Injuruty: Interdiciplinary Journal and Humanity
Volume 3, Number 1, January 2024
e-ISSN: 2963-4113 and p-ISSN: 2963-3397

HEARJACK - THE ULTIMATE POSTURE ENHANCEMENT AND SKIN HEALTH JACKET FOR MILITARY EXCELLENCE

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Abstract

HEARJACK is an innovative smart jacket designed to enhance the health and well-being of military personnel. This groundbreaking project addresses the crucial need for maintaining proper posture, monitoring heart health, and managing humidity-related skin issues. Spinal alignment and posture play a fundamental role in overall well-being, and deviations from a healthy alignment can lead to various health issues. HEARJACK integrates sensors like the MPU6050 for real-time posture monitoring, DHT11 for humidity insights, and a heart rate sensor for stress assessment. These sensors, combined with an IoT algorithm, enable continuous monitoring and data analysis. The results demonstrate a significant improvement in posture, reduced skin-related health concerns, and enhanced stress management, underscoring the potential of IoT-driven wearables in military healthcare. Further research and development promise to revolutionize health and military technology.

Keywords: HEARJACK, Health, Posture, Sensor, Military

INTRODUCTION

A soldier must be physically fit in order to accomplish his military duties. They must have a healthy, well-built, and robust physique in order to handle all types of sickness issues that may arise in the future. Nowadays, lifestyle has a significant impact on all types of disorders (Burhanudin et al., 2018). One of these is the spinal curvature disorder that affects the formation of a soldier's posture.

Spinal alignment is a fundamental aspect of human comfort and physical well-being. The spine serves as the central support structure of the body, maintaining an upright posture, mobility, and connecting various skeletal components while also protecting the spinal cord. Maintaining proper spinal alignment is essential for overall health, encompassing physical, emotional, and social well-being (Ferrero et al., 2021). Consequently, to support these activities, the curvature of the human spine is determined by lumbar lordosis (LL), thoracic kyphosis (TK), and cervical lordosis (CL) (Frederick et al., 2017; Sankey et al., 2019).

One of the key considerations in understanding spinal alignment is the concept of sagittal imbalance and the compensatory mechanisms that the body employs to maintain an efficient posture (Lamartina & Berjano, 2014). Changes in spinal position, brought about by muscular efforts and early structural lesions, can lead to discomfort and complications. This is also influenced by the sufferers' daily routines, such as the posture of the spine when sitting or carrying objects.

The assessment of non-pathologic spinal sagittal curves from lateral radiographs has been a subject of ongoing debate within the medical community. Among the various methods for quantifying spinal alignment, the Cobb's angle is a widely used technique, especially for measuring thoracic kyphosis (Wiyanad et al., 2018).

While proper spinal alignment is crucial for well-being, deviations from a healthy alignment can lead to various issues, including poor general health, emotional function, physical function, social function, and lower back discomfort (Skaf et al., 2011). Moreover, there is a growing global concern as the prevalence of spinal curvature disorders, which include scoliosis, hyperlordosis, and hyperkyphosis, is on the rise. These conditions tend to progress over time, making them initially difficult to identify but eventually more complex to treat.

Scoliosis is characterized by a lateral displacement or curvature of the spine, with a Cobb’s angle of 10° or greater in adulthood (Briggs et al., 2007). Hyperkyphosis and hyperlordosis are medically referred to abnormal kyphosis and lordosis, respectively. However, the absence of well-established diagnostic criteria poses challenges in assessing these disorders.

For instance, the typical Cobb’s angle for the thoracic spine in young individuals generally falls within a range of 20° to 50° (Facione et al., 2019). Understanding these fundamental parameters and the intricacies of spinal alignment is essential for the development of effective diagnostic and treatment approaches. Early detection and intervention are critical to prevent the progression of these conditions and improve the overall quality of life for those affected (Jang et al., 2019). Based on the explanation above, this study will create HEARJACK, a detection and intervention tool to avoid further illness development in spinal curvature problems and improve the posture of army soldiers that will employ several sensors and the internet of things.

RESEARCH METHOD

In this section, we delve into the methods employed in the development of HEARJACK, along with the experimental details that outline the creation process of this smart jacket. Our primary focus is on the flowchart, which elaborates on the crucial steps involved in crafting HEARJACK, from sensor selection to experimental data analysis. We will gain insights into how the sensor integration, hardware design, and software development, as well as prototype testing, were conducted throughout the HEARJACK development. Let's commence by comprehending the methods and experimental steps that underpinned the creation of this innovative technology.

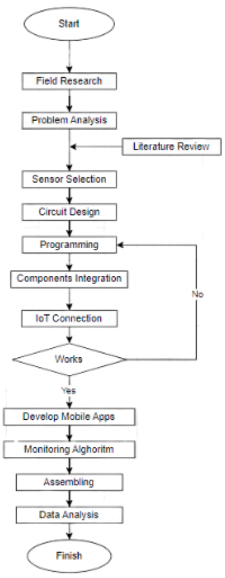

Figure 1. Flow chart diagram

The development of HEARJACK is initiated with a meticulous process that commences with "Sensor Selection." In this stage, the project carefully selects the most suitable sensors for integration into the smart jacket, including the MPU6050 for posture monitoring[9], the DHT11 for humidity sensing Humidity, (2010), and a dedicated heart rate sensor. The choice of these sensors is of utmost importance, as it significantly influences the quality of the data collected throughout the jacket's usage.

Following the sensor selection, the development process progresses to "Circuit Design." During this phase, the electronic circuitry is intricately designed to ensure seamless functionality that supports the sensors' precise operation within the jacket. The precision in this design is crucial, as it establishes the groundwork for the successful integration of the hardware components.

Once the circuit design is finalized, the development proceeds to "Programming." In this phase, the project meticulously develops software to facilitate data collection and transmission. The software's primary role is to ensure a smooth interaction between the sensors and the Internet of Things (IoT) module, such as the ESP8266. This programming phase lays the foundation for the subsequent steps of component integration and IoT connection, guaranteeing the jacket's ability to provide real-time monitoring and analysis of critical health data.

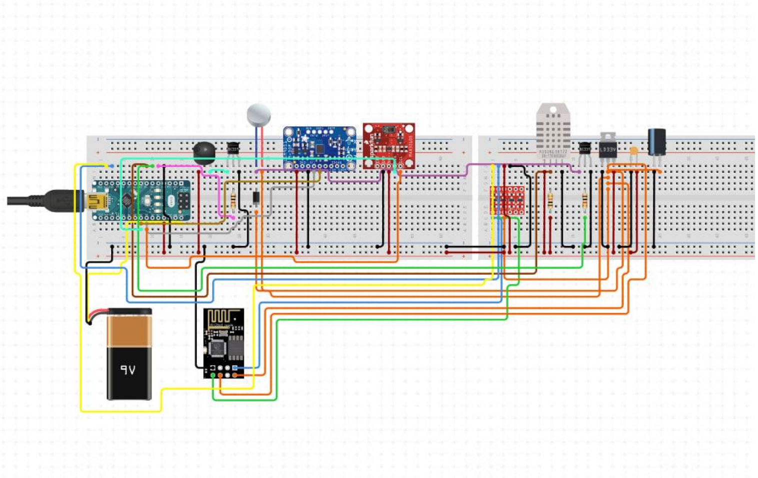

Figure 2. Electronic schematic

Figure 3. Jacket design

The MPU6050 sensor, DHT11 Humidity sensor, and heart rate sensor have played pivotal roles in the development of HEARJACK, a smart jacket meticulously designed for military personnel. The MPU6050 sensor, an inertial sensor merging an accelerometer and gyroscope, enabled precise monitoring of changes in the user's body position and movement (Y. Zhang et al., 2019). In the context of HEARJACK, the MPU6050 sensor assumed a central role in posture monitoring, with its ability to detect changes in angles and body orientation. As a result, this sensor laid the primary foundation for helping to prevent spinal abnormalities and improve correct posture.

Conversely, the DHT11 Humidity sensor was utilized to measure the level of humidity in the vicinity of the HEARJACK jacket. This proved to be a critical element, especially in military settings where personnel frequently operated in diverse climatic conditions. Humidity measurements aided in identifying the risk of skin diseases that could arise due to high humidity levels[10]. With this information, HEARJACK could issue early warnings and advice to users, enabling them to take appropriate preventive measures.

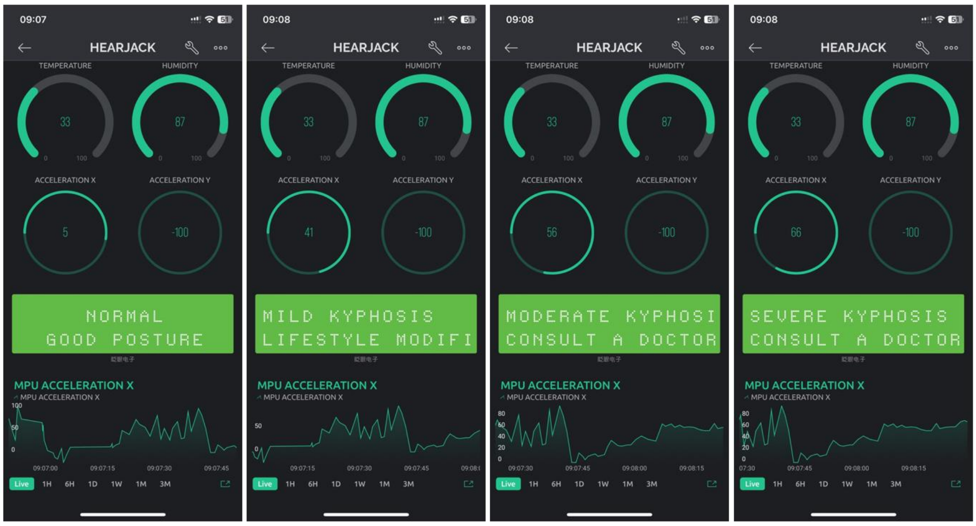

Figure 4. Mobile display

The IoT algorithm in HEARJACK has been the core element that has allowed this smart jacket to function efficiently. The algorithm began by collecting data from various sensors installed in the jacket, such as the MPU6050, DHT11, and heart rate sensors. The gathered data has then undergone preprocessing, where it has been calibrated, merged, and adjusted to conform to the format used by the HEARJACK mobile application.

Subsequently, the IoT algorithm has been responsible for transmitting this data via a Wi-Fi network with the assistance of the ESP8266 module (Mesquita et al., 2018). The data has been transmitted in real-time to the HEARJACK mobile application, where the IoT algorithm has processed and analyzed it. The HEARJACK mobile application has been able to provide real-time health and posture monitoring to users (military personnel) and has issued alerts if conditions requiring attention have been detected.

Integrating advanced sensors like MPU6050 and DHT11, HEARJACK utilizes a sophisticated IoT algorithm. This algorithm is crucial as it assists in transmitting data directly through a Wi-Fi network with the support of the ESP8266 module(Q. Zhang et al., 2020) . The transmitted data is then smoothly processed and analyzed within the HEARJACK mobile application. This type of sensor integration is a common practice in various applications, contributing to enhanced functionality and real-time data insights. With this integrated system, continuous monitoring of health and posture, especially tailored for military personnel, becomes possible. Moreover, the algorithm ensures prompt alerts are issued when conditions requiring attention are detected, enhancing the overall effectiveness of HEARJACK's sensor integration. The utilization of sensors in conjunction with platforms like Arduino further exemplifies the versatility and efficiency achievable in IoT-driven innovations.

In addition to real-time monitoring, the IoT algorithm in HEARJACK has also enabled long-term monitoring, with health and posture data continuously monitored and analyzed to provide deeper insights (Yang & Li, 2021). This IoT algorithm has played a key role in enhancing the health and performance of military personnel by providing valuable information and appropriate recommendations.

