B must be turned off.

- The default output state will be low
- When a contact is discovered, it changes the situation and remains in that state until another touch is discovered.

Configuration 3:

- For a single configuration, A must be in closed mode and B must be in open mode.
- The default output state will be high
- Status (changes to low) when you discover a touch, and returns to default when you edit touch

Configuration 4:

- To get a configuration, stations A and B must be in closed mode.
- The default output state will be high
- When a contact is discovered, it changes the situation and remains in that state until another touch is discovered.

Adjust touch sensitivity

Sensitivity can be adjusted by increasing capacity, ranging from 0 to 50 pf, where 0pf provides complete sensitivity and provides 50pf minimum sensitivity. For example, if you need a touch key to pass through glass or acrylic, you need to adjust the sensitivity according to the thickness of the material.

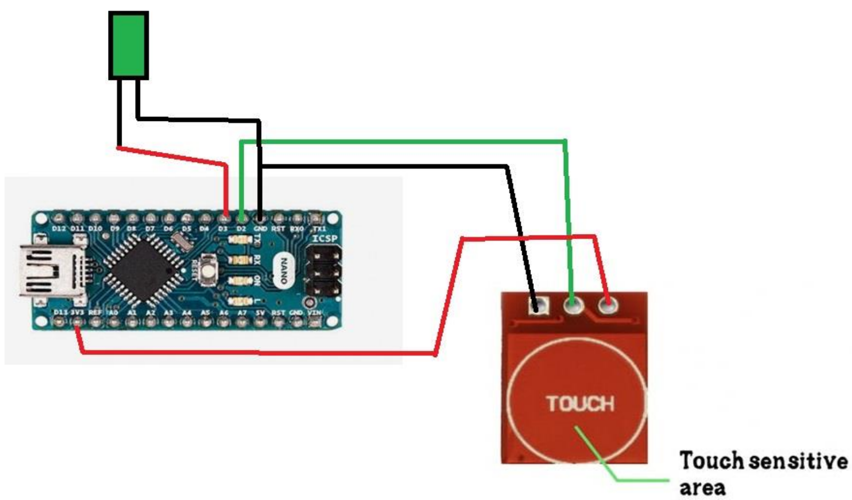


Figure 21: Simple Circuit with LED and touch module

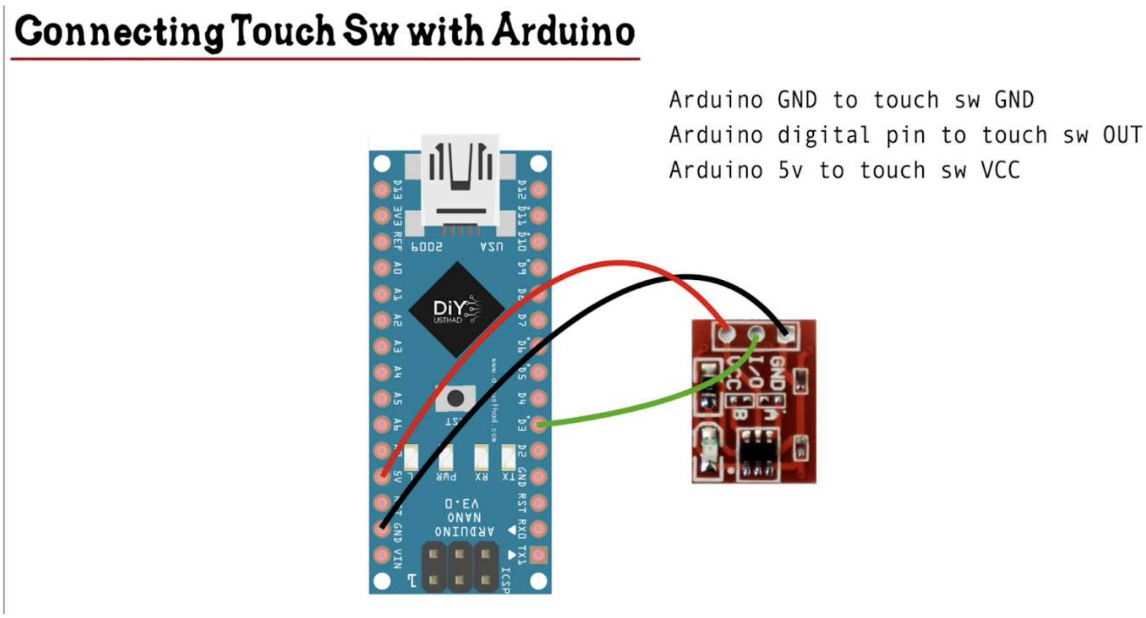


Figure 22: Interfaces with ESP32

Table 1: Touch Module

ESP32	**Click on the program icon**
interrupt	interrupt
5 volts	interrupt
D3	Inputs/Outputs

4.4 MH Series Sensor

MH series sensor is an optical line sensor. This sensor is compatible with both digital and analog mode. It is easy to use sensor. Its infrared light reflects on surface used for line tracking or sense object or obstacle

Characteristics

TCRT5000 is the sensor IC.

Detection range: 60 millimeters

Sensitive to surfaces that are black or white in colour

Typical Characteristics

LM393 is a logical IC.

3.3–5V operating voltage

15 mA output current

Sensitivity can be adjusted using a potentiometer.

POWER and OUTPUT LED indicators are included

Bolt holes are pre-drilled for ease of installation.

32 x 14 mm in size

Figure 23: MH sensor series

4.5 Max30102 Pulse Oximeter Sensor

Introduction

Max30102 sensor is an improved version of the MAX30100 sensor. It is used as a heart rate monitor and pulse oxygen meter. These features are achieved through the sensor structure, which consists of two LED lamps, a light detector, improved optics, and a low-noise signal processing kit. It's easy to use with microcontrollers such as ESP32, ESP32, ESP8266 Node MCU, etc. to build effective heart rate and oxygen saturation devices.

