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Bluetooth IOT Paralysis Patient Health Care

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Abstract: The device providing aiding individuals with paralysis, who struggle to communicate their needs due to impaired motor coordination. The system facilitates communication by allowing the user to transmit text messages using finger movements, particularly beneficial in situations where direct assistance is unavailable. Leveraging Bluetooth technology, the system detects the tilt direction of the user's finger to operate effectively, enabling patients to interact with healthcare professionals, therapists, and family members remotely.

Moreover, the system incorporates continuous monitoring of vital signs, such as heart rate, crucial for healthcare settings. By integrating a microcontroller and a transmitting module, the system collects and transmits periodic data, ensuring realtime monitoring of the patient's health status. The received data is decoded and displayed on graphical interfaces accessible via laptops, empowering healthcare providers to oversee multiple cases simultaneously.

Furthermore, the system offers functionalities for anomaly detection and status monitoring, enabling prompt intervention in case of any deviations or changes in the patient's condition. This comprehensive approach enhances the efficiency of healthcare management and ensures timely responses to critical situations.

The development of this solution required the creation of a specialized device capable of translating elementary motions into meaningful communication. The device is designed to be discreet, fitting within the user's clothing or worn on their finger, ensuring comfort and convenience while facilitating seamless communication.

In summary, the proposed system addresses the communication challenges faced by individuals with paralysis, offering a reliable and accessible means of interaction. By integrating motion-sensing technology with continuous health monitoring capabilities, the system empowers both patients and healthcare providers, facilitating efficient communication and enhancing patient care in various healthcare settings.

Keywords: Internet of Things. Smart healthcare. Flexible sensor. Bluetooth in medical application. Human-machine interaction.

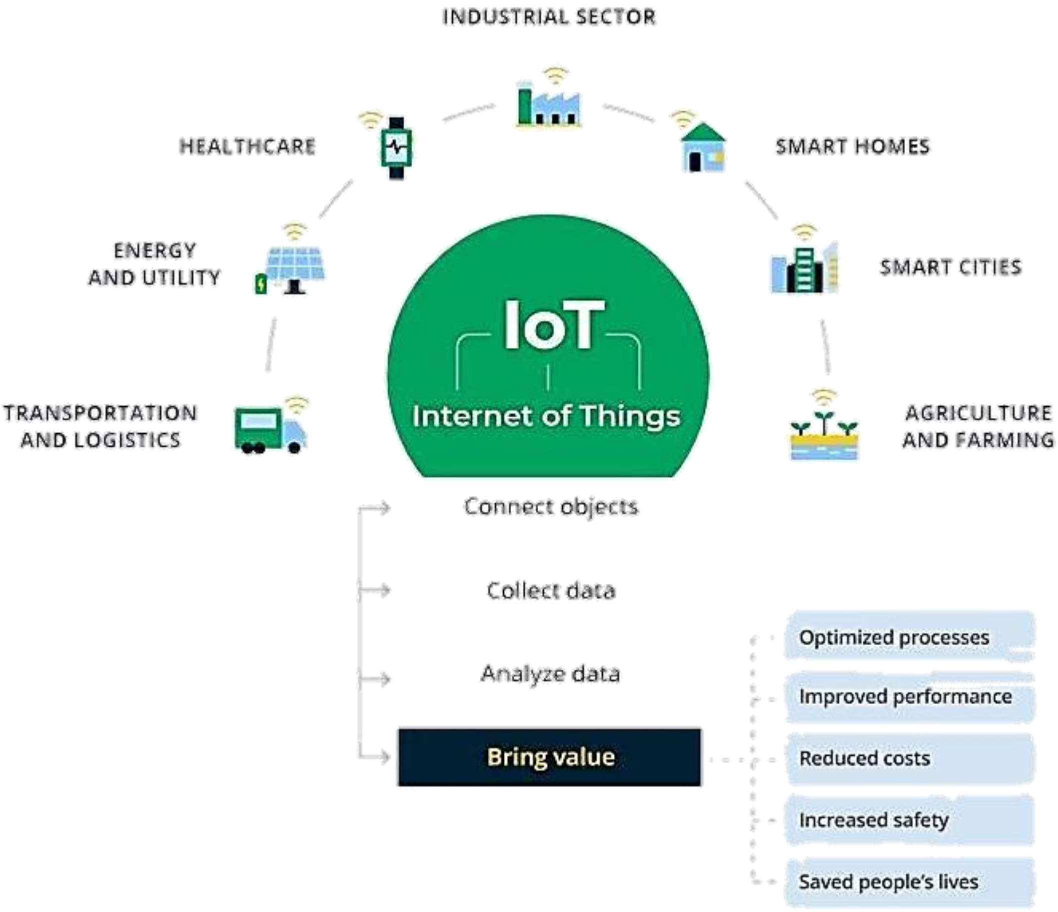

Figure (1) IOT Internet Of Things

1. INTRODUCTION

The Paralytic Patient Healthcare System represents a significant advancement in healthcare technology, aiming to empower individuals with paralysis to lead more independent and dignified lives. At its core, this system is designed to facilitate communication between patients and their caregivers, enabling them to convey various messages, whether it's to a doctor, nurse, family member, or caretaker.

One of the key features of this system is its utilization of microcontroller-based circuits, which serve as the backbone for achieving its functionality. By leveraging these circuits, the system can interpret and respond to hand motions, allowing patients to control essential functions such as turning lights or fans on and off. This not only enhances the autonomy of physically disabled individuals but also reduces their reliance on others for simple tasks, promoting a greater sense of independence and self-sufficiency.

Moreover, the system extends beyond mere convenience to encompass vital aspects of healthcare monitoring. Through continuous monitoring of health records, including parameters like heartbeat and blood oxygen levels, caregivers and medical professionals can remotely assess the patient's health status from any location at any time. This real-time monitoring capability is especially crucial in situations where there may not be someone physically present to attend to the patient, providing peace of mind for both patients and their caregivers.

The need for such a system is underscored by the challenges faced by individuals with paralysis, who often experience varying degrees of mobility impairment due to conditions such as spinal cord damage, stroke, or multiple sclerosis. These conditions can result in partial or total loss of movement in different parts of the body, severely limiting the individual's ability to perform everyday tasks independently.