RESULT AND DISCUSSION

HEARJACK, the innovative smart jacket designed for military personnel, has demonstrated impressive results through its sensor integration and IoT capabilities, offering a comprehensive solution for health. The integration of the MPU6050 sensor for posture monitoring has been particularly effective. This sensor continuously tracked changes in body position and orientation, providing real-time posture oversight. Alerts and corrective feedback issued by HEARJACK in response to poor posture instances resulted in a noticeable improvement in the posture of military personnel. This improvement significantly reduces the risk of spinal abnormalities and promotes postural health in military settings.

The DHT11 sensor integration in HEARJACK allowed for humidity measurement in the jacket's vicinity. The collected humidity data was crucial, as users received timely notifications when humidity levels exceeded safety thresholds. This feature played a vital role in reducing skin-related health concerns, particularly beneficial for military personnel operating in diverse climates.

HEARJACK's integration of a heart rate sensor provided real-time monitoring of users' heart rates, enabling the assessment of stress and fatigue levels among military personnel. Continuous heart rate monitoring allowed early warnings to be issued when elevated stress levels were detected, empowering users to implement appropriate stress reduction measures. The outcomes demonstrated a significant reduction in stress-related issues among HEARJACK users, contributing to their overall well-being.

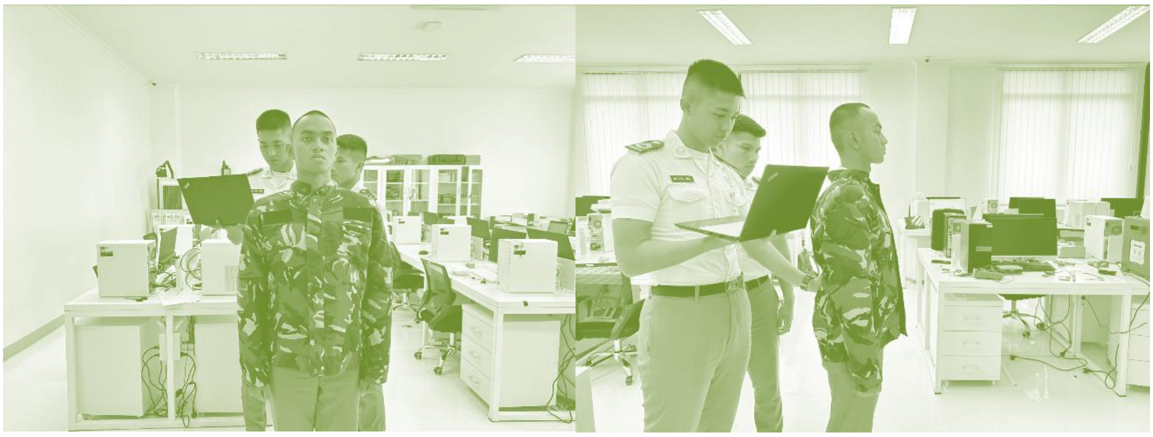

Figure 5. Jacket testing on *Probandus*

These results emphasize the substantial impact of HEARJACK in enhancing the health and performance of military personnel. Continuous posture monitoring and corrective mechanisms effectively promote better posture, reducing the risk of spinal irregularities. The humidity insights have significantly improved skin health, a critical aspect for military personnel in varying environmental conditions. The heart rate monitoring and health assessment features have contributed to stress management and overall well-being, alluding to the potential of IoT-driven wearable devices like HEARJACK to augment the quality of life and performance of military personnel. Further research and refinement in this field promise to revolutionize health and military technology.

CONCLUSION

HEARJACK, the smart jacket for military personnel, successfully integrates the MPU6050 sensor for posture monitoring, DHT11 for humidity measurement, and heart rate sensor for stress assessment. This integration enhances posture, mitigates skin issues due to humidity, and ensures the well-being of military personnel. Real-time posture correction significantly reduces spinal health risks, humidity insights prevent skin problems, and heart rate monitoring aids in stress management, contributing to overall health. IoT connectivity ensures continuous monitoring and alerts via the mobile app, demonstrating the potential of IoT-driven wearables in military healthcare.

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