Enhancing soldier safety and position tracking by real-time IoT activation system with effective LPWAN and WBAN Technology

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Abstract- The soldier Health and Position Tracking System allows military to track the current GPS position of soldier and also checks the health status including body temperature and heartbeats of soldier. The GPS modem sends the latitude and longitude position with link pattern with the aid of that military can track the current position of the soldier. Ad-hoc wireless networks are increasingly being used for a variety of reasons and applications. These involve Low Power Wide Area Networks (LPWAN) and wireless body area networks (WBAN), which have emerging uses in health monitoring and user location tracking in emergencies. Real-time activation of IoT equipment and emergency alarms can also be achieved by inferring a user's position utilizing sensors and personal gadgets connected via an LPWAN, It's important to conserve battery life for sensors and appliances that send data to a central server. This research proposes a framework for safe messaging systems and data fusion to reduce data size while preserving accuracy. A Multilayer Inference System (MIS) conserves battery life for wearable and sensor devices. Adding other biometrics and health data can improve authentication accuracy even more.

Keywords— GPS, LPWAN, Internet of Things, Sensors, WBAN.

INTRODUCTION

In today's world the nation security depends on enemies' warfare. So, the life of our soldier is very important. There are many risks occur in warfare region. Risks such as hazardous gas, snow slides, heavy snow fall, and variation in their body temperature may affect their health condition, sudden heart problems may also lead to problems in warfare. One of the main problem for soldier is not able to communicate with control room. In this project we are proposed to find the exact location and the health parameter of the soldier in real time so that the action should be taken quickly. There has been extensive study on mobile health (mHealth), including apps and informatics. IoT and Low Power Wide Area Networks (LPWAN) are emerging technologies. Replace prior sensor networks and technology. These Two networks combined give an acceptable answer for the military applications because they can meet the specific needs for Military mobile networks need to be adaptive to Environmental circumstances and requirements are constantly changing and often unpredictable. Military wireless network sensors have computational and battery limits due to their reliance on portable batteries with limited power. To address these issues, this research suggests using a Multilayer Inference System (MIS) to create a framework for military mobile networks. The sections below provide an overview of the inspiration, description of the issue, selected methodology, and techniques utilized to produce the solution.

MOTIVATION

The researcher established the Human Performance Research Network (HPRnet) to enhance military personnel, including research on soldier performance management, load modelling, adaptation and performance. This includes assessing and describing troops' physical demands and physiological responses during military training, as well as predicting their outcomes using wearable sensor data and psychometric inventories. [1].

A separate research program, The Fight Recorder, examines the use of a small, light, and robust emergency beacon worn by combat soldiers to capture data for incident investigation and insight into military service in deployed environments. This application includes an emergency beacon, which can be triggered by the wearer or a healthcare professional. When the gadget connects to satellites, it transmits its geographic location, allowing for the location of persons during emergencies, such as evacuations [2].

Monitoring soldiers' health throughout training and missions can significantly improve mission effectiveness and success. The Internet of Things (IoT) has seen an increase in wireless sensors and devices that can connect to ad-hoc networks such Wireless Body Area Networks (WBAN) and Low Power Wide Area Networks (LPWAN). Mobile Health (mHealth) refers to the use of networks and sensors/devices in healthcare applications, such as monitoring troops' health status. However, these network types are not confined to this use case. WBAN and LPWAN systems have various features, including network availability without infrastructure (e.g. Internet connections, cellular towers), short and long communication distances, sensor devices, long-lasting batteries, and reduced data sizes.
In a mHealth system, sensors implanted or linked to the body collect user data and transmit it to an intermediary device, such as a smartphone or other smart device. The data is transmitted to a cloud server for processing, analysis, and viewing by healthcare providers [3]. Using a mHealth system in military and emergency settings presents two obstacles. The obtained sensor data may not adequately reflect a soldier's health status. Additionally, the surroundings may not enable access to public networks like the global web or cellular networks for data transmission. Previously, activity recognition was recommended as an extra variable to determine the legitimacy of emergency alarm activation [4] and [5]. Existing network technologies like LoRa, NB-IoT, and Sigfox can alleviate the need for public networks [6]. The inference system suggested in [7] can increase the accuracy of warning notifications in a mHealth system for the military's mobile network by including scenario determination algorithms.
To summarize, it's important to monitor soldiers' activity and health in the field. mHealth can monitor troops' health and engagement status in military systems utilizing inexpensive sensor (IoT) devices and low-cost networks like LPWAN. Health data, including vital signs, can be transferred using smaller data packets. An improved Multi-layered Inference Algorithm (MIA) can extend battery life by lowering data volume and maintaining high accuracy through efficient energy allocation. This is accomplished by lowering the frequency of data transfer from sensors to an intelligent device, which then sends it to a cloud server. The frequency of sensor data transmissions can significantly reduce battery consumption due to radio communications. This study provides a framework for military mHealth networks with a Multilayer Inference System (MIS) and several military applications utilizing mHealth with LPWAN.

LITERATURE SURVEY

This section covers various literature survey works such as mobile and wireless networks for military purposes, IOT and GPS based soldier positioning and health tracking in the Emergency situation, GPS based soldier tracking and communication system, Healthcare system for the soldier using Machine learning.

(Singh et al, 2018) proposed Internet of Things (IOT) and GPS based soldier positioning and health tracking. In the Emergency situation, the soldier can communicate to each other. The power consumption is reduced by the use of ARM CPU and peripheral with minimum requirements. Soldiers safety is achieved by the health monitoring System, Which also tracks location via GPS.
(Pramod et al, 2018**)** proposed soldier tracking and communication system which was GPS based, In this the soldier can ask for help to the army control unit in case if he feels lost. The army control unit can assist the soldier to take them to safe zone and GSM will enable the soldier unit with Base unit. By getting the accurate location of the soldier .It will help soldier to discuss about battle strategies and can take advice from soldier Base unit.
(Gondalic et al, 2019) proposed Healthcare system for the soldier using Machine learning. This system helps army base station to track the location Using GPS and see health status of the soldier using Heart Beat sensor. The information from this GPS and heart beat and temperature sensors gets wireless transmitted to other soldiers Using Zigbee System. In addition Lora can be also used to for the wireless networking.
(Manoj K. et al, 2020) proposed a research paper named as Soldier Health Monitoring and position tracking using GSM and GPS technology. In this method, they concentrated on the knowing exact location of soldier and also medical status of soldier. When the message gets sent to the arm base station through GPS. The base station will come to that exact spot where soldier is present. It also checks health status and provides medical treatment to soldiers. Here Google Maps are used to display location of the soldier.

RELATED WORK

This section covers related works such as tracking position with health data and IoT devices, military wireless and mobile networks, inference systems, health status alert notification, and personnel identification using health data.
A battlefield monitoring system integrates several sensors and mobile devices. Several surveillance systems can then be combined to establish a surveillance network [19], which is essential for communication, collaboration, and operations planning. Military wireless and mobile networks include Integrating Tactical Networks (ITN) [20], [21]. Terahertz transmission may have military applications in wireless and mobile networks. The Terahertz (THz) frequency spectrum (0.1 - 10 THz) is ideal for wireless radio communication, allowing for high-speed sensor data transfer [22]. The number of sensors integrated into soldiers' gear and weaponry will generate a large amount of sensor data, necessitating massively parallel wireless cloud storage and quick analytics access. It might improve communication among soldiers, between coalition members, along with between command centers. In essence, tracking soldiers on the battlefield is crucial for their safety and the success of their missions. The combined use of biological, biometric, and environmental detection in an integrated surveillance system can dramatically optimize military mobile networks, surpassing existing networks and large data storage solutions. On the battlefield, troops' health can be actively checked and

treated for acute situations. To ensure correct notifications, further activity categorization and systems for decision-support are needed, as well as advanced event reasoning. The incident classification system should be connected with the overall surveillance system.

Mobile ad-hoc networks are utilized in various military and not militarized applications, including healthcare, environmental monitoring, position tracking, and activity identification. Mobile ad-hoc systems are increasingly being used in healthcare, with research aimed at maximizing their performance. Mobile ad-hoc networks are ideal for use in military missions due to their autonomy, flexibility, adaptability, and self-configuration [23]. Adding more relay nodes to ad-hoc networks improves physical-layer performance and spatial diversity [24]. Military radar bands are underutilized, while public cellular networks make extensive use of spectrum bands [25]. Spectrum-sharing opportunities and enhancements are mostly employed for use by the military [26]. Optimizing the energy utilization of Wireless Sensor Networks (WSNs) is a critical issue for military mobile networks. Mobile sinks are utilized to avoid the difficulty associated with static sinks in WSNs. Sensor networks use different mobility patterns to improve energy efficiency and data collection [27]. Naghibi and Barati demonstrated a low-energy wireless sensor network method for data collection and delivery to sink nodes. Mobile sinks were used to separate the network into regional cells [28].

A user-feedback system was implemented for activity recognition to reduce false alert messages. The technology intends to reduce the frequency of data transmission at detectors in WBANs that are [4].A new kind of recognizing activities integration was created to connect a soldier's mHealth data with automotive data to change a vehicle protection system via an internet-based information system. This system integrates new mobile health services with military automobiles using WBAN sensors and gadgets [30]. Kang et al. created an inference system that predicts short- and long-term health status using health information. This technology, which is developed with big data through the cloud, can help prevent life-threatening scenarios [31]. This innovative method used an inference system to decrease data transfer from sensors to other networks, minimizing the impact of IoT on device performance. This strategy aims to eliminate excessive data transmission and battery consumption by inferring data from sensors [32]. The inferential system was changed and improved with the addition of beacon data points, which are transferred at predetermined intervals independent of the preliminary inference. To increase data accuracy, the inference system should transmit data at regular intervals, which can be changed based on variance rates [32].

Combining military mobile networks with IoT and LPWAN offers the advantage of tracking users in the field. Utilizing health data and IoT devices, a low-cost, low-data-rate tracking and locating system for individuals and items with low power consumption can be implemented utilizing ZigBee/XBee technology [33]. They reduced power usage and improved battery life, allowing for 126 days of use with a 1000mAh capacity. Santos et al. presented algorithms for mobile gateway services as a communication channel. The researchers identified three indicators for accessing the algorithm: device power consumption, monitoring service accuracy at the mobile gateway, and interoperability with the environment. Patii and Iyer [35] presented a low-cost wireless IoT system for monitoring and tracking soldiers on the battlefield, addressing issues such as loud noise, installation costs, and signal loss. This technology allows for real-time data transfer, tracking of soldiers' whereabouts, and the tracking of physiological data including heart rate, temperature, and oxygen levels. Lagkas et al. [36] introduced Hot-Cold, a new technique for locating mobile targets or humans in IoT systems in dynamic contexts with undefined infrastructure. This technology maintains proximity by using RF signals sent by humans or targets to communicate location data from sensors.

Mobile network convergence with IoT and LPWAN can enable identification and authentication of personnel, including soldiers and other targets. Han suggested a verification system for finger-based personal authentication that includes hand geometry and a user's palmprint. The usage of Positive Quadratic Function (PQF) and bootstrapping increased performance. Beritelli and Serrano developed a system to identify humans using phonocardiogram (PCG) data, which is unique to each individual. They presented a study to identify individuals by analysing the cardiac frequency of 20 persons.

This study's technique for detecting the two loudest heart sounds was effective in analysing frequency and signal matching, resulting in a dependable physiological indicator known as the PCG sequence. Girish Rao Solanki et al. suggested a new method for identifying individuals by analysing Photo plethysmography (PPG) signals in different states (stressed and calm) and applying the distance calculated by Mahalanobis between waveforms. PPG is a reliable statistic that cannot be easily copied, unlike other biometrics like face, voice, and fingerprint. Gui et al. presented an EEG-based framework for proving human identity and authenticity. They reduced noise and extracted frequency characteristics by ensemble averaging, low-pass filtering, and wavelet packet decomposition. Their classification system, based on an artificial neural network, achieved 90% accuracy in recognizing authorized individuals. Spanakis et al. used Speech X-rays, a platform for facial and speech recognition, to analyze voice acoustics and verify user authentication. The study demonstrated that a voice-and-face-recognition-based biometrics platform is effective for accessing sensitive data in the eHealth industry.

METHODOLOGY

This section outlines the proposed system, which incorporates a mHealth network integrated with IoT, LPWAN networks, Sensors and Soldiers GPS Monitoring System.

A. When the sensor begins to operate, the GPS will begin monitoring the soldier's position in both latitude and longitude.

B. The soldier's temperature is determined using a temperature sensor, and the natural temperature of the human body is between 31 and 37 degrees Celsius. If the sensor level oscillates below or above the usual body temperature, a warning SMS is sent to the control room, and the thermoelectric device automatically begins heating the soldier's body if it falls below the normal level.

C. The soldier's pulse rate is calculated using a heartbeat sensor, and a typical human heartbeat rate is 60 to 100 beats per minute. The control room will receive an SMS with the position if it goes below or above the usual threshold value.

D. To assess the level of pressure, a pressure sensor is used. If the pressure falls below or increases above the normal range of 80 to 120, it is considered dangerous.

E. The standard gas level is 100 to 150 ppm, and the gas concentration is determined using a Grove gas sensor. A warning SMS with the Oxygen level and position will be sent to the control room if it exceeds the normal level.

F. In the event that a soldier uses a button available there in an emergency, the control room will be notified via his locator that the soldier is in an emergency situation.

G. The mHealth network consists of internet connectivity devices and systems designed to gather, classify, and disseminate health information efficiently. The journey often begins with the users/patients (recording vital physiological signals) and traverses through many mHealth uses specialized technologies and protocols for data collecting, information management, user-centric device/sensor performance, and data communication. This section focuses on the Body Area Network (BAN) segment, as depicted in Figure 1. XBANs refer to Wireless Body Area Networks (WBAN), Body Sensor Networks (BSN), and Medical Body Area Networks (MBAN).

H. The Internet of Things (IoT) enables xBAN devices to efficiently route health-related data across networks and provide bidirectional feedback to users and remote doctors. IoT-enabled mHealth devices have improved patient and user access to healthcare services. The mHealth network consists of internetworking devices and systems designed to efficiently gather, classify, and disseminate health information. The journey often begins with the users/patients (recording vital physiological signals) and traverses through many the mHealth industry use several technologies and protocols.

I. Nazir et al. Identified two types of IoT applications in healthcare: single health conditions and cluster health (many illnesses). The major circumstances include glucose level, blood pressure, oxygen level, body temperature, and electrocardiography signal capture. The cluster condition applications focus on wheelchair, rehabilitation, and smartphone intervention healthcare solutions. The study examined IoT-based healthcare services, including Ambient Assisted Living (AAL), Internet of mHealth Things (mIoT), mHealth Community Healthcare (mCH), and mHealth Paediatric Healthcare (mPH).

J. Smart Cities refer to the integration of IoT devices, city infrastructure systems, and architectural. The Smart City Paradigm optimizes the management of devices and data to efficiently monitor and analyse interactions between urban stakeholders. [61] Smart citizens, smart energy, smart buildings (including residences), smart mobility (traffic and transportation), smart healthcare, smart infrastructure, smart government, smart education, and smart security are among the areas covered. Radio-Frequency Identification (RFID), Near Field Communication (NFC), Low Rate Wireless Personal Area Network (LWPAN), ZigBee (and its longer-range/higher throughput variant, ZBee), and IPv6 over Low-Power Wireless Personal Area Network (6LoWPAN) are communication protocols used to connect IoT-based devices and gadgets to smart city communication grids. Military and defense applications fall under the smart city paradigm and require exceptionally resilient devices and protocols to operate in severe situations (e.g., low visibility, high mobility, low bitrate). Requirements for these applications.

K. Biometric data is able to identify soldiers and activate/deactivate armament to prevent unauthorized use. Biometric data can be retrieved from physiological and behavioural attributes, including iris, fingerprints, face patterns, keystroke recognition, and voice. Seven features of a biometric trait affect its suitability for certain biometric applications.

L. Uniqueness is the primary criteria for a biometric attribute. Biometric features used to establish identity must be unique to each individual. Biometric traits should be universally present for most individuals. In rare cases, certain individuals may lack specific characteristics.

M. Permanence refers to a trait's consistency over time. Measurability: A biometric feature should be simple to capture without requiring much time or money. Application performance requires meeting recognition accuracy requirements. A biometric trait ought to have low intra-user variability and high inter-user variability. Multiple acquisitions of the same individual should yield comparable features, however features derived from various individuals should differ.

N. Acceptability: Participants must be willing to use the attribute in biometric applications. Circumvention: biometric traits should be difficult to imitate.

O. The mHealth network's data inference method reduces data transmission frequency and conserves sensor device battery power, which is crucial for mHealth security. MIS enhances accuracy and efficiency by applying numerous inference techniques and optimizing the process. The combination of health data and biometrics improves identification accuracy through multi-factor authentication.

P. The iris recognition mechanism is being studied to measure physiological factors for identification recognition. The iris recognition system was assessed using a publically available database (CASIA-IrisV3-Interval.

Q. IoT and military mobile medical networks can save battery power by utilizing inference algorithms to control data flows to the command office. Improving data processing accuracy and selectivity can lead to longer battery life. Additionally, this strategy helps cut logistics costs and equipment weight for soldiers.

R. Implementing a central power supply for equipment can increase compatibility with various battery types. Another option is to reduce device battery utilization, such as using a sophisticated algorithm that determines the frequency of radio transmissions. Can infer data. The following strategy is being considered:
   • Structured infrastructure networks, including cellular and Wireless internet connections are not consistently available in the battle environment.
   • In an emergency circumstance, such as when a soldier is being rendered unconscious, indicating their health state and place managing personnel is critical.
   • It's important to monitor personnel gadgets. Availability, battery level, remaining equipment supplies and need to conserve battery power using an algorithm.
   • Remote control (actuation) of the apparatus is not now feasible.

S. A converged mHealth network with IoT networks captures user health data and device management data, including sensor battery levels. The information is sent to a mobile device in a WBAN, then which in turn connects to an LPWAN gateway as a spontaneous node. The LPWAN gateway sends data to a regional administrative server, which links to central servers through internal (proprietary) networks. Pre-transmission data inference at sensor nodes reduces battery usage in WBAN. The efficiency and accuracy demands are set based on application needs. This work builds on a paradigm proposed in a previous paper [10], which addresses growing mHealth and LPWAN networking for military mobile devices. This work builds on previous research by introducing a novel multiplayer inferencing technique and conducting more experiments. In order to solve this challenge, five areas must be integrated:

I. The mHealth network collects health data to monitor both personnel and equipment. The system connects to IoT networks via a smart device that acts as an aggregating node, communicating with a command center server.
II. During an emergency, Activity Recognition (AR) is utilized to trigger alarm notifications. To prevent false alerts, this function needs understanding staff posture and activity.
III. Remote device activation allows for the location of personnel during emergencies. Search and rescue crews can activate devices to pinpoint locations.
IV. To ensure network security, personnel are identified using health data and biometrics for better multi-factor authentication.
V. Optimal crew placement during mission planning relies on accurate health prediction.

A WBAN entrance connects to a neighbouring WBAN gateway via LPWAN, enabling security tasks with increased processing power and battery usage. WBAN devices, such as personal health devices, collect and transfer data to a smart device that acts as a node in an LPWAN network. Military-grade wearables can link to a smart device for administration and actuation as depicted in
Diagram 1

BLOCK DIAGRAM

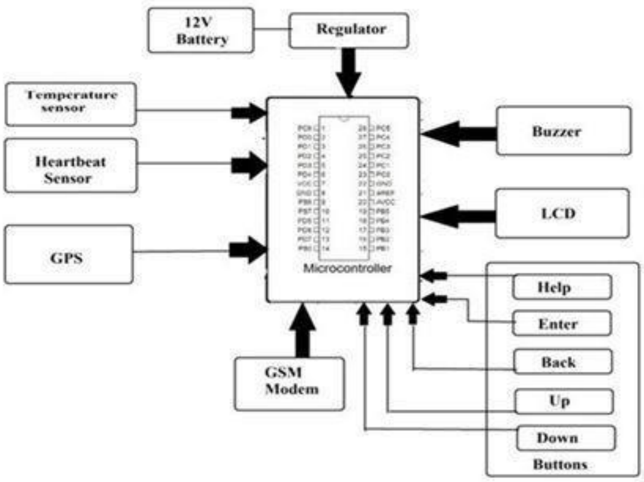
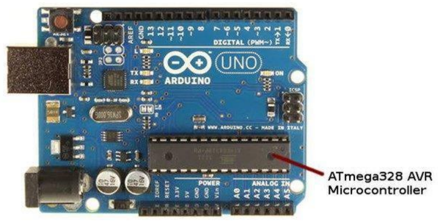


Diagram 1: Soilders Health and Position Tracking System



HARDWARE & SOFTWARE SPECIFICATION

- **Atmega 328 Microcontroller**

The ATmega328 is an 8-bit microcontroller from the AVR family, developed by Atmel (now part of Microchip Technology). It's widely known for its use in Arduino boards. Here are three key points:

1. **Specifications**: The ATmega328 features 32 KB of Flash memory for storing code, 2 KB of SRAM for data, and 1 KB of EEPROM for non-volatile data storage. It operates at a maximum clock speed of 20 MHz and has 23 general-purpose I/O pins.
2. **Peripherals**: It includes various built-in peripherals such as 6 analog-to-digital converters (ADC), 3 timers, and a USART for serial communication. It also supports PWM (Pulse Width Modulation) and has internal pull-up resistors for its I/O pins.
3. **Programming and Interface**: The ATmega328 can be programmed using the Arduino IDE, which simplifies development with its user-friendly environment and extensive libraries. It supports In-System Programming (ISP) via the SPI interface and can be interfaced with other devices through I2C and serial communication.

- **GPS Modem**

A GPS modem is a device that interfaces with GPS satellites to provide location and time information. Here are three key points about GPS modems:

1. **Functionality**: A GPS modem receives signals from multiple GPS satellites to determine precise location coordinates (latitude, longitude, and altitude), speed, and time. It processes these signals to calculate accurate position data and then outputs this information in a standard format, such as NMEA sentences.
2. **Interfaces**: GPS modems commonly connect to other devices via serial communication (RS-232, UART), USB, or other communication protocols. This allows them to integrate with microcontrollers, computers, or other systems to provide real-time location data for various applications.
3. **Applications**: GPS modems are used in a wide range of applications, including navigation systems, fleet management, tracking devices, and geocaching. They are crucial in systems that require precise positioning, such as automotive navigation, surveying, and remote monitoring.

- **LCD Display**

An LCD (Liquid Crystal Display) is a type of flat-panel display technology commonly used in various electronic devices. Here are three key points about LCD displays:

1. **Technology**: LCDs use liquid crystals sandwiched between two layers of glass or plastic. By applying an electric current, these crystals align to control the passage of light through the display. This technology enables the display of images and text with relatively low power consumption compared to older technologies like CRTs (Cathode Ray Tubes).

2. **Types**: There are several types of LCDs, including alphanumeric displays (used for showing characters and simple graphics), graphic displays (capable of showing complex images and text), and full-color LCDs (used in devices like smartphones and TVs). The most common types in embedded systems are character-based displays (e.g., 16x2 or 20x4) and graphical LCDs.

3. **Applications**: LCD displays are widely used in consumer electronics, such as calculators, digital watches, and televisions, as well as in industrial and medical equipment. Their ability to present clear, readable information in a compact form factor makes them suitable for a variety of applications requiring user interfaces or visual feedback.

- **Heartbeat Sensor**

A heartbeat sensor is a device designed to monitor and measure a person's heart rate. Here are three key points about heartbeat sensors:

1. **Functionality**: Heartbeat sensors typically use optical or electrical methods to detect the heartbeat. Optical sensors, like those based on photo plethysmography (PPG), use light to measure changes in blood volume as the heart pumps. Electrical sensors, such as electrocardiograms (ECGs), detect the electrical signals generated by heartbeats.

2. **Data Output**: The sensor processes the detected signals to determine the heart rate, which is usually displayed in beats per minute (BPM). Some sensors may also provide additional data such as pulse rate, heart rate variability, and other cardiovascular metrics.

3. **Applications**: Heartbeat sensors are widely used in health and fitness devices, including smart watches, fitness trackers, and medical monitoring equipment. They are crucial for tracking cardiovascular health, managing fitness goals, and providing real-time feedback on physical activity.

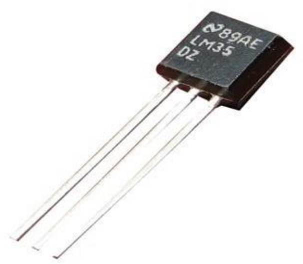
- **Temperature Sensor**

A temperature sensor is a device used to measure temperature and convert it into an electrical signal. Here are three key points about temperature sensors:

- **Types**: There are several types of temperature sensors, including thermocouples, resistance temperature detectors (RTDs), thermistors, and integrated circuits (ICs) like the LM35. Each type has its own characteristics: thermocouples are suitable for high-temperature ranges, RTDs offer high accuracy, and thermistors are good for precise temperature measurements in a limited range, and IC temperature sensors are easy to interface with digital systems.

- **Functionality**: Temperature sensors work by detecting temperature changes and converting these changes into an electrical signal. For example, a thermocouple generates a voltage that varies with temperature, while an RTD changes its electrical resistance in response to temperature changes. This signal can be measured and processed to determine the temperature.

- **Applications**: Temperature sensors are used in a wide range of applications, including environmental monitoring, industrial process control, home appliances (like thermostats), and medical devices. They help ensure proper operation and safety by providing accurate temperature readings in systems where temperature control is critical.



- **12V Battery**

A 12V battery is a common power source used in various applications. Here are three key points about a 12V battery:

1. **Voltage and Capacity**: A 12V battery provides a nominal voltage of 12 volts. Its capacity, typically measured in ampere-hours (Ah), indicates how long the battery can supply power before needing a recharge. The capacity varies depending on the type and size of the battery, impacting its suitability for different applications.

2. **Types**: Common types of 12V batteries include lead-acid (both flooded and sealed, such as AGM and gel), lithium-ion, and nickel-metal hydride (NiMH). Lead-acid batteries are widely used in automotive applications due to their robustness and cost-effectiveness, while lithium-ion batteries offer higher energy density and longer life.

3. **Applications**: 12V batteries are widely used in automotive starting systems, backup power supplies, and various portable and stationary devices. They are common in applications like car batteries, uninterruptible power supplies (UPS), solar energy storage systems, and recreational vehicles.

- **Buzzer**

A buzzer is an electronic device used to produce sound or audible alerts. Here are three key points about buzzers:

1. **Types**: Buzzers come in two main types: active and passive. Active buzzers have a built-in oscillator that generates a specific tone when powered. Passive buzzers, on the other hand, require an external signal or frequency to produce sound, allowing for a wider range of tones and pitches.

2. **Operation**: Buzzers convert electrical energy into sound energy. In active buzzers, applying a voltage causes the internal circuitry to vibrate, producing a fixed tone. In passive buzzers, the sound is generated by the vibration of a piezoelectric element or similar mechanism in response to an external audio signal or waveform.

3. **Applications**: Buzzers are used in various applications to provide audible alerts or notifications. They are commonly found in alarm systems, timers, electronic toys, and appliances. They help alert users to specific conditions or events, such as an error, a completed task, or an approaching deadline.

- **Resistors**

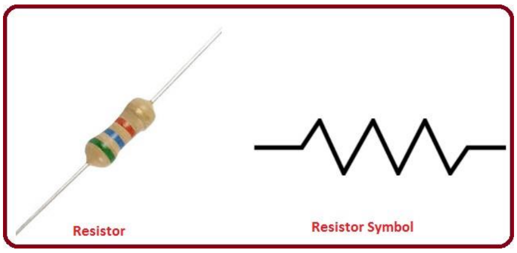
Resistors are fundamental electronic components used to control the flow of electric current in a circuit. Here are three key points about resistors:

1. **Function**: Resistors limit or regulate the amount of current flowing through a circuit by providing a specific amount of electrical resistance. The resