"IMPLEMENTATON OF SWALLOW AND RESPIRATORY MONITORING SYSTEM"

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Abstract—: Maintaining appropriate levels of food intake and developing regularity in eating habits is important. The system can be used to monitor the swallows and respiratory system of patients who are at risk for aspiration. This paper presents the concepts, design, and algorithms for a wearable swallow monitoring system. Swallow monitoring can be used forassessing a person's overall food and drink intake habits. The importance and development of wearable devices for breathing monitoring and pattern detection. Wearable devices offer the advantage of continuous monitoring and data storage, allowing for various applications such as sleep monitoring, respiratory rate detection, and breathing pattern detection. These devices need to be comfortable, non-restrictive, and able to share patient data with healthcare professionals, researchers, and family. Additionally, they should have low energy consumption, long battery autonomy, and wireless communication capabilities.

Monitoring breathing activity with wearable devices has significant implications for medical care services. For individuals with asthma or chronic obstructive pulmonary disease, wearable devices can continuously measure air quality and pulmonary function, triggering alerts for drug uptake or contacting medical professionals in case of emergency. Monitoring air quality is crucial as pollutant exposure can lead to acute asthma attacks. Wearable devices also find applications in sleep monitoring for apnea detection, tracking respiratory movement for radiotherapy, and developing smart fabrics for healthcare, sports, and military scenarios.

To develop effective wearable devices for breathing monitoring, an understanding of the anatomy and physiology of the respiratory system is essential. This knowledge enables the development of devices that do not interfere with respiratory mechanics and daily activities. It also helps in selecting appropriate sensors and understanding signal processing and machine learning techniques. The chapter provides concise information on these topics, serving as a guide for individuals interested in developing wearable devices for respiratory monitoring.

In the context of dysphagia treatment, the goals are to maintain adequate nutritional intake and maximize airway protection. Rehabilitation methods, such as dietary modification and swallowing techniques, are usually effective in managing disorders of oral and pharyngeal swallowing. Surgery is rarely required, except in severe cases where enteral nutrition may be necessary to bypass the oral cavity and pharynx entirely

The Supraglottic Swallowing Method and the Super Supraglottic Swallowing Method are techniques used to facilitate safe swallowing of food and liquid. These methods help close off the airway to prevent aspiration into the lungs during swallowing

Introduction:

Wearable devices mean whatever a person can wear since they do not restrict daily activities or mobility. Recently, progress has been made in the use of wearable sensors for breathing monitoring devices, so that it is considered a promising area. Many applications, including sleep monitoring, breathing pattern detection, and respiratory rate detection, require comfortable and wearable devices that patients can wear in their homes, if possible, for continuous monitoring and storage of relevant data. Other requirements for wearable devices involve (i) the ability to share patient data with healthcare professionals, researchers, and family, (ii) very low energy consumption and long battery autonomy, and (iii) wireless communication with other devices. Wearable Devices 2 The main topics for the development of wearable devices for breathing monitoring and pattern detection are discussed in this chapter.

Why is it important to monitor breathing activity with wearable devices?

The development of wearable devices to monitor breathing activity allows giving rise to various medical care services. For example, considering people with asthma or chronic obstructive pulmonary disease, the environmental conditions directly affect their breathing, and a wearable device can continually measure air quality and pulmonary function. The device could trigger alarm functions for drug uptake, contact a general practitioner for an appointment, or call emergency services. The measurement of air quality is important, as pollutant exposure can lead to acute asthma attacks. This happens usually after days under exposure. If a system detects pollutant exposure, it can warn the person and help to prevent attacks. Other applications of wearable devices include sleep monitoring for apnea detection, speaking detection as an indicator of social interaction, respiratory impedance, etc. The detection and tracking of respiratory movement for image guided chest and abdomen radiotherapy, for compensation of movement during treatment, are additional uses of wearable devices. Moreover, researchers have studied ways to develop smart fabrics, which are comfortable and nonintrusive, for different applications such as healthcare, sports, and military scenarios.