The work aims to address the challenges faced by individuals with paralysis, particularly those who are frequently left alone without adequate care and support. The goal is to develop wearable technology that enables patients to connect with their caregivers and monitor their health in real-time. This innovative approach leverages IoT-based solutions to create a paralyzed patient healthcare system, facilitating communication with healthcare professionals and family members over the internet.

To achieve this, the system utilizes electronics centered around a microprocessor, incorporating a reception and broadcast circuitry, as well as a hand gesture detection circuit. The hand circuit employs a flexible sensor to detect finger movements, transmitting this data wirelessly over RF to the transceiver. This seamless communication mechanism enables patients to convey their needs and concerns to caregivers, ensuring timely assistance and support.[1]

The term "immobility" refers to the inability to purposefully and independently operate one's muscles, which can be either temporary or permanent. It is often caused by complex diseases, spinal cord injuries, or strokes. Paresis, a severe form of paralysis, results in the complete loss of mobility and is typically caused by disruptions to the neurological system, particularly the spinal cord.[2-4]

Therapeutic interventions aim to help individuals adapt to life with paralysis by promoting independence and autonomy. However, existing technologies for assisting paralyzed individuals are often bulky, expensive, and limited to medical settings, hindering their accessibility and usability in everyday life. This presents a significant challenge, especially in emergency situations where immediate assistance is crucial but may not always be available.

Therefore, there is a pressing need for innovative approaches to support individuals with paralysis, emphasizing the importance of leveraging technology to enhance their quality of life. As aspiring engineers, it is our responsibility to develop new and accessible solutions to address the unique needs of paralyzed individuals, ensuring their safety, comfort, and independence.

By developing wearable technology that integrates seamlessly into patients' daily lives, we can empower them to communicate effectively with caregivers, monitor their health, and access assistance when needed. This holistic approach not only improves the quality of care for paralyzed individuals but also promotes inclusivity and independence, aligning with our collective responsibility to support those with disabilities.[5]

2. OBJECTIVES

Our project aims to address the cost constraints faced by medical institutions by developing innovative solutions for basic nursing care. Through the introduction of a secure IoT-based paralyzed patient healthcare monitoring and facilitation system, we seek to provide comprehensive patient care without the need for constant nursing supervision. Our primary objective is to design a gadget capable of retraining patient mobility, enabling individuals to utilize it independently while maintaining affordability to ensure accessibility for all. This technology also serves to bridge gaps in care by facilitating communication in situations where immediate assistance is unavailable, allowing patients to convey messages via Bluetooth through their mobile devices.

The functionality of our proposed system hinges on tilt detection, where the device responds to the user's movements by tilting the gadget at specific angles, demonstrated by the positioning of the user's knuckles on the mobile arm. By simply tilting the gadget, users can communicate messages, with variations in tilt conveying different messages. To achieve this, the system utilizes an altimeter to measure mobility characteristics, which are then transmitted to the microcomputer for processing.

By focusing on mobility retraining and communication facilitation, our project aims to empower patients with paralysis to regain a sense of independence and control over their daily lives. Additionally, the affordability and accessibility of our solution ensure that patients can acquire the necessary support without relying solely on healthcare institutions or external assistance. Through innovative technology and user-centered design, we aspire to improve the quality of life for individuals living with paralysis while alleviating the burden on medical institutions and caregivers.

3. LITERATURE REVIEW

Smart healthcare is essential for continuous monitoring, particularly in rural areas where access to conventional medical facilities is limited. This study introduces a smart health monitoring system utilizing biomedical sensors to assess patients' conditions and Bluetooth technology for communication with relevant parties. Biomedical sensors are connected to an Arduino Microcontroller, which regulates data reading and is then transmitted to a TV display or daily monitor for observation. Vital signs such as heart rate and blood oxygen levels are crucial indicators of a patient's well-being, guiding treatment strategies and monitoring treatment responses. However, gathering vital sign information for a large population can be challenging due to logistical issues and the risk of inaccuracies. To address this challenge, a digitally calibrated, real-time vital sign monitoring device is proposed, capable of recording and transmitting data for expert consultation.

Beyond improving health tracking efficiency, the data generated by this device can also be utilized for statistical analysis, enhancing healthcare quality and efficacy. The Internet of Things (IoT) plays a significant role in modern healthcare by facilitating communication and interaction between interconnected devices. In healthcare monitoring applications, IoT serves as a valuable assistant, contributing to improved patient care and broader healthcare advancements. [7]

The escalating healthcare expenses and rising patient demand for home-based care have underscored the imperative to overhaul healthcare systems. Consequently, there is a surge in research aimed at creating solutions facilitating remote health monitoring, empowering healthcare providers to assess patients' well-being from their homes. This paradigm shift reflects a fundamental rethinking of traditional healthcare delivery models, emphasizing the importance of leveraging technology to deliver care efficiently and conveniently.

Such advancements not only enhance patient comfort but also alleviate the strain on healthcare resources, paving the way for a more accessible and sustainable healthcare ecosystem.[8]

Expanding clinical experience may enhance the clinical utility of existing measures. However, there is a current need for the development of new instruments or adaptation of existing measures and scaling methods to facilitate individual-patient assessment and monitoring. [9]

Implementing the Internet of Things in healthcare faces the significant challenge of monitoring patients across diverse locations. However, it offers a solution for costeffective and efficient patient monitoring, minimizing the trade-off between patient outcomes and disease management.[10]

4. EXPERIMENTAL WORK

4.1 The Main Components

The main components of the hardware:

1. Microcontroller Arduino
2. Battery charger 5v
3. Battery
4. Bluetooth module
5. level shifter
6. flexible sensor

7. Glave
8. Jumper Wire
9. Pulse Oximeter SPO2 & Heart-Rate Module

4.1.1 Arduino Microcontroller

The Arduino microcontroller, introduced in 2005, revolutionized the development landscape by offering an open-source platform easily programmable and updatable. Originally intended for professionals and students, Arduino enables the creation of interactive devices utilizing sensors to interface with the environment. Featuring inputs and outputs for data acquisition and transmission, Arduino can process information and generate corresponding outputs. Moreover, Arduino microcontrollers can seamlessly communicate over the internet via HTTP requests, facilitating remote data exchange. A notable example is the ESP board, a simple microcontroller capable of connecting to Wi-Fi networks as a client or functioning as a Wi-Fi server, expanding the possibilities for internet-enabled projects.

Arduino platform can be divided into two: Hardware and Software.