Below you can see a diagram of max30102:

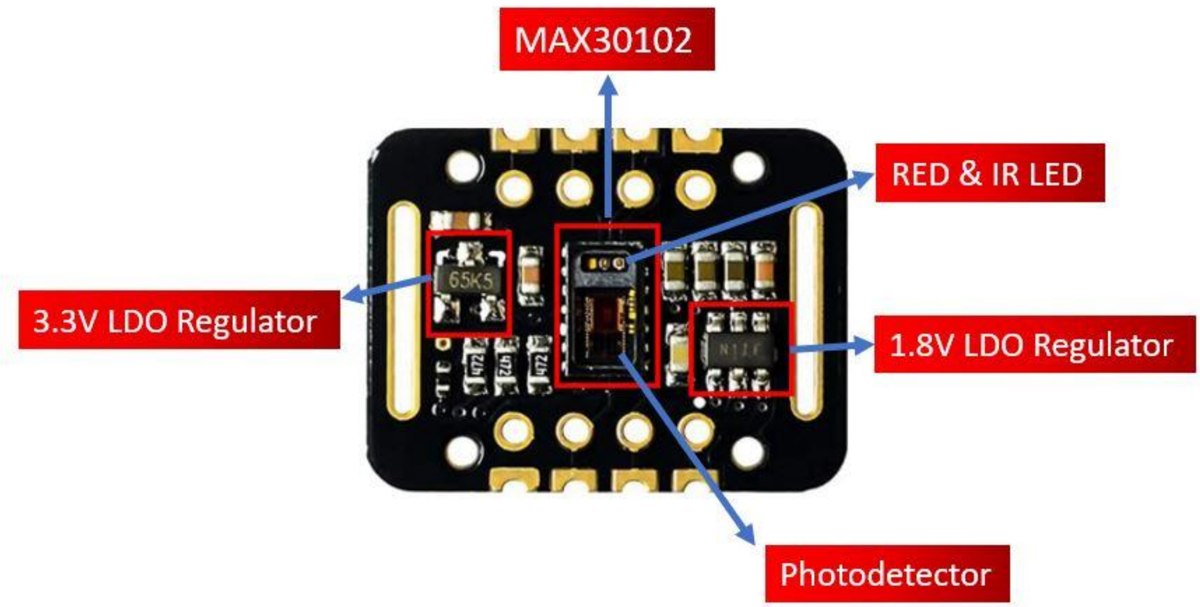


Figure 24: Max30102

As I noted, IC MAX30102 is located in the center of the unit. The unit consists of two different types of LED lamps (red and infrared) and optical detectors. Oxygen saturation and heart rate are found to take advantage of these two main properties. We'll then learn how the sensor actually works to get BPM and SpO2 readings.

Another important feature you may have noticed is that the MAX30102 sensor unit consists of LDO regulators. This is because the MAX30100 IC requires 1.8V and LED lamps need 3.3V to function properly. By adding an voltage regulator, we can use a microcontroller safely that uses an input/output level of 5/3.3/1.8V.

Additionally, if you look at the unit from behind, you can take a look at the bridge to determine the logical voltage level. By default, it is set at 3.3 volts, but you can also change it to 1.8 volts depending on the logical requirements of the microcontroller.

Key features

- The MAX30102 sensor unit features a very low power operating current of 600μA (measurement mode) and 0.7μA (standby mode). Therefore, a great choice for use on wearables such as smartwatches.
- It features a high sample rate feature as well as rapid data output.
- In addition, the sensor has a built-in ambient light cancellation function.
- Another feature of the MAX30102 sensor unit is to include the temperature sensor on the slide. This gives us a dead temperature (-40°C to +85°C) and exactly ± 1°C.

- To communicate with the microcontroller, the sensor uses SCL and SDA I2C pins.
- Another advantage of the sensor is that it **uses a 32-sample FIFO buffer** to store data, while MAX30100 has only 16 samples of the fiFO buffer. In other words, it reduces power consumption because it already has up to 32 heart rate value and SPO2.
- Max30102 can also be used to interfere with some energy sources, such as current power sources, ready-made new data, ambient lighting cancellation, temperature completion, and near-complete FIFOs. By generating interference, the microcontroller can perform other events that will not occur during the implementation of the serial program while the sensor continues to obtain new data samples.

The following table explains the details of this sensor:

Table 2: Details of Max30102

Maximum current use	6 mAh
location	3.3-5 volts
Frequency of sampling	50 Hz 3200 Hz
Temperature range	-40°C to +85°C
Temperature accuracy	± 1°C
BLK accuracy	18 bits
Maximum IR LED wavelength	880 nm
Peak wavelength of red LED	660 nm

How max30102 pulse oximeter works

In this section, we talk about how the MAX30102 heart rate monitor and pulse oxygenometer work.

Pulse oxygenation scale

To find the concentration of oxygen (%) in the blood, it is important first to know that we are responsible in the blood for the transfer of oxygen. When a person carries a pulsed oxygenometer, light from the device passes through the blood on the finger. This is used to track oxygen levels by measuring changes in light absorption in oxygenated and non-oxygenated blood.

As mentioned earlier, the MAX30102 sensor consists of two LED lamps (red and infrared) and a photo Dynic diode valve. Both LED lamps are used for SpO2 measurements. Lamps emit different wavelengths of light, with a red LED of about 660 nm and an infrared LED indicator of ~880 nm. At this very wavelength, oxygen and deoxyhemoglobin have very different absorption properties.

The figure below is taken from the MAX30100 IC data sheet. You may see differences between HbO2 (oxygenated hemoglobin) and Hb (different mojian lengths of dioxi hemoglobin).

System block diagram

Oxygenated hemoglobin absorbs more infrared light and reflects red light again, while dioxi hemoglobin absorbs more red light and reflects it back into infrared light. Reflected light is measured by optical detectors. Max30102 sensor reads these different absorption levels to find the concentration of oxygen in the blood (SpO2). The percentage of infrared and red light received by the optical detector provides us with oxygen concentration in the blood.

Measuring heart rate

To measure your heart rate, we don't need a red LED, we just need an IR LED lamp. This is because oxygenated hemoglobin absorbs more infrared light.

Heart rate is the time ratio between two consecutive heartbeats. Similarly, when human blood is distributed in the human body, this blood is compressed into hairy tissue. As a result, the number of hair tissue increases, but after each heartbeat this amount decreases. This change affects the amount of hair tissue on infrared light from a sensor that transmits light after each heartbeat.

The sensor's work can be verified by placing a human finger in front of it. When the finger is placed in front of this pulse sensor, the reflection of infrared light changes according to the amount of blood in the capillaries. This means that during a heartbeat, the amount of blood in the capillaries will be high and then low after each heartbeat. Therefore, when you change this volume, the LED light changes. This change in LED light measures the finger's heart rate. This phenomenon is called "photography".

MAX30102 at the push of the sensor pin oximeter button

The MAX30102 unit consists of eight pins.

