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Internet of Things based Smart Military Jacket for Soldiers

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ABSTRACT: Integrating Internet of Things technology into a smart jacket elevates soldier safety and operational effectiveness through continuous health tracking with precise location tracking. Engineered to withstand the rigors of military environments, this system prioritizes durability and non-intrusiveness. By harnessing IoT capabilities, a network of interconnected devices is established, facilitating seamless communication with military bases to uphold constant vigilance over soldiers' well-being. This introduction lays the groundwork for an in-depth exploration of the smart jacket's design, functionalities, and its potential transformative impact on military operations. Enabling instantaneous monitoring of a soldier's location and vital health metrics during combat engagements, the control room will help the soldier to theirdesignated location utilizing this soldier navigation system.

KEYWORDS: Internet of Things; Smart Jacket; Health monitoring; Sensors.

I. INTRODUCTION

In the current global landscape, safeguarding our nation against both external and internal threats stand as a paramount concern, heavily reliant on the strength of our armed forces. Each year, numerous military personnel sustain various injuries in the heat of battle, often without immediate aid available [1]. This lack of timely assistance leads to significant hardships for the military, exacerbated by the absence of crucial information on the injuries sustained by personnel, potentially resulting in heightened casualties or permanent disabilities. To confront these obstacles and enhance the security of our military personnel, leveraging advanced technologies becomes imperative [2]. Establishing a system capable of real-time tracking of soldiers' locations and vital health statuses emerges as a crucial solution. The soldier's whereabouts can be monitored utilizing GPS and Wi-Fi modules, facilitating wireless communication between soldiers and base stations [3]. Monitoring the soldier's health status involves the utilization of biomedical sensors, like temperature sensor and heartbeat sensor. rendering them responsive to their environment [4]. Through IoT, the soldier's status can be swiftly transmitted across networks, streamlining the monitoring process and facilitating prompt decision-making. Leveraging GPS technology allows for precise tracking of the soldier's position and orientation [5]. This system will enable GPS tracking of messages from the soldier, containing temperature, latitude, longitude, and Heart rate data, thereby enhancing situational awareness and enabling swift response measures. The jacket is crafted to maintain the body's temperature. to 37 degrees Celsius, irrespective of atmospheric conditions, ensuring soldiers can endure even sub-zero temperatures. Employing Internet of Things (IoT) technology for this proposed system proves instrumental. IoT, defined by interconnected devices with sensors, software, and network connectivity, enables seamless datacollection and exchange,

II. LITERATURE REVIEW

Researchers evaluated various materials used in bulletproof vests and identified the most suitable one in accordance with conditions such as directional bending, overall deformation, shear stresses, and principal stresses under bullet impact. They opted for composite material due to its high specific strength and stiffness, excellent corrosion resistance, and fatigue resistance. Another study by Bogdan Muset et al. presents a system for measuring the distance traveled by an individual within a structure as an alternative to GPS [6]. The system relies on a developed algorithm that calculates distance based on step count. This approach provides benefits such as affordability. and portability of the

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sensor circuit. M.V.N.R. Pavan Kumar et al. discussed a paper focusing on tracking soldiers and facilitating communication between warriors and officers during warfare. The proposed solution involves a wristwatch displaying position, direction, ambient temperature, and serving as an altimeter. This aids military personnel in planning war strategies effectively. R. Archana et al. outlined a system capable of monitoring soldiers' health parameters, location, real- time video transmission, and detecting wounds and bombs [7]. The soldier unit include sensors for pulse rate, bomb detection, vibration, and temperature, with GSM used for communication and transmitting data to the control room. Rosarium Pila et al. introduced an innovative method for counting human steps using accelerometers and proximity sensors. This method aims to prevent false step detection by combining proximity sensing with accelerometer-based motion detection. While the concept is novel, similar ideas for monitoring soldier health have been proposed previously. Consequently, these papers' ideas were consolidated, along with an effective shot detection system, to develop the most comprehensive jacket aiming to address soldiers' critical challenges.