1. Hardware

The Arduino microcontroller is a versatile development board equipped with several key components that facilitate its functionality and connectivity with peripheral devices.

- At the heart of the Arduino is the microcontroller, serving as the central processing unit responsible for receiving and transmitting data or commands to connected peripherals. The specific microcontroller utilized may vary between Arduino models, each boasting unique specifications tailored to different applications.
- An external power supply is essential for providing the Arduino with the necessary DC voltage, typically ranging from 9 to 12 volts, ensuring stable operation and sufficient power for various tasks.
- the Arduino can be powered via USB plug, which serves a dual purpose. Firstly, it allows for the convenient uploading of programs to the microcontroller using a USB cable. Secondly, the USB cable itself can deliver a DC power of 5 volts to the Arduino board when an external power supply is unavailable.
- The internal programmer facilitates the programming and configuration of the Arduino, enabling users to upload code and modify settings as needed.
- A reset button is also integrated into the board, allowing for quick and easy resets when necessary.
- Analog pins are utilized for analog input/output, providing the capability to interface with analog sensors and devices. The number of analog pins available varies depending on the specific Arduino model, accommodating different project requirements.
- digital I/O pins enable digital input and output operations, with the quantity varying between Arduino boards to suit diverse project needs.
- Power and ground (GND) pins are essential for providing stable power and grounding connections to peripheral devices and components. These pins typically offer 3.3 volts, 5 volts, and ground connections, supporting a wide range of electrical configurations and ensuring compatibility with various sensors, actuators, and other peripherals.

the Arduino microcontroller's diverse array of components empowers users to create and innovate across a wide spectrum of projects, from simple prototypes to complex electronic systems, with flexibility, reliability, and ease of use at the forefront of its design philosophy.

2. Software

The Arduino Integrated Development Environment (IDE) serves as the primary software tool for creating sketches, or program code, for Arduino boards. Comprising various components, the IDE provides a user-friendly platform for programming and debugging Arduino projects.

- At its core is the text editor, where users can write and edit code in the C/C++ programming language, the primary language used for Arduino development. This intuitive interface simplifies the coding process, enabling users to implement desired functionalities efficiently.
- The message area plays a crucial role in providing feedback to the user. It displays errors encountered during code compilation, as well as notifications related to saving and exporting code. This feature helps users identify and address any issues in their code, ensuring smooth development and troubleshooting.
- The console, another essential component of the IDE, presents text output generated by the Arduino environment. This includes comprehensive error messages and other information relevant to the programming process, aiding users in understanding and resolving any issues that may arise.
- the console toolbar offers convenient access to various functions such as compiling, uploading, creating new sketches, opening existing projects, saving code, and accessing the serial monitor. These tools streamline the development workflow, empowering users to create and deploy Arduino projects with ease and efficiency. [11-12].

Figure (2) Arduino Control

4.1.2 Battery

Lithium polymer batteries, abbreviated as LiPo, are rechargeable batteries that utilize lithium-ion technology with a polymer electrolyte. Unlike traditional lithiumion batteries with liquid electrolytes, LiPo batteries employ highly conductive semisolid (gel) polymers as electrolytes. This design choice results in higher specific energy, making LiPo batteries ideal for applications where weight is a critical factor, such as in mobile devices, radio-controlled aircraft, and some electric vehicles.

The development of LiPo batteries traces back to Alessandro Volta's invention of the first practical batteries, which were crucial as the primary source of electricity before the advent of generators. Ancient electric cars also utilized semi-sealed wet cells, laying the foundation for battery technology. The discovery of LiPo cells evolved from advancements in lithium-ion and lithium-metal cells in the 1980s, as researchers delved deeper into the characteristics and capabilities of lithium-based battery technologies. This historical context underscores the continuous evolution of battery technology and highlights the significance of LiPo batteries in modern applications requiring lightweight and high-energy power sources. [13].

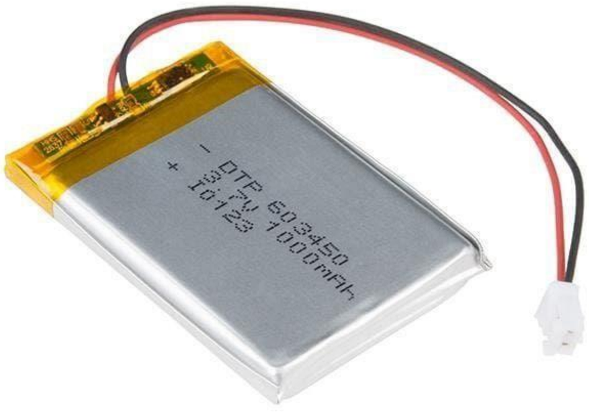

Figure (3) Battery

4.1.3 Bluetooth Module

Bluetooth module is a high efficiency and performance Bluetooth module, which is compact and easy to use. The module enables wireless communication between two devices, and is used in many applications, such as robotics, medical devices, remote control systems, and more.

The HC-06 Bluetooth module features a number of important features, including:

1. Support high-speed Bluetooth connections.
2. Working range of up to 10 metres.
3. Compatible with Bluetooth 2.0 and 2.1 standards.
4. It uses an RX receiver and a TX transmitter.
5. It consumes low energy.
6. Easy to install and use.

The HC-06 Bluetooth module is typically used in projects that require remote control, such as lighting control, home appliances, robots, and car control. They can also be used in wireless Internet applications, alarm and security systems, and more [14].

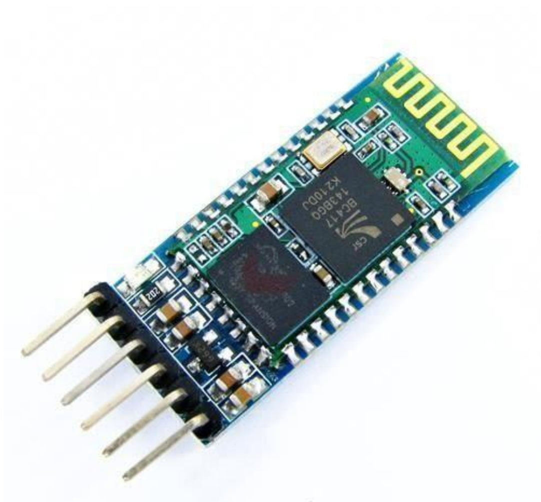

Figure (4) Bluetooth Module

4.1.4 Level Shifter

A level shifter, crucial in modern electronics, facilitates seamless communication between components operating at different voltage levels. Its versatility enables compatibility across various integrated circuits, including processors, sensors, and logic units. With prevailing logic levels typically at 1.8V, 3.3V, and 5V, level shifters ensure smooth data exchange even when dealing with non-standard voltage ranges.

These shifters come in several types to suit diverse applications:

1. Uni-directional variants channel inputs from one voltage domain to outputs in another, maintaining strict segregation.
2. Bi-directional models offer more flexibility, with options like dedicated ports for each voltage domain or external indicators to dictate data flow direction.
3. auto-sensing bi-directional shifters stand out for their adaptive nature, dynamically adjusting data direction based on external stimuli, without requiring a separate control pin.

level shifters are indispensable bridges in electronic systems, harmonizing the disparate voltage requirements of different components and enabling seamless operation across diverse hardware environments. Their role extends beyond mere voltage translation, contributing to the interoperability and efficiency of modern electronic systems. [15-16].

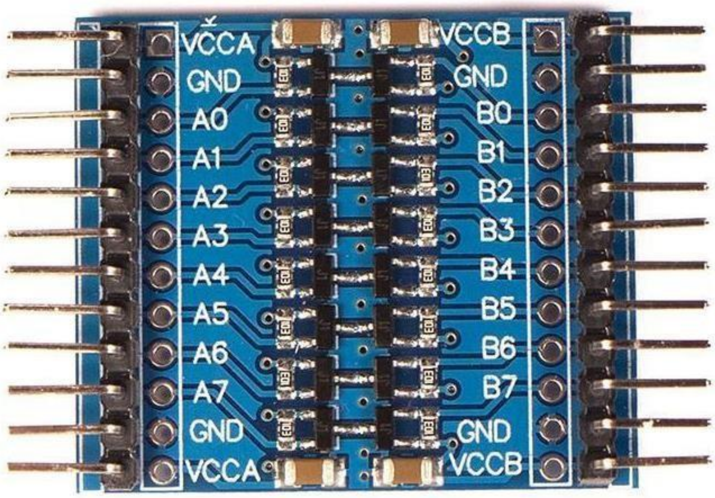

Figure (5) level shifter

4.1.5 Flexible Sensor

A flexible sensor, also known as a bend sensor, measures deflection or bending by utilizing materials like plastic and carbon. The sensor's resistance changes as the plastic strip, coated with carbon, bends. This resistance variation is directly proportional to the amount of bending, making the sensor versatile for applications like goniometry, where precise angle measurement is needed. By leveraging the properties of carbon and plastic, flexible sensors offer a simple yet effective solution for detecting and quantifying bending or deformation, finding applications in various fields such as robotics, medical devices, and consumer electronics. [17].

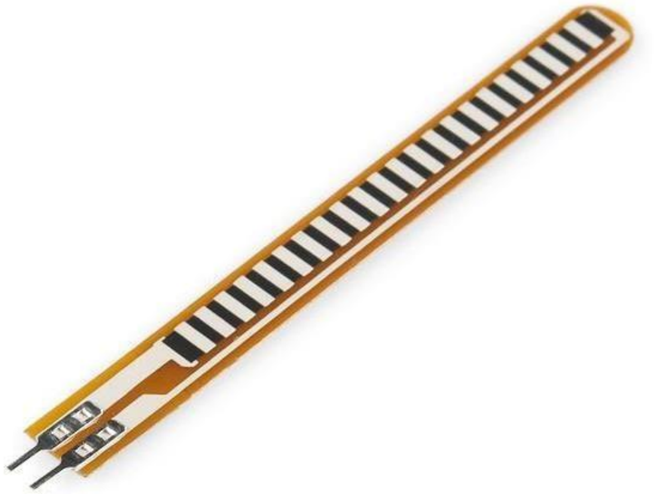

Figure (6) flexible sensor

4.1.6 Glaves glaves made of cotton material intended for luxurious hand.

Figure (7) glaves

4.1.7 Jumper Wire

Jumper wires serve as indispensable tools in electronics prototyping, facilitating easy circuit connections without the need for soldering. These wires feature connector pins at each end, making them compatible with breadboards and other prototyping platforms. They come in three main variants: male-to-male, male-tofemale, and female-to-female.

Whether in hobbyist projects or professional prototyping, jumper wires play a crucial role in simplifying the development process and enabling innovation in electronics.

[16].

Figure (8) Jumper Wire

4.1.8 Pulse Oximeter Spo2 & Heart-Rate Module

The MAX30102 stands out as an integrated module for pulse oximetry and heartrate monitoring, offering a compact and efficient solution for mobile and wearable devices. Its internal components, including LEDs, photodetectors, and optical elements, combined with low-noise electronics, ensure accurate readings with ambient light rejection.

Operating on a single 1.8V power supply with a separate 3.3V supply for LEDs, the MAX30102 communicates via a standard I2C interface, simplifying integration into existing systems. Its ability to be shut down via software with zero standby current enhances power efficiency, ideal for battery-powered devices.

Key features include its tiny footprint of 5.6mm x 3.3mm x 1.55mm, making it suitable for compact designs. The integrated cover glass enhances performance and durability. With ultra-low power consumption and programmable sample rates, it caters to the needs of mobile devices, offering power savings without compromising performance.

Moreover, its robust motion artifact resilience ensures accurate readings even in dynamic environments. The module operates across a wide temperature range of 40°C to +85°C, further extending its versatility and suitability for various applications.

the MAX30102 provides a comprehensive solution for pulse oximetry and heartrate monitoring, combining efficiency, compactness, and reliability to meet the demands of modern wearable and mobile devices.[16]

Figure (9) Pulse Oximeter SPO2 & Heart-Rate Module

4.2 System Architecture

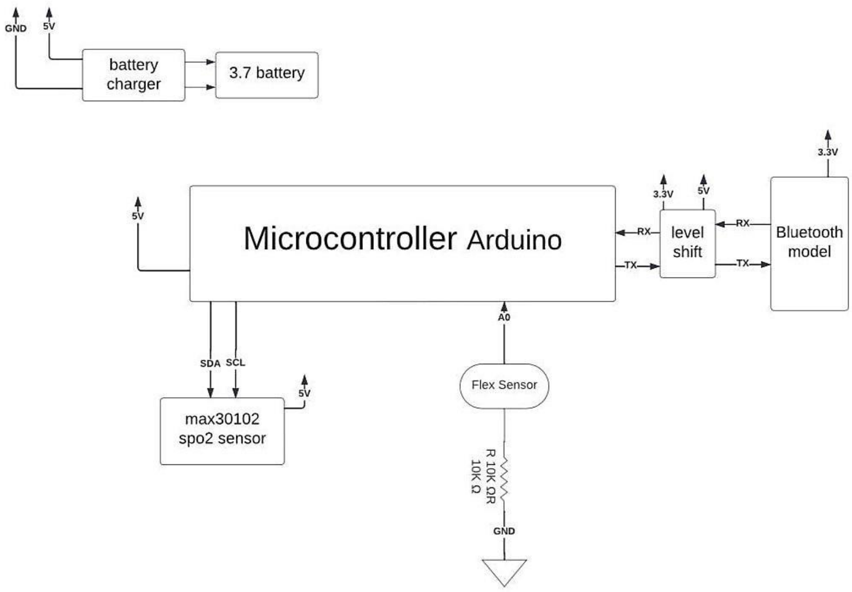

Figure (10) System Architecture

In embarking upon the creation of an IoT Paralysis Patient Health Care Project, the initial step involves assembling a comprehensive array of components. These include the indispensable Arduino microcontroller, serving as the central hub for data processing and system control. To ensure uninterrupted operation, a 5-volt battery charger and a 3.7-volt battery are indispensable components, providing the necessary power supply. Communication capabilities are facilitated through the inclusion of a Bluetooth module, while a level shifter ensures seamless compatibility with various devices and sensors.The project's efficacy in patient monitoring hinges upon the integration of a flexible sensor, strategically embedded within a glove for ease of use and continuous data acquisition. Establishing connectivity across the system requires the deployment of jumper wires or connecting wires, enabling seamless communication between components. Vital health metrics, including SPO2 levels and heart rate, are meticulously monitored through the inclusion of specialized modules such as the SPO2 pulse oximeter. Collectively, this amalgamation of components forms the backbone of a sophisticated healthcare monitoring system tailored specifically to the needs of paralysis patients. Leveraging the capabilities of IoT technology, ultimately improving the quality of life for individuals living with paralysis.

Figure (11) IoT Paralysis Patient Health Care Project

To commence work, the charger and battery are intertwined through a fundamental connection mechanism involving two wires. One wire establishes a link from the charger to the positive terminal of the battery, while the other wire extends from the charger to the battery's negative terminal. This arrangement forms a complete circuit, enabling the flow of electric current necessary for the charging process. By directing electrons from the charger's positive terminal to the battery's positive terminal and from the charger's negative terminal to the battery's negative terminal, the circuit facilitates the transfer of energy from the charger to the battery. This flow of energy kick-starts the charging process, replenishing the battery's stored power and preparing it for subsequent use. Essentially, the connection of the charger to the battery via these wires initiates a pathway for the exchange of electrical energy, ensuring the effective transfer of power from the charger to the battery, ultimately facilitating the functionality of the device.

This methodical connection strategy not only facilitates the charging process but also minimizes the risk of electrical mishaps by adhering to standard safety protocols. By adhering to this procedure, the project initiates on a solid foundation, laying the groundwork for subsequent stages of development and implementation.

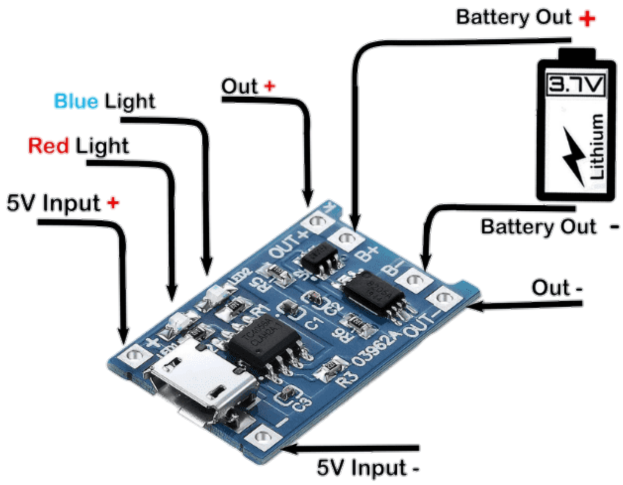

Figure (12) Connect the charger with the battery

Following the initial connection between the battery and charger, both components are firmly affixed onto the board to prevent any unintended movement or dislodgement during operation. This installation ensures stability and reliability within the system. Subsequently, two additional wires are drawn from the charger: one originates from the positive terminal of the charger and is routed to the switch, while the other emerges from the negative terminal and is securely attached to the board. These wires serve to establish further connectivity within the circuitry. By connecting the positive wire to the switch, a crucial control mechanism is implemented, enabling the regulation of electric current flow. Meanwhile, securing the negative wire to the board completes the circuit, facilitating the smooth transmission of electricity throughout the system. This meticulous arrangement not only enhances the efficiency of power distribution but also safeguards against potential disruptions or hazards. Overall, the installation of the battery, charger, and associated wiring onto the board represents a crucial step in ensuring the functionality, stability, and safety of the electrical setup.

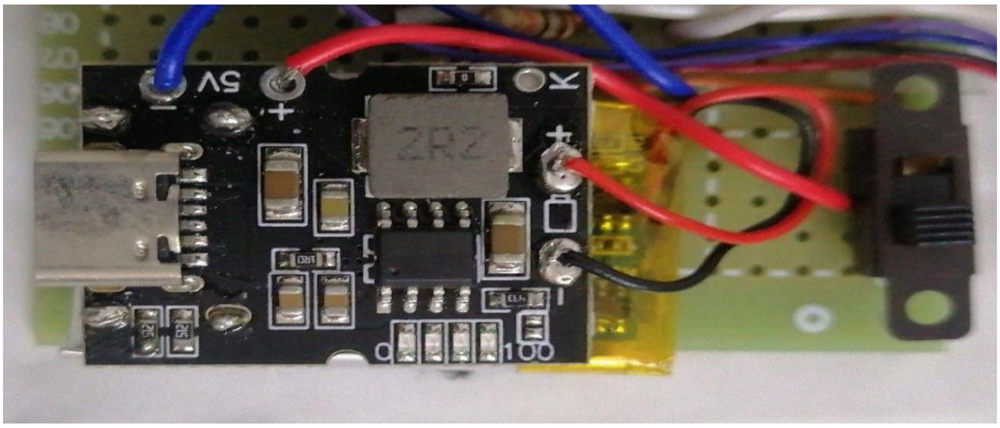

Figure (13) Connect the charger with the switch

Starting from the attachment point of the negative terminal of the charger on the board, two connecting wires extend, each serving a distinct purpose within the system. The first wire establishes a connection with a flexible sensor, designed to detect and monitor a wide range of physical movements and variations. This sensor's flexibility enables it to adapt to different body contours and environments, ensuring accurate and reliable data collection. Meanwhile, the second wire from the negative terminal is linked to a vital monitoring device: the blood oxygen level and heart rate sensor. This sensor plays a critical role in assessing cardiovascular health and oxygen saturation levels in the bloodstream, providing essential information for medical diagnosis and monitoring. By integrating these sensors into the system, comprehensive physiological data can be gathered and analyzed in real-time, offering valuable insights into the user's health status and facilitating prompt interventions if necessary. This intricate network of connections underscores the sophistication of modern health monitoring systems, leveraging advanced technology to empower individuals with actionable insights into their well-being. Ultimately, the integration of these sensors with the charger and associated wiring represents a holistic approach to health monitoring, prioritizing accuracy, reliability, and user-centric design for optimal healthcare management.

The installation of the controller onto the board marks a crucial step in the assembly process, facilitating the connection between various components essential for the functionality of the device. With meticulous precision, two connection wires are employed to establish a seamless link between the controller and the blood oxygen and heart rate sensor. The first wire serves as the conduit between pin VCC on the controller and pin SCL on the sensor, ensuring the transmission of vital data with precision and reliability. Meanwhile, the second wire plays an equally pivotal role by bridging pin A3 on the controller with pin SDA on the sensor, fostering seamless communication and data exchange between these integral components.

Additionally, the controller extends its reach to include the flexible sensor, further enhancing the versatility and scope of the device's capabilities. Through a dedicated connection wire, pin A0 on the controller establishes a direct line of communication with the flexible sensor, enabling the extraction and interpretation of essential physiological metrics. This strategic integration not only expands the device's functionality but also underscores its adaptability in catering to diverse user needs and scenarios. The intricate network of connections forged between the controller and its accompanying sensors epitomizes the synergy and precision required in the realm of biomedical engineering. Each wire serves as a lifeline, facilitating the seamless transmission of critical data essential for monitoring vital signs and ensuring the well-being of the user.

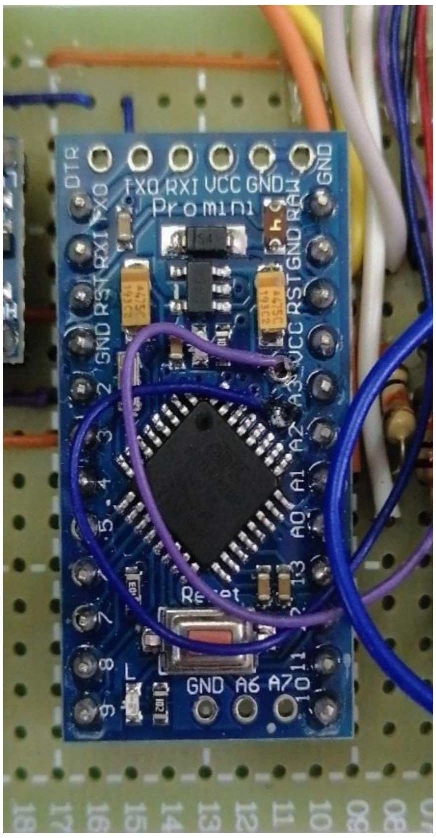

Figure (14) Connecting the controller with the sensors

A regulator is added to the board to transform the incoming 5V current from the battery into a stable 3.3V output, ensuring compatibility with the device's components and optimizing functionality while maintaining efficiency and reliability.

The installation of a Bluetooth module on the board facilitates seamless communication between the controller and the level shifter, enabling the transmission of data to the user's mobile phone.

This integration enhances user accessibility and convenience by allowing remote monitoring and control of the system via a smartphone. By leveraging Bluetooth technology, the device enables wireless data transfer, eliminating the need for cumbersome physical connections. This feature enhances the versatility and usability of the board, making it more adaptable to various applications and scenarios where remote monitoring and control are essential for efficient operation.

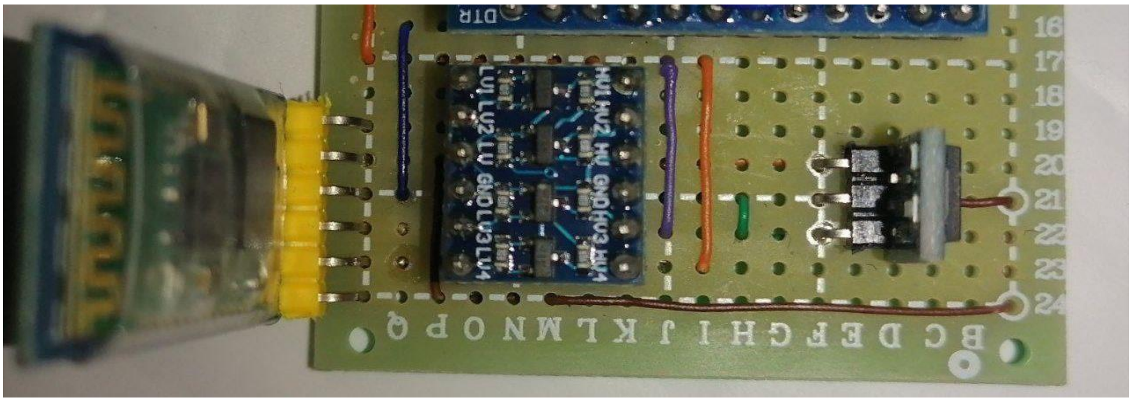

Figure (15) Connecting the level shifter between the controller and the Bluetooth module

Once the circuit components are affixed onto the board, it is meticulously stitched onto the glove, securing its placement for optimal functionality. Regarding the integration of the flexible sensor, as previously outlined, it interfaces with the circuitry via two connecting wires. One wire establishes a direct connection to the controller, ensuring the smooth transfer of vital information and instructions critical for monitoring. Concurrently, at this connection point, a 10k resistor is strategically introduced to shield the sensor from potential damage, with its opposite end grounded to maintain stability within the circuit. Meanwhile, the second wire of the flexible sensor is meticulously linked to the negative terminal of the charger before being carefully mounted onto the palm using adhesive, effectively immobilizing it to prevent displacement during use. This meticulous installation process underscores a dedication to precision engineering, ensuring the reliability and accuracy of data collection and transmission. By integrating these components seamlessly into the glove, the device achieves a harmonious balance between functionality and user comfort. The stitched attachment of the board ensures durability and longevity, while the strategic placement of the flexible sensor guarantees optimal performance without impeding the user's range of motion. Additionally, the inclusion of protective measures such as the resistor serves to safeguard the integrity of the circuitry, enhancing the device's resilience to external factors.

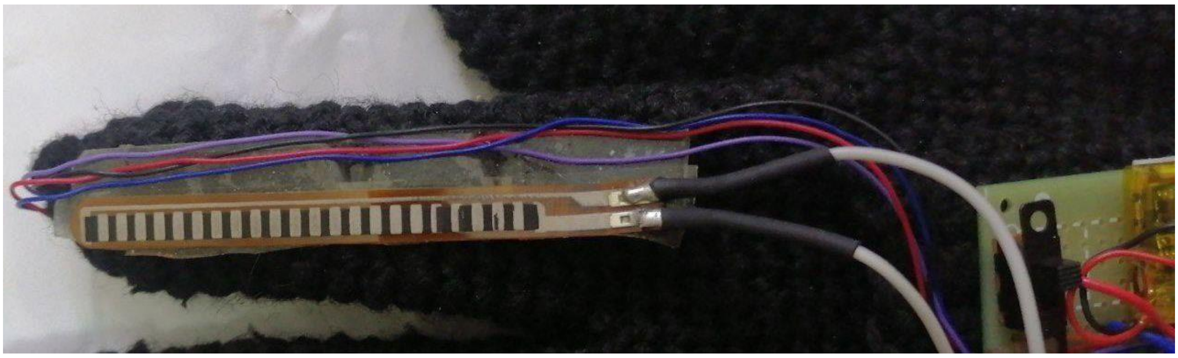

Figure (16) Flexible sensor

In the final integration stage, the sensor of heart rate and blood oxygen are seamlessly linked to the circuitry using four connecting wires. Initially, the sensor are connected to the circuit via a wire that establishes a direct connection to the negative terminal of the charger, ensuring proper power supply. The second wire serves to bridge pin VCC on the controller to pin SCL on the sensor, facilitating the exchange of data between the components. Similarly, the third wire connects pin A3 on the controller to the SDA pin on the sensor, further enhancing communication and information transfer within the circuit.

Lastly, to maintain stability and ensure proper functioning of the circuit, the fourth wire is grounded, completing the intricate network of connections. Once the sensor are integrated into the circuit, they are meticulously affixed onto the palm by sewing them into a small hole located at the end of the index finger. This strategic placement ensures direct contact between the finger and the sensor, enabling accurate and reliable measurements of vital signs. This meticulous integration process not only underscores a dedication to precision engineering but also highlights the device's effectiveness in monitoring vital signs with precision and accuracy. By ensuring direct contact between the sensors and the user's finger, the device maximizes its potential to provide actionable insights into the user's health status, thereby empowering them to make informed decisions regarding their well-being.

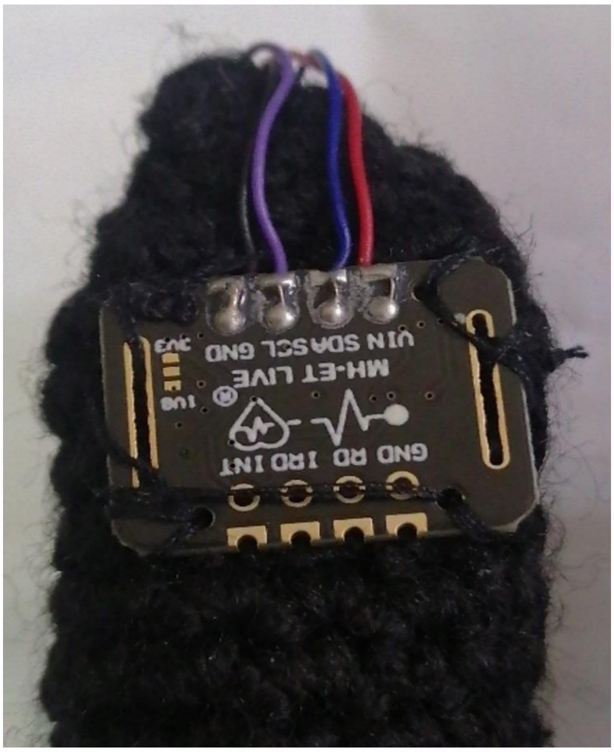

Figure (17) Pulse Oximeter SPO2 & Heart-Rate Module

4.3 Remote XY program

RemoteXY is a versatile platform that allows users to design and create custom mobile apps for controlling various electronic devices remotely. Here are some more details about its features and functionalities:

- Graphical Interface Design: RemoteXY provides a drag-and-drop interface for designing graphical user interfaces (GUIs) for mobile apps. Users can easily add buttons, sliders, gauges, text labels, and other interactive elements to create intuitive control interfaces.
- Hardware Integration: The platform supports integration with popular microcontroller platforms such as Arduino and Raspberry Pi. Users can write code for their microcontrollers to communicate with the RemoteXY mobile app over Bluetooth, Wi-Fi, Ethernet, or USB connections.
- Communication Protocols: RemoteXY supports multiple communication protocols, including Bluetooth, Wi-Fi, Ethernet, and USB. This flexibility allows users to choose the most suitable communication method for their specific project requirements.

- Code Generation: Once the GUI is designed, RemoteXY generates the necessary code for both the mobile app and the microcontroller firmware. This simplifies the development process and reduces the amount of manual coding required.
- Cross-Platform Compatibility: RemoteXY mobile apps are compatible with both Android and iOS devices, ensuring broad accessibility for users regardless of their preferred mobile platform.
- Libraries and Examples: RemoteXY provides libraries and code examples to help users get started with their projects quickly. These resources include documentation, tutorials, and sample projects to demonstrate various features and capabilities.
- Community Support: RemoteXY has an active community of users who share their projects, ideas, and experiences on forums, social media, and other online platforms. This community support can be valuable for troubleshooting issues, seeking advice, and gaining inspiration for new projects.

Overall, RemoteXY simplifies the process of creating mobile-controlled electronic projects by providing an intuitive interface, robust communication capabilities, and extensive support resources. It empowers hobbyists, makers, and developers to bring their ideas to life with ease.

5. RESULTS AND DISCUSSION

Our project is a device designed to deliver comprehensive healthcare for paralyzed patients, the elderly, and stroke victims who have lost speech. It functions by transmitting instructions regarding the patient's needs via Bluetooth, utilizing finger movement to interact with a phone interface. Additionally, it incorporates components to measure oxygen saturation and heart rate. These components are assembled, linked together, and programmed according to the specifications illustrated in the provided image. Through this integrated approach, our device aims to provide vital assistance and monitoring for individuals with mobility limitations and communication impairments, enhancing their quality of life and facilitating better healthcare outcomes.

Figure (18) IoT Paralysis Patient Health Care Project

1-This indicator is a measure of the level of oxygen in the blood through Pulse Oximeter SPO2 & Heart-Rate sensor and depends on direct contact between the finger and the sensor.

Figure (19) An indicator for measuring blood oxygen levels

2- This number represents the number of heartbeats and is measured through Pulse Oximeter SPO2 & Heart-Rate sensor and also depends on direct contact between the finger and the sensor.

Figure (20) The number of heartbeats

3-When you move the finger in a simple and light motion at an angle of 180 degrees, a notification is sent to the device that the patient needs to go to the bathroom.

10.

Figure (21) notice of bathroom

4-When moved at an angle of 120 degrees, a notification is sent to the device that the patient needs water to drink.

Figure (22) notice of water

5-When moved at an angle of 60 degrees, a notification is sent to the device that the patient needs to sleep.

Figure (23) notice of sleep

6-When moved at an angle of 0 degrees, a notification is sent to the device that the patient needs help immediately.

Figure (24) notice of help

6. CONCLUSIONS

1. The system designed to monitor blood oxygen levels and heart rate provides vital data for healthcare providers to track the patient's condition in real time.
2. Displaying this information enables caregivers to respond quickly to any changes, which reduces pressure on health care systems and enhances the quality of patient care.
3. In addition, by utilizing technology to transmit messages from paralyzed patients to caregivers using gloves, communication barriers are overcome.
4. When the patient tilts his finger, a message is automatically sent to the designated caregiver, ensuring timely assistance.
5. This innovative approach enhances the well-being of individuals and promotes prosperous and fulfilling lives through advanced healthcare technology.

7. RECOMMENDATIONS FOR FUTURE WORK

1. To enhance efficiency and convenience, future systems could incorporate wireless technology for eyelash detection.
2. Utilizing a combination of Bluetooth and Wi-Fi technology would ensure effectiveness, safety, and ease of control.
3. Additional security indicators such as light and sound cues could be integrated to enable continuous patient monitoring.
4. The entire healthcare monitoring system could be condensed into a compact unit resembling a cell phone, wristband, or smartwatch.
5. Both desktop screens and Android applications could support the implementation of the system for remote monitoring purposes.

REFERENCES:

1. D. Dhinakaran et al., "Secure Android Location Tracking Application with Privacy Enhanced Technique," 2022 Fifth International Conference on Computational Intelligence and Communication Technologies (CCICT), pp. 223229, 2022. Crossref
2. J. S. Prasath, "Wireless Monitoring of Heart Rate Using Microcontroller," International Journal of Advanced Research in Computer Science and Electronics Engineering (IJARCSEE), vol. 2, no.2, 2013.
3. Sharma et al., "Smart Health Monitoring System Using IoT," International Journal for Research in Applied Science and Engineering Technology, vol. 8, no. 5, pp. 654–658, 2020.

4. Nor Shahanim Mohamad Hadis et al., “IoT based Patient Monitoring System Using Sensors to Detect, Analyse and Monitor Two Primary Vital Signs,” Journal of Physics: Conference Series, vol. 1535, pp. 1– 12, 2020. Crossref,

5. Imran khan et al., “Healthcare Monitoring System and Transforming Monitored Data Into Real Time Clinical Feedback Based on IoT Using Raspberry Pi,” Proceedings of the 2nd International Conference on Computing, Mathematics and Engineering Technologies (ICFOMET), pp. 1-6, 2019. Crossref,

6. J. Aruna Jasmine et al., "A Traceability Set Up Using Digitalization of Data and Accessibility," 2020 3rd International Conference on Intelligent Sustainable Systems (ICISS), pp. 907-910, 2021. Crossref,

7. Kadhim, Kadhim Takleef; Alsahlany, An Overview of Patient's Health Status Monitoring System Based on Internet of Things (IoT).Wireless Personal Communications . Oct2020, Vol. 114

8. Jemal H. Abawajy; Mohammad Mehedi Hassan, Federated Internet of Things and Cloud Computing Pervasive Patient Health Monitoring System, IEEE,January 2017.

9. C. A. McHorney & A. R. Tarlov, Individual-patient monitoring in clinical practice: are available health status surveys adequate ,Published: August 1995

10. R. Kumar; M. Pallikonda Rajasekaran ,An IoT based patient monitoring system using Raspberry Pi, IEEE,October 2016.

11. ARDUINO.CC, "Arduino -Introduction", 2015 [Online] Available:

12. Badamasi, Y.A., "The working principle of an Arduino," in Electronics, Computer and Computation (ICECCO), 2014 11th International Conference on, vol., no., pp.1-4, Sept. 29 2014-Oct. 1 2014. doi: 10.1109/ICECCO.2014.6997578 [10] LilyPad Arduino, 'LilyPad Arduino', 2015. [Online]. Available:.

13. Schweber, William L. (1986), Integrated Circuits for Computers: Principles and Applications, McGraw-Hill, pp. 157–158, ISBN 9780070536241

14. Horan, B. (2013). Practical Raspberry Pi. Technology in Action. Apress. p. 167. ISBN 978-1-4302-4972-6.

15. Development of a quad-channel high-resolution digital picoammeter for beam diagnostics, Donatti M.Cardoso F.Tanio L.Journal of Instrumentation (2024)