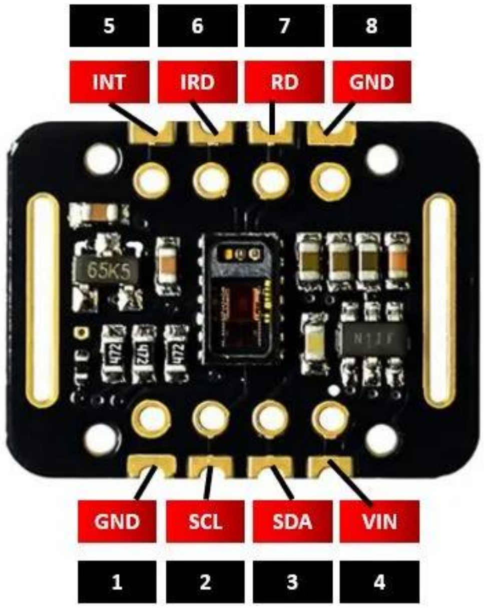


Figure 25: Max30102 and its pins

Table 3: Max30102 pins

anchor	description
location	This pin is used to turn on the sensor. The sensor runs at 3.3-5 volts.
interrupt	This is the I2C series watch pin.
interrupt	This is the I2C series data pin.
international	This needle discomfort is low motion. It is pulled by the pulse on board, but when an error occurs, it falls until the interference becomes clear.
Purchasing power parity	Infra and LED cathode points of contact for the driver
Research and development	Red LED cathode and LED driver contact points
interrupt	This is used to provide the soil with a sensor and to connect to the earth's pin of the source.

MAX30102 interface sensor with ESP32

In this section, we will learn how to connect the MAX30102 sensor with ESP32. We will use only four sensor pins to connect our microcontroller.

The sensor connection to ESP32 is as follows:

Table 4: Connection of Max30102 wit ESP32

Max30102 unit	ESP32
interrupt	3.3 volts
interrupt	BLK 22
interrupt	BLK 21
interrupt	interrupt

Connect the default PIN ESP32 I2C code to the SCL PIN code and the SDA unit. In addition, the sensor works with 3.3V in ESP32, and both causes are similar.

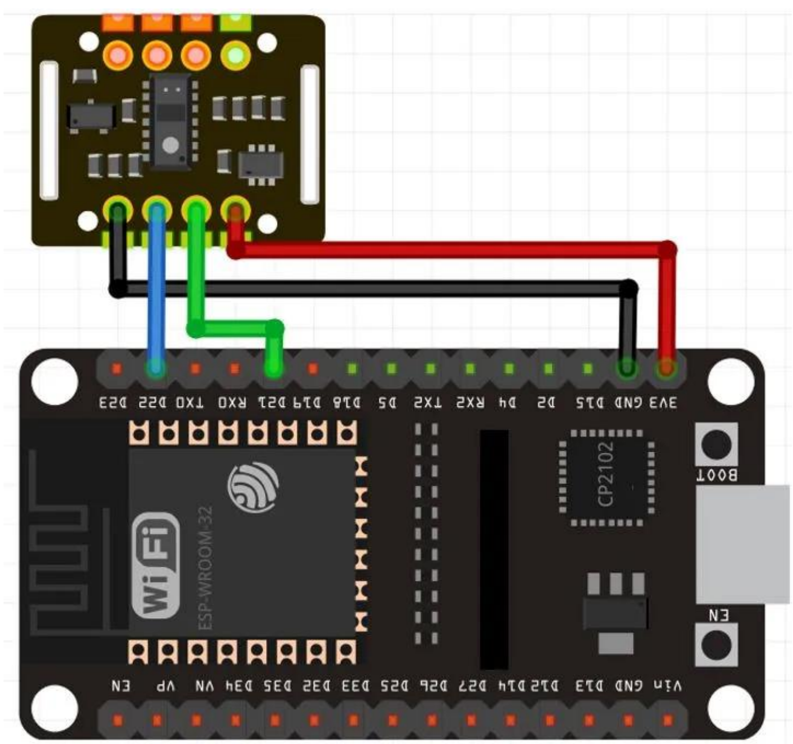


Figure 26: Max30102 with ESP32 wiring scheme

4.6 Global Positioning System

GPS is a satellite-based navigation system made up of at least 24 satellites. GPS works in any weather condition, anywhere in the world, 24 hours a day, without a subscription or setup fee.

How GPS works

Orbit satellite GPS is planet twice a day in technical orbit. Each satellite transmitted a unique signal on orbital parameters allowing GPS devices to encrypt and calculate the exact location of the satellite. THE GPS uses this information and triple measurement to calculate the user's exact location. Basically, a GPS receives distance to each satellite by how long it takes to receive the signal transmitted. With the distance measuring from more satellites, the recipient can find and see the user.

To calculate your 2D location (longitude in latitude) in track of motion, you need to lock the GPS receive signal from at least 3 satellites. If 4 or more satellites are shown, the recipient can determine your 3D location (latitude, long and height). Typically, a GPS recipient will track 8 or more satellites, but it depends on the time of day and where you are in the forget.

After determining rider location, the GPS unit mainly calculates information, such as:

- Speed
- Bearing
- Track
- Trip distance
- Distance to destination

What's the GPS signal?

Signals from GPS satellites send at slightest 2-power remote signals. Flag travel over the line of locate, which suggests they pass through clouds, glass and plastic, but not through most strong objects such as buildings and mountains. Be that as it may, present day beneficiaries are more delicate and regularly screen prisoners.

GPS signals contain 3 different types of information:

- The arbitrary code is an ID code that alludes to the adj. that conveys data. you'll be able discover out which satellites get rider device's partisan page.
- The calendar information tells the GPS where each GPS fawning will be substantial at any time of day and orbital show data on this partisan and all other satellites within the framework.

- Data transient is required to find the adj. and give vital data on the legitimacy of the satellite and current date and time.

4.7 LED array to ESP 32

This small example has an LED that is connected to a pulse of 230 Ω. You can use any pulse value between 230 Ω and 500 Ω, and the LED will be bright. However, be sure not to fall below 230 Ω because this LED pulls a lot of current from ESP32, which can cause damage.

Connect the LED anode to the GPIO in ESP32, the blue rail cathode, and the blue rail with one of the GND pins of the ESP32 development group.

You can see the chart below.