III. METHODOLOGY

The underlying technology utilized in this paper is the Internet of Things (IoT), which stands as a rapidly emerging technology in recent years. Leveraging IoT enables the immediate collection of data from various global locations [8]. This capability is particularly valuable in monitoring soldiers during occurrences or incidents. We can observe today that numerous troops were impacted by health problems. As a result, our suggested system can identify the circumstance when soldiers are in any urgent situations or conditions outside of networked regions. To assess a soldier's health, heart rate and body temperature are monitored during Operations [9]. To Provide real-time alerts to command centers when abnormal health readings are detected. To access the Location status of soldiers during emergency allowing for rapid response and rescue operations when needed. Since in very cold temperatures, the most serious concern is the risk of hypothermia or dangerous overcooling of the soldier's body. Henceforth we have developed a smart army jacket as an important resource for the army soldiers as soldiers play a very important role to protect our country in extreme cold conditions [10]. To transmit the information regarding the soldier's health abnormality and emergency conditions. To design the system with lightweight components incorporating in a thermal resistance A jacket that guarantees soldiers can fulfill their duties without disruption.

The proposed system comprises a transmitter and receiver setup, with the Node MCU module serving as the transmitter and receiver of information, as shown in Figure 1. The temperature, Max30100 sensor, and GPS modules continuously gather data about the soldier, transmitting it periodically. All parameters related to the soldier's health, including pulse, blood pressure, oxygen level, and current location, are transmitted via the Node MCU module [11]. This health- related information undergoes segregation and analysis through the Internet of Things (IoT) framework. The resultant data is then stored in the cloud, where it is analyzed to produce a report on the soldier's health. The system is highly responsive to abnormal or unsatisfactory heart rate conditions [12]. Additionally, an emergency trigger button is located at the soldier's end, allowing for the blind transmission of the soldier's current location to receiver end. This button serves to identify any issues the soldier may be facing beyond the predetermined parameters. The workflow of the soldier condition tracking system is depicted.

The Node MCU serves as a suitable tool for accurately measuring and monitoring various health parameters of soldiers, establishing a sturdy framework for gathering crucial data. The BMP180 sensor enables the measurement of both pressure and temperature, providing digital output indicative of atmospheric pressure. This data is instrumental in weather monitoring, altitude measurement, and environmental control. The MAX30100 sensor is a versatile device capable of monitoring both heart rate and pulse oximetry, offering utility in fitness tracking, health monitoring, and wearable devices, all while operating with minimal power consumption. A GPS module, a compact electronic device, interacts with satellites to determine and transmit precise geographic coordinates, including latitude, longitude, and often altitude, making it indispensable in navigation systems. An inductive proximity sensor detects nearby metal objects without physical contact, contributing to enhanced situational awareness. A voltage regulator ensures a consistent voltage output of 5V, crucial for maintaining device stability, especially considering input fluctuations from an 8.4V battery. A Li-Battery powers the entire unit, with provisions for recharging facilitated by an additional hand crank. An emergency button is incorporated for soldiers to use during critical situations [13].

Dynamic Real time Data Detection in Battlefield:

Information gathered from the battlefield will serve as an indicator of soldiers' health status, with data revealing insights such as nearby landmine detection. To achieve this, a selection of suitable sensors is recommended for deployment, enabling data analytics through K-Means algorithms [14]. This analytical method aids the control unit in precisely mapping theconditions surrounding the soldiers.

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Data Transmission:
Information is relayed from the soldier to the control room via internet communication. Subsequently, the control room gathers the data and stores the data using Thinkspeak server. The data transmission can occur periodically at predefined time intervals or selectively when there is notable alteration in soldier's biomedical sensor readings.

System Summary:

The system consists of two units: the soldier's unit and the control room. The soldier's unit is worn on the soldier's hand and gathers data regarding their physical health and environmental conditions [15]. This data is subsequently relayed to the control room unit, where it is analyzed using the IoT to assess the soldiers' health status. Based on findings, decisions regarding the necessity of surgeries for the soldiers' safety are made. Additionally, the soldier unit is equipped with a GPS module, allowing the control room to track soldier's precise location [16]. This capability enables timely intervention to save soldiers in peril and ensures accurate location tracking for their safety.
The soldier's status, current whereabouts, and prevailing weather conditions can be monitored using an IoT system. The jacket comes with features such as heartbeat rate sensor, enabling continuous monitoring of the soldier's heart rate. Additionally, it incorporates a small GPRS module, facilitating precise tracking of the soldier's location from the base station [17]. Data collected from sensors like body temperature, heart rate, and GPS are transmitted directly to the control room or monitoring station dedicated to each soldier via Node MCU. The entire system is powered by a compact and efficient rechargeable battery, which can be recharged either through electricity or solar energy, depending on availability [18]. It establishes a unified mesh network with limited bandwidth and frequency to streamline communication within thesystem.

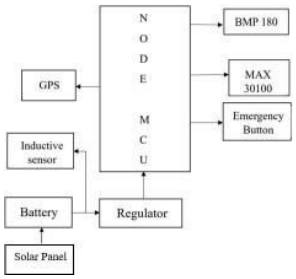

Fig. 1. Block Diagram of the smart Jacket

IV. EXPERIMENTAL RESULTS

During our tests, we carefully checked how well the jacket's sensors worked, like the ones measuring heart rate and temperature. We also made sure that the jacket could talk to the control room without any problems. We wanted to see how long the battery would last and if the GPS could tell exactly where the soldier was. If there was an emergency, we timed how quickly help could arrive. We looked at all the health data collected and made sure we could spot any problems quickly. Lastly, we checked that everything in the jacket worked together smoothly. Overall, we wanted to make sure the jacket kept soldiers safe and worked well during missions.

(a) (b) (c)

Fig. 2. Sensor working (a) solar panel (b) components before implementing (c)

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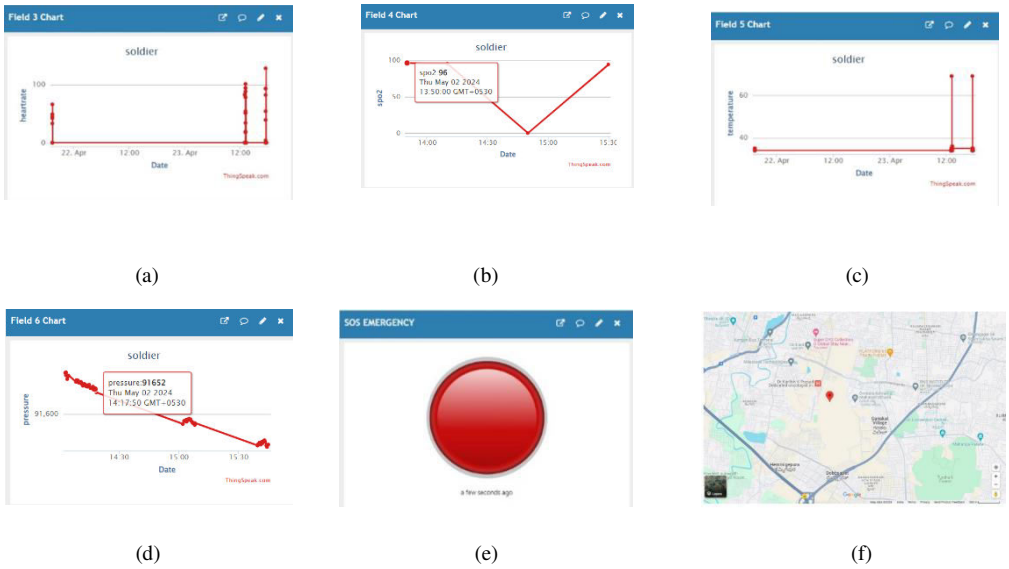

(a) (b) (c)

(d) (e) (f)

Fig. 3. Data received to control room, Heartrate of soldier (a) Spo_2 of soldier (b) Body temperature of soldier (c) Air pressure near soldier (d) Emergency button output (e) Geolocation of soldier

V. CONCLUSION

The smart jacket ensures the safety of soldiers, offering an affordable alternative with the NODE MCU wifi board serving the same purpose. Biomedical sensors on the vest transmit data regarding each soldier's heart rate, body temperature, Spo2 and overall health to the control room. To accurately pinpoint the location of a lost soldier in any critical condition and mitigate the issue of soldiers going missing in action, GPS and RF modules track their whereabouts worldwide. Soldiers maintain continuous communication with the base station, And addressing system makes it easier for soldiers to locate the control room and communicate effectively with each other. during emergencies. Consequently, this approach serves tosafeguard army troops effectively.

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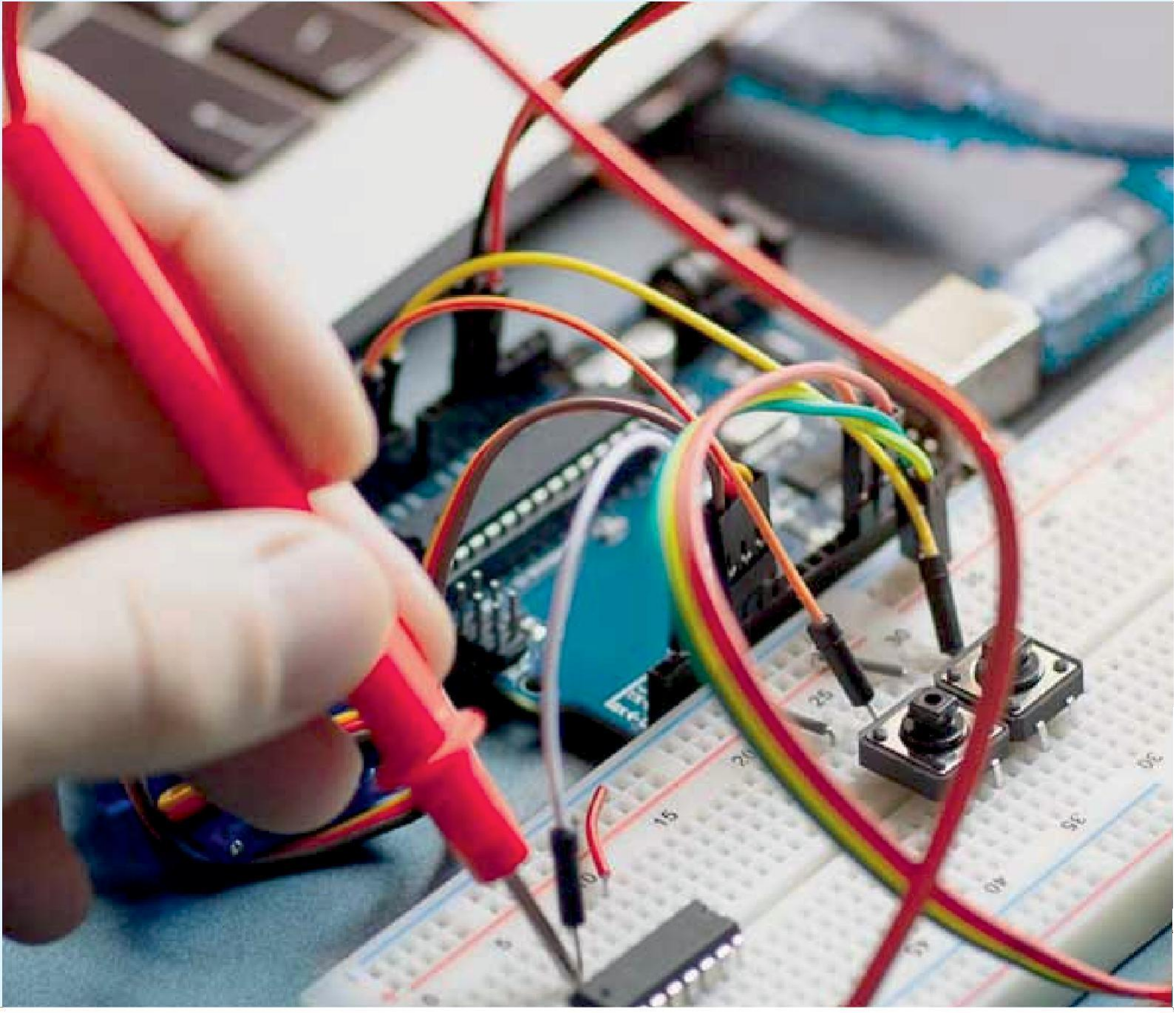

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