What is important to know for the development of a wearable device for breathing monitoring and pattern detection?
The creation of these wearable devices requires understanding the anatomy and physiology of the respiratory system. The knowledge about its structure and function leads to the development of devices that do not interfere with respiratory mechanics or daily life activities. It also allows selecting the best sensors in each case. Therefore, it is important to have an overview of the main types of electronic sensors used in recent years and how they have been applied, as well as signal processing and machine learning methods. This chapter covers these topics concisely as a guide for people interested in developing wearable devices for respiratory monitoring. The next section introduces the anatomy and physiology of the respiratory system. The sections 3, 4, and 5 discuss, respectively, the electronic sensors, signal processing methods, and machine learning techniques applied to respiratory signals for pattern recognition.

METHODOLY AND IMPLEMENTATION

The methodology begins by placing electrodes on the targeted muscle to capture its electrical variations. These signals are then transmitted to a signal conditioning block, which includes protective measures to prevent electrical shocks and a module to eliminate high-frequency disturbances. As the obtained signal is typically weak (millivolt or microvolt range), it undergoes amplification through an instrumentation amplifier and further filtering via a high-pass filter to remove low-frequency noise.

Following the signal amplification stage, the waveform is once again amplified using a regulated gain amplifier. The resultant analog signal needs to be converted into a digital format for further processing. This conversion is accomplished by a microcontroller, which employs a 10-bit resolution and samples the signal at a rate of 256 samples per second. The converted digital signal is then organized into packets and sent to software running on a personal computer.
Within the software, the packets are processed to calculate the threshold values for supraglottic swallowing. These threshold values serve as a reference for distinguishing between normal and abnormal swallowing patterns. To visualize the supraglottic swallow waveform, an Organic LED (OLED) display is employed, chosen for its faster response time compared to LCD displays.
In summary, the methodology involves electrode placement, signal acquisition, signal conditioning with protective measures and high-frequency rejection, signal amplification through instrumentation amplifiers and regulated gain amplifiers, analog-to-digital conversion by a microcontroller, packet formation, threshold calculation through software, and waveform display using an OLED screen.

PROPOSED SYSTEM

The electrodes will pick up the electrical variations of the muscle. This information is fed to signal conditioning block consists of high voltage protection or high isolation part in order to prevent the risk from the electrical shocks. Output from isolation is fed to the high frequency rejection in order to avoid the variations in the MCU. The obtained signal is low in amplitude i.e., in milli volt or sometimes in micro volt. To process this signal, signal needs to be amplified using instrumentation amplifier. The signal is given to the high pass filter to eliminate the low frequency noises. Then the waveform is once again amplified using the amplifier with regulated gain. The output is analog in nature which needs to be converted into digital for further processing.