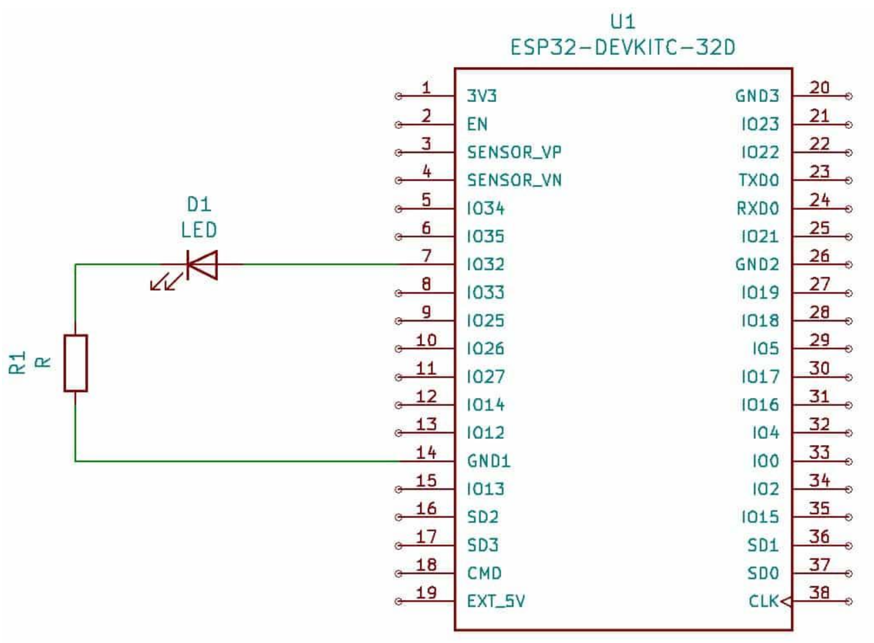


Figure 27: LED lamps are controlled by GPIO32 and protected by a 230-Ω pulse connected to GND1.

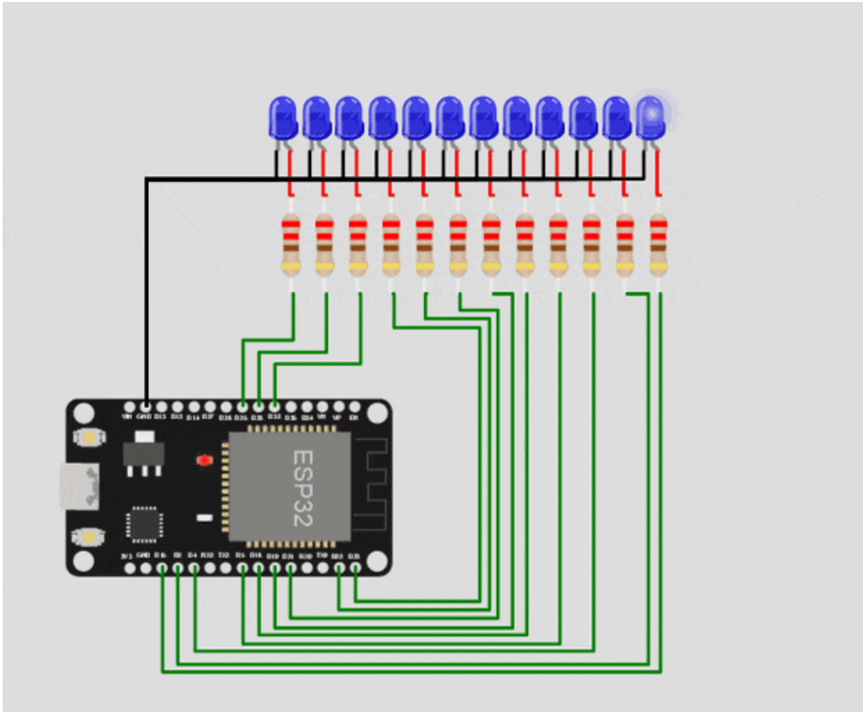


Figure 28: LEDs Connected to ESP32

4.8 Final Circuit

The final chart of all the above components in Proteus is as follows.

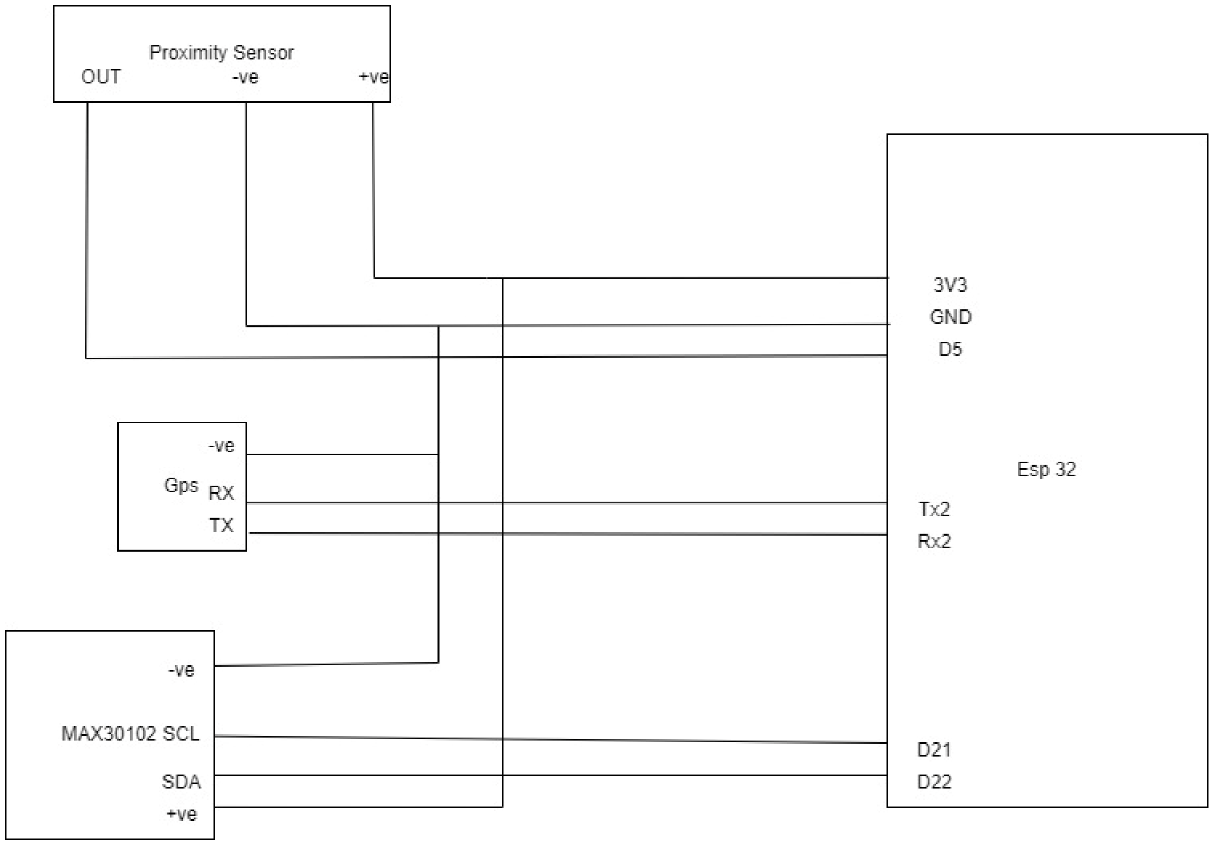


Figure 29: Smart Glove Architecture v 1.0

Chapter 5: Mobile Application

5.1 App Introduction

We created Android (Figure 3-15 represents the flowchart of the application, and forms 3-16 demonstrate the main interface of the application) to turn it into an interface between the glove and the user, and it is a simple and affordable way to communicate. The app was developed using the Android Studio IDE. For more information about the code..

Android Studio is Google's integrated development environment (IDE) that provides developers with the tools to build Android apps. Android Studio is available for download on Windows, Mac and Linux. Android Studio Foundation is based on IntelliJ IDEA. The Android Studio IDE can be downloaded and used for free. It has a rich UI development environment and templates that provide a launch pad for Android development for new developers. Developers will find that Studio gives them the tools to create solutions for phones and tablets, as well as emerging technology solutions for Android TV, Android Wear, Android Auto, Glass, and other contextual models. (Android Studio)

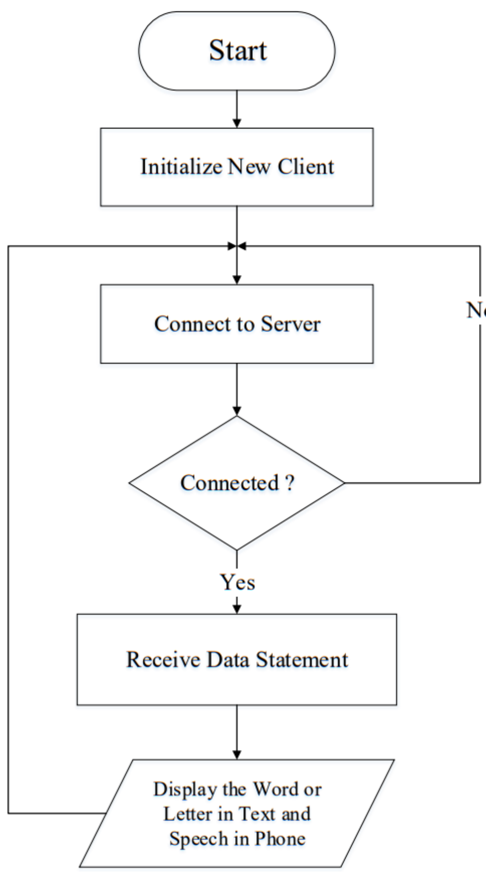


Figure 30: Shape: Flowchart of the base station unit

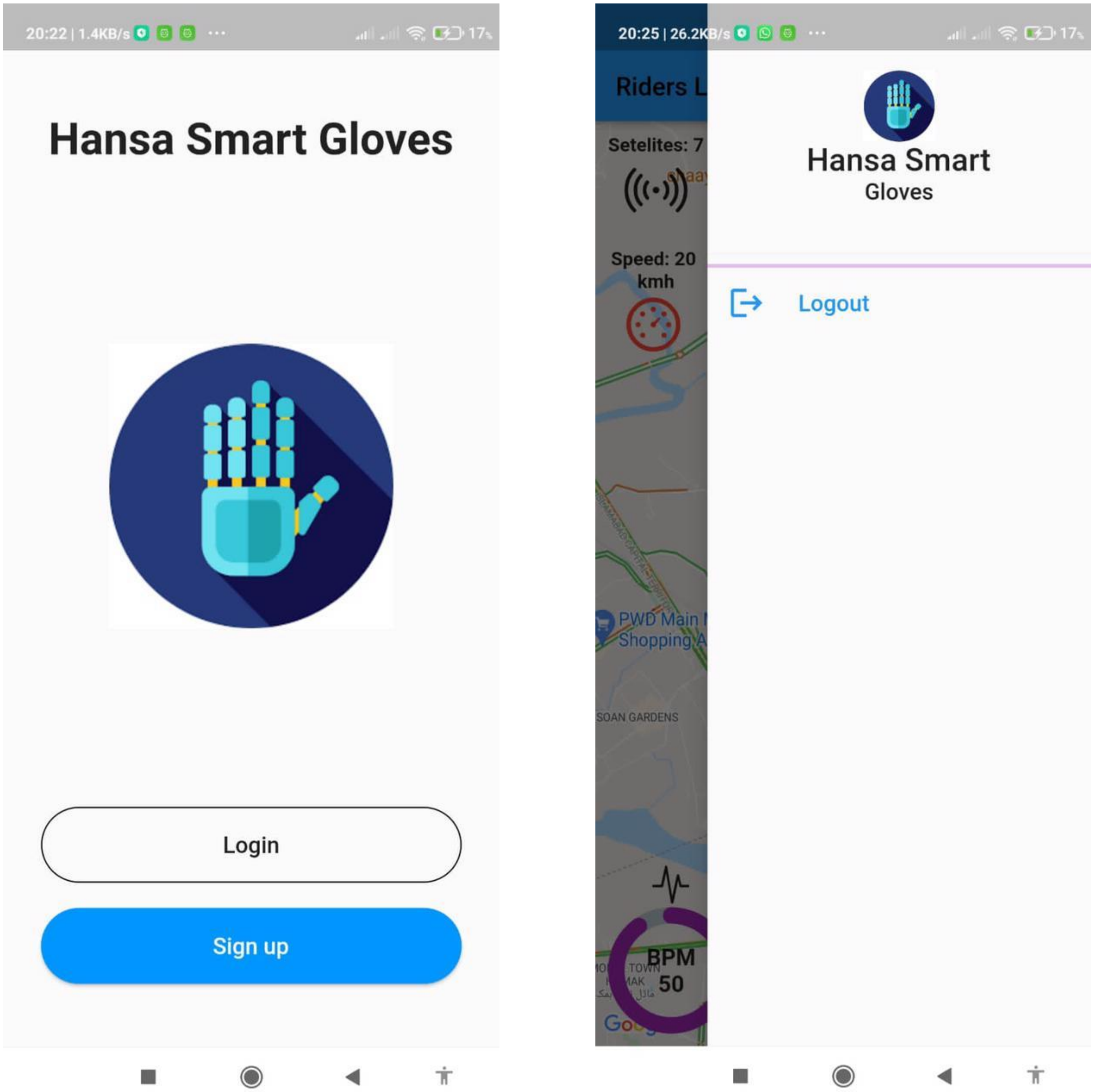


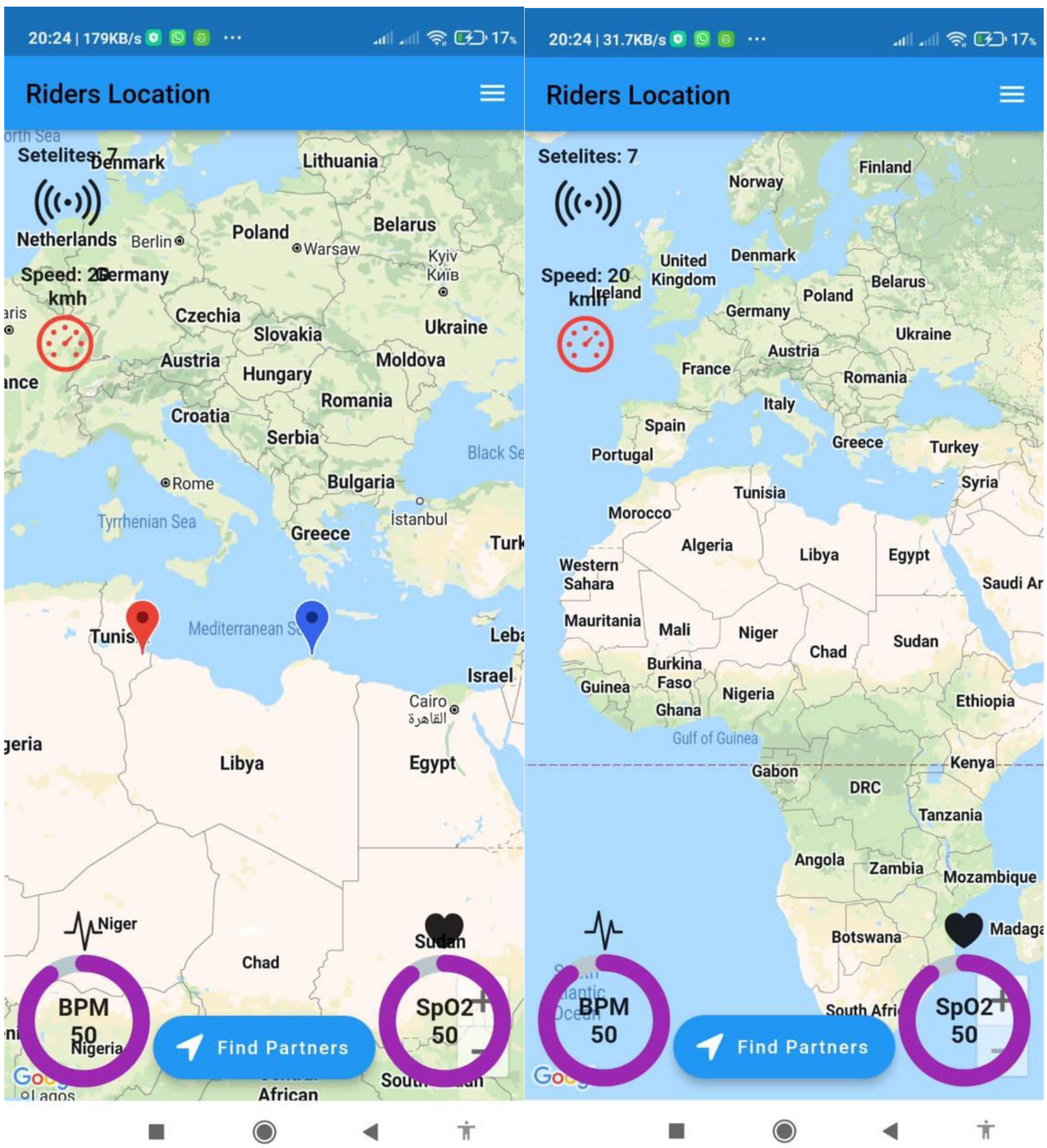
Figure 31: Main interface of the Android app

5.2 Google TTS

Google Text-to-Speech could be a screen peruser application created by Android, Inc. for its Android working framework. Run the app to examined text aloud on the screen (Read Aloud). Typically incredible innovation planned to assist individuals with visual disabilities. In any case, today's equipment producers permit Android to change over content to discourse, permitting books to be perused out loud and unused dialects to be learned. Android content was presented with sound when Android 4.2.2 Jellybean was presented, with more conversational capabilities so clients might get commonplace human-like intuitive. As of late, Google's text-to-speech innovation presented two high-quality computerized voices, assist improving the text-reading android app, which isn't common among Android clients. Right presently, there aren't numerous Android text-to-speech apps on the advertise that utilize Google's content discourse innovation totally, and the app is essentially built from two parts: plan and control code. Both are composed in Android Studios, which is what makes it simpler.

5.3 Google Maps

Android allows us to integrate Google Maps into our app. That's why Google offers us a library through Google Play Maps. You can display any location on the map, or you can see different shapes on the map .c. You can also customize the map according to rider choices.



5.4 Application Planning

The design, as shown in Figure 3-16, is written in the XML programming language, and its control code is written in Java. The code itself basically consists of two main parts. The first is the part that functions as a server, a socket server that receives data sent from Arduino, and to achieve this, an IP number of a Wi-Fi unit and a port number that can be configured from Arduino are required. 38 Part II is an integration with a built-in library called TextToSpeak that allows us to pronounce words and use them for this purpose.

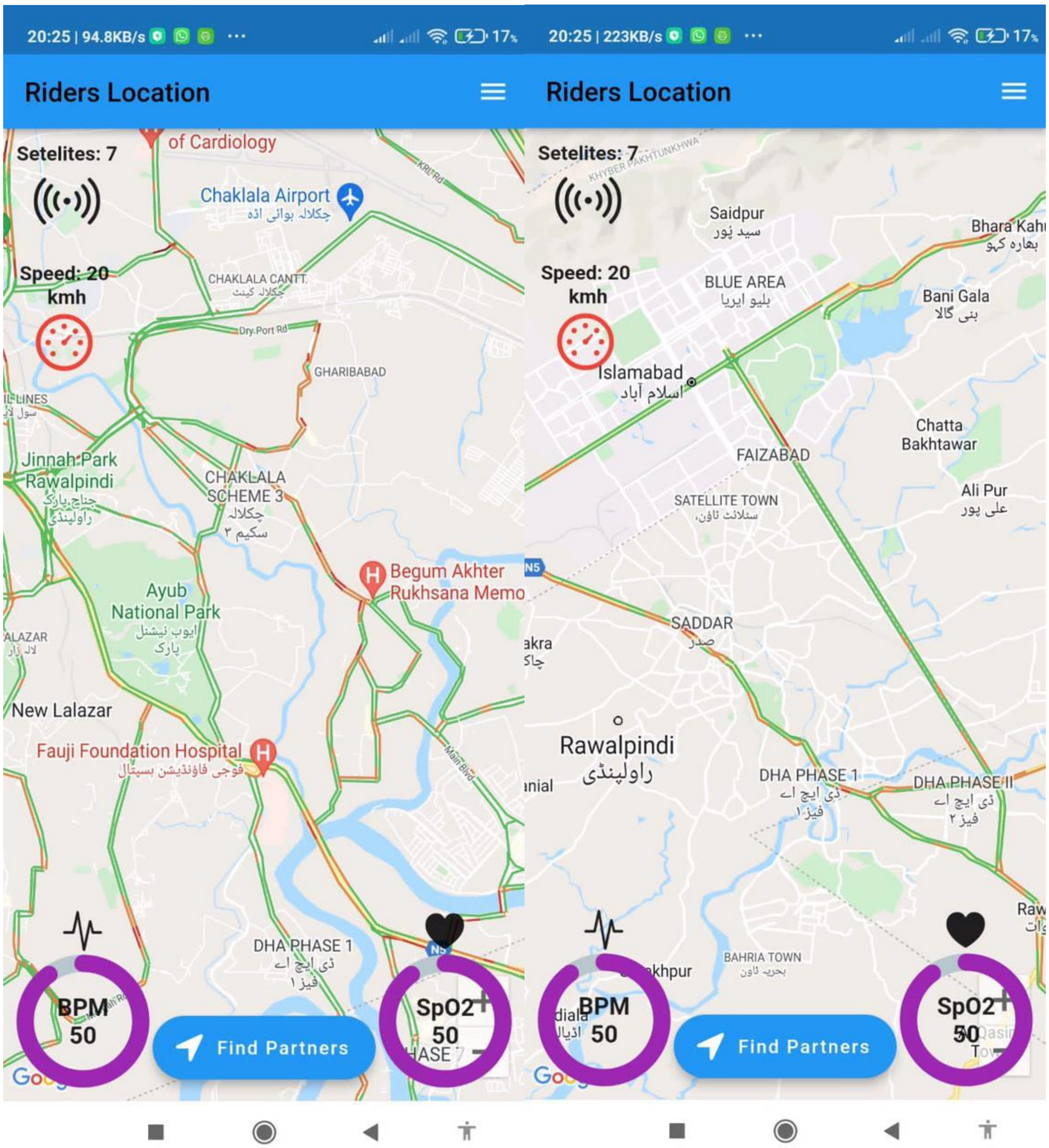


Figure 32: Integrated local map of rider data.

5.5 Socket Server

Plugs allow communication between two different processes on the same device or on different devices. More precisely, it is a way to communicate with other computers using standard Unix file descriptors. On Unix, each input/output process is done by writing or reading a file descriptor. The file description is simply a valid number that links to an open file that can connect to a network, text file, terminal, or anything else. For programmers, sockets look and behave like low-level file descriptors. This is because commands like read and write and plugins work in the same way as files and pipelines. These plugs were originally introduced in 2.1BSD and then revised in their current form in 4.2BSD. Plugs are now available for most of the latest versions of UNIX

Chapter 6: Hardware Test

The effectiveness of gloves can be confirmed by testing on bike riders with different degrees of degradation. Accident impact riders usually have different degrees of injury to the left and right sides of the body. The amount of cramping between the fist and fingers may also vary.

Figure 33: Prepared Gloves Design With hardware features

Before testing smart gloves on the contestants, they initially performed effective tests when performing three different tasks. Tasks are performed wearing gloves and are carefully selected to combine many stretches of fingers and fist. This is ensured by performing tasks repeatedly.

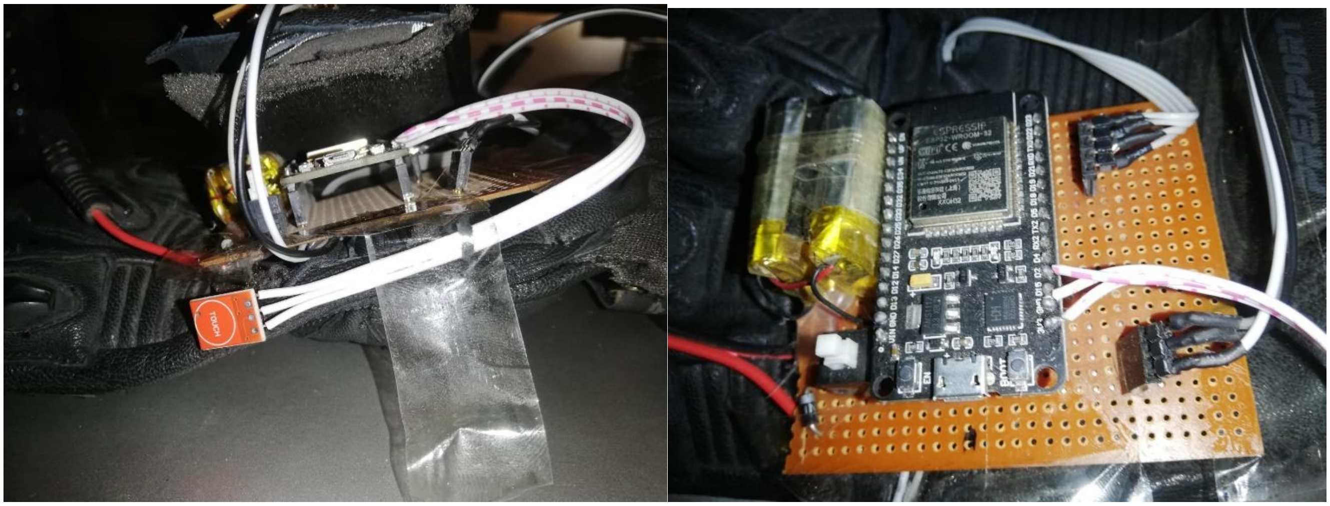


Figure 34: (a)Side View (b)Top view

Table 2. Summary of 3 Tests on Health Topics

Table 5: Connections

Session No.	Wrist connection	Finger connection	Total number of connections	Total time (minutes)	Average total number of connections	Average total time (minutes)
1	76	120	196	15.45		
2	145	72	217	15.1	206	15.21
3	116	91	207	15.07		

The average duration of the meeting was 15.21 minutes. Gloves are able to capture different types of communications made during the session.

6.1 Test Two Wheel Riders

Smart gloves were tested on two-wheel riders at Research Centre and Labs. Two-wheel riders have varying degrees of injury, depending on the extent of accident impact or traumatic brain injury. Therefore, for the testing process, a smart procedure is used for the two-wheel rider and modifications to the design are implemented or proposed based on comments from subsequent meetings.

At first, riders must wear gloves and make different stretches of their fingers and fists. Because conductors have varying degrees of motor neuron interference, the sensitivity level is set to reveal the maximum range each person can do. Riders are asked to perform the task of boxes and blocks, sit at the table, and are asked to take the lower blocks from the table and put them in the box on the floor.

Chapter 7: Results

Smart gloves were successfully manufactured at a total manufacturing cost of Rs. 10,000, making it possible for pointss and passengers to be accessible to all. An appropriate connection is created between data acquisition, data conversion, data processing, and visualization units. Smart glove-related anti-intelligence sensors can detect finger and fist contact between the control object and the race driver when responding. Sensitivity can be adjusted to independently detect fist and finger connections according to the amount of cramping indicated on the fist and finger. An additional Velcro belt is sewn into the glove to provide a comfortable fit for the wearer.

A successful interface has been created between external devices and the console. The exact controller is programmed to work based on an algorithm that checks the sensor's pulse value by 250 milliseconds. Expansion is detected by a continuous decrease in sensor pulse over a period of time. The sensitivity value can be altered between 0 and 100 in the program. The period of the response session can be expressed in a millisecond resolution.

The serial screen in the nut loader program can fill in the fist count and finger extensions each time the target performs during the response session. At the end of the ride, a summary is created with details of how many connections were made and how long the session was made.

Adequacy of these gloves has been tried in engine neuron two-wheel riders who have been educated to wear gloves when performing errands amid the reaction session. Comments and comments are collected after each session, and the glove plan is altered amid the session to encourage the unhindered development of the subject's hand amid the reaction. The glove can identify distinctive sorts of communication between race pilots with diverse levels of obstructions. Usually accomplished by carefully altering the level of clench hand affectability and finger expansions agreeing to the degree of disintegration. By making steady plan changes with progressive sessions based on collected comments, individuals were able to wear gloves admirably amid their gatherings. The primary model of keen gloves works productively.

Chapter 8: Discussion

During the test, a number of adjustments had been made to the gloves, consisting of casting off the whole forearm besides for the index finger and shortening the threads to ESP32. While the first prototype was once functionally effective, the glove required a lot of change earlier than it ought to be extensively examined in factors and homes.

Initially, when trying out all glove functions, there used to be a large distinction in the quantity of fist extensions and fingers that had been performed for the identical set of duties in the course of the session. This may also be due to the fact of a unique way to resolve the task. When you operate a venture in a session, you do not pay tons interest to the kind of visitors blanketed in the task. Accident influence restoration response periods are commonly evaluated via the variety of instances the challenge is completed. Smart gloves can grant vital statistics about the kind of motion that combines to whole the activity.

This can additionally be considered in The Rider 2 from Research Lab. Since each arms have distinct stages of cramping, there is a considerable distinction in the wide variety of fingers and fist extensions detected when performing the equal undertaking with one-of-a-kind hands. When you operate a task, the predicted incidence of a unique kind of connection can be done via imparting the problem with the right guidelines and remarks whilst performing the task. This was once proven in Rider three and Rider four as they carried out extra fist and finger extensions at some stage in the session. Before the session, they will get clear guidelines on how to function the task. In addition, the processor can decide compensation with the assist of real-time get admission to to session logs on the screen. Two-wheel riders are notified every time compensation is considered. This helps them to function the required step constantly.

Pilot 1 had remarkable problem carrying gloves due to the excessive diploma of cramping on his hands. He should no longer attain out to his fingers and pass them in every other's gloved toes. After this session, the finger opening is reduced off from the glove, besides for the index finger opening the place the sensor is mounted. In successive sessions, human beings have now not had plenty situation carrying gloves. In addition, the processor will every so often assist you make some connections. Gloves can't discover lively and passive connections. This hassle can be resolved through shutting down the device as lengthy as the processor desires to make terrible movements. This can additionally inspire the processor to keep away from making terrible movements.

The cell show interface does no longer grant wonderful remarks to passengers and wants to be redesigned. They can't center of attention on the serial display screen for statistics about the kind of connection detected. This can be resolved with the aid of imparting audio remarks when the transaction is carried out correctly. This eliminates the want to pay specific interest to accomplished studying values on your laptop display screen when performing the task. Through auditory feedback, vacationers can alternate the way they function duties to amplify the incidence of positive kinds of communication.

Most two-wheel riders can solely create a faraway connection to their fingers. The gloves are designed to test close by links. After a session with Pilot 1, it was once additionally mentioned that the cable connection at ESP-32 MCU used to be fragile. Mainly due to the use of multi-fiber conductive cables to weld contact with the perf panel connected to the nut. This hassle can be solved by means of changing multifiber cables with skinny stable copper wire cables. As a brief treatment, enhance the welded connection on the overall performance plate.

Another plausible gain of gloves is to keep away from convulsions prompted through use. Convulsions are a kind of muscle dysfunction characterized with the aid of muscle stiffness that limits the bendy motion of the joints. Due to the loss of sternum indicators from the spinal cortex, injured two-wheel riders do now not have the potential to manage muscle movements. Convulsions appear in 30% of accidents that have an impact on two-wheel riders and show up in first few days an accident influence performed a learn about on 103 motor neuron two-wheel riders to reveal a range of types of convulsions (Wissel et al., 2010). In the higher limbs, convulsions in most cases influence the elbows (79% of two-wheel riders) and fists (66%). The most frequent structure of cramping is bending elbows, fists, and fingers (Casals et al., 2011). Since convulsions can manifest due to excessive motion that happens at some stage in healing, they are one of the foremost limitations to imparting motor neuron recovery. Smart gloves can be worn to keep away from convulsions that rely on this use via limiting the quantity of fist/finger connections that motive convulsions and permitting the therapist to keep away from such movements.

Our findings endorse that smart glove can discover close by fist and finger contacts amongst two-wheel riders with various ranges of damage. Some format flaws should be overcome earlier than being examined on a massive variety of two-wheel riders in factors and homes. However, smart gloves have the plausible to grow to a less-priced auxiliary system.

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