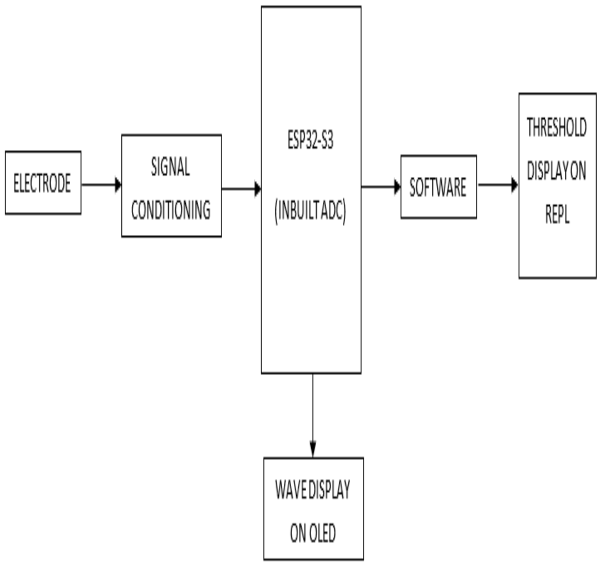


Fig. 1. Block diagram

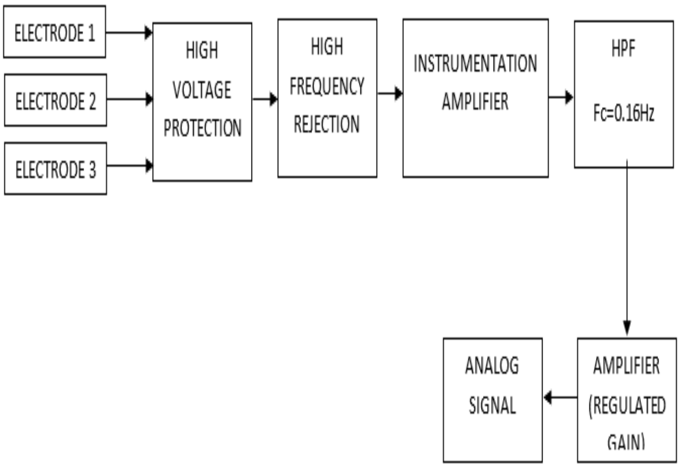


Figure 2: Proposed block diagram of overall system

The microcontroller converts the analog signal to digital signal using 10-bit resolution with 256 samples/second. The converted digital signal will be formed into packets. The packets are sent to the software to obtain the supraglottic swallow threshold values on personal computer. An Organic LED (OLED) is provided for displaying of supraglottic swallow waveform, as OLED gives much faster response than LCD, OLED is being used.

HARDWARE SOFTWARE REQUIREMENTS

Hardware Description:

In the wake of encountering in depth detail we have connected with the distinctive Hardware and Software necessities which are implemented in the project.

Hardware Requirements

1. ESP32-S3 Controller
2. Electrode
3. OLED
4. Stretchable cord (Resistive Type)

Software components: IDE software:
Software Description:

Requirement of software for an electronic device development phase is considered as significant portion of the project. It starts with the top-level outline and streaming down to the necessities to smaller modules that is dealt separately.
Software Requirements

- I2C
- RTOS
- Tasks
- Scheduling
- Priorities
- Binary Semaphores
- Handling interrupts
- Critical sections

Algorithm:

Step 1. Start
Step 2. Initialize ADC
Step 3. Initialize dependency
Step 4. Initializer median filter.
Step 5. Initialize task
Step 6. Create task
Step 7. Stop

FLOW CHART

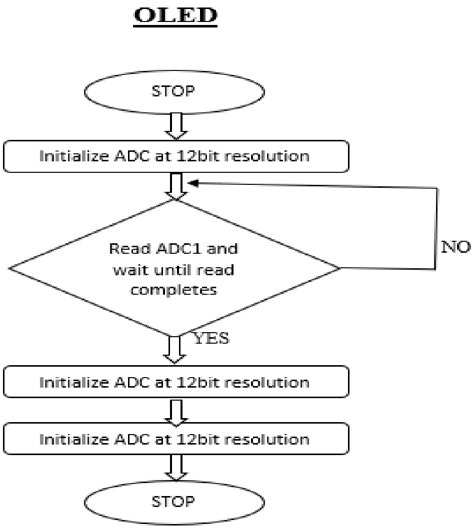
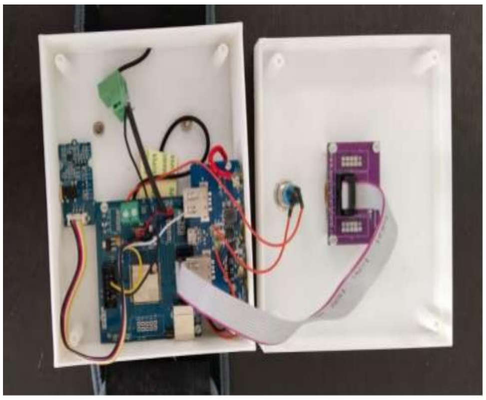


Figure 4. Flow Chart

Activity of the project:



Figures 5. Activity of our Project

Objective:

- The primary objective of the proposed work for the project Virtual Fencing in Agricultural Field is todevelop a robust and accurate virtual fencing system that can effectively contain and manage livestock without the need for physical barriers.
- Secondly, the project will develop software that can receive signals from PIR sensors and alert the animalsvia their collars when they are approaching the virtual fence boundary.
- Thirdly, the proposed work will address environmental factors that could affect the virtual fence's effectiveness. Virtual fencing can help protect crops from damage caused by livestock. By setting up virtualboundaries around crop fields, farmers can ensure thatlivestock are kept away from these areas, minimizing the risk of trampling, grazing, or destruction.
- Fourthly, the project will evaluate the performance of the virtual fencing system by conducting field tests in real-world agricultural settings. The system's accuracy, reliability, and effectiveness will be measured against traditional physical fencing systems, and any necessary improvements will be identified and addressed.

ADVANTAGES:

- It is a soft and flexible material
- This device is easy to use .
- It is a lightweight and wearable belt device
- Low cost

LIMITATIONS

- Technical limitations: Swallow and respiratory monitoring systems rely on various technologies such as sensors, electrodes, or wearable devices. These technologies may have certain limitations, such as accuracy issues, false readings, or technical failures. Inaccurate readings can lead to incorrect diagnoses or unnecessary interventions.
- Discomfort and invasiveness: Some monitoring systems require the insertion of sensors or electrodes into the body, which can cause discomfort and may not be well-tolerated by all patients. This invasiveness can affect the patient's quality of life and adherence to the monitoring system.
- Cost: Implementing and maintaining swallow and respiratory monitoring systems can be costly. The initial investment in equipment, training, and infrastructure, as well as ongoing maintenance expenses, can strain healthcare budgets. This cost factor can limit the widespread adoption of these systems in certain healthcare settings.
- Privacy and data security: Monitoring systems often involve the collection and storage of sensitive patient data. Privacy concerns arise regarding the potential misuse or unauthorized access to this data. Safeguarding patient information and ensuring data security becomes crucial, requiring robust measures and compliance with data protection regulations.
- Limited applicability: Swallow and respiratory monitoring systems may not be suitable for all patients or medical conditions. Certain individuals, such as those with severe respiratory conditions or other underlying health issues, may require more invasive monitoring techniques or alternative approaches. The limitations of these systems can restrict their effectiveness and impact on certain patient populations.
- Misinterpretation of data: The data collected by monitoring systems needs to be properly analyzed and interpreted by medical professionals. Incorrect

APPLICATIONS

- Paralyzed persons
- Spinal cord injury persons
- It is uses for health care applications
- It can be used to monitor and track the swallowing and respiratory patterns of individuals,

The application may use various technologies, such as wearable sensors or microphones, to track swallowing and respiratory patterns.

EXPERIMENTATION AND RESULTS

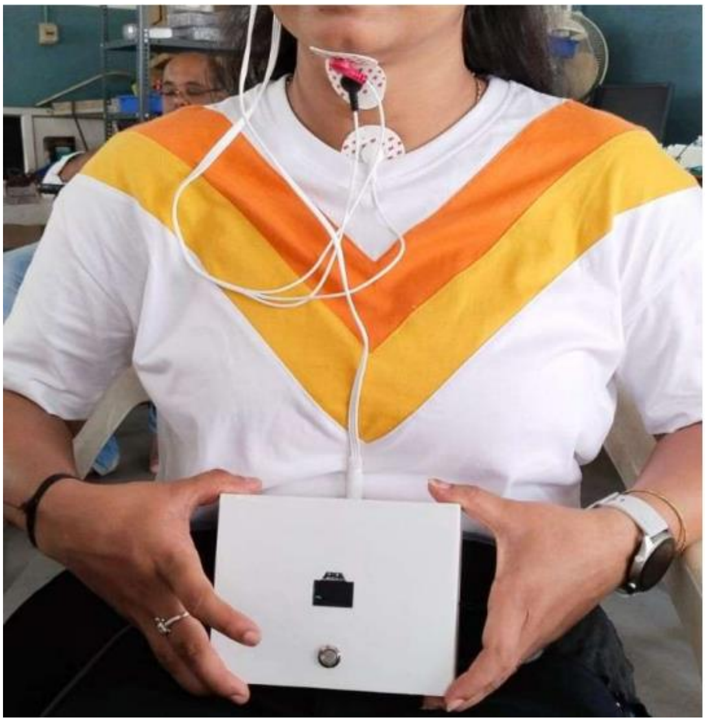


Fig 6.2.1 BREATH AND SWALLOW SENSING ON OLED WITH ELECTRODES FOR EMG SENSING

FIG 6.2.2BREATH SENSING WAVE ON OLED

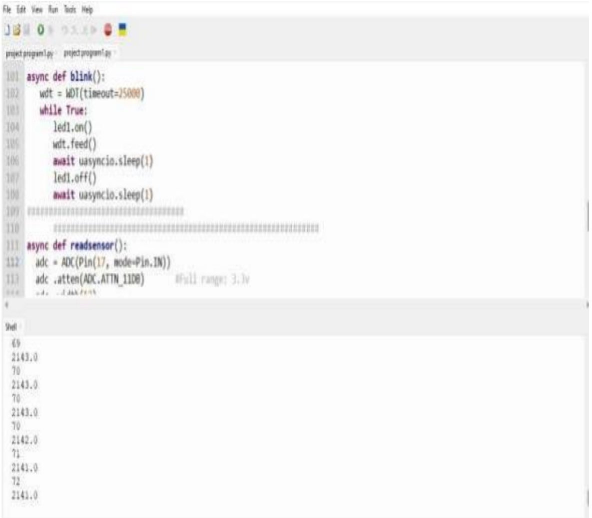


FIG.6.2.3. DIGITAL VALUES ON PC

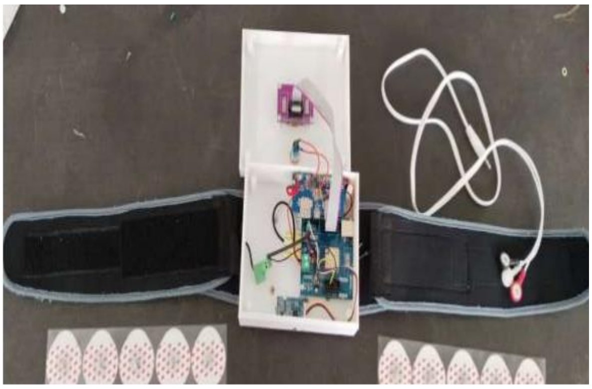


FIG.6.2.4. FINAL MODEL OF THE PROJECT

CONCLUSION:

Wearable devices for breath monitoring and signal detection are not simple devices. They must not interfere with the other system activities and need to be highly opaque to external signals. The understanding of the respiratory mechanics is most important for the development of wearable sensors. And, one should know how to connect them in a correct way to capture the breathing signals. The methods used mainly depend upon the type of the signal studied and the right methods can be applied during any clinical diagnosis, biomedical research, hardware implementations and end user applications. EMG signal carries valuable information. Brief information about EMG and EMG signal has been discussed along with the methodology to capture the EMG signal. The used Techniques for EMG signal detection discussed along with their advantages and disadvantages. The obtained EMG signal will directly tell us the supraglottic swallow pattern of a particular person who wears the device. The right methods can be applied during any clinical diagnosis, biomedical research, hardware implementations and end user applications. Both swallow and breath detection help the dysphagia treatment to maintain adequate nutritional intake for the patient and to maximize airway protection for the patients with swallowing disorders. Patients with oral and pharyngeal swallowing disorder require rehabilitation which includes dietary modification and training in swallowing techniques. In swallowing technique there comes the picture of supraglottic swallow. (Supraglottic swallow is a swallowing technique in which a person coughs right at the end of a swallow to help prevent any swallowed food or liquid from going down into the airway.

FUTURE SCOPE

A prototype has been designed to capture both EMG signal and breath signal. In future, its size can be minimized and the cost can be reduced so that the device can be available at ease to the patients with swallowing disorders (Especially the epileptic patients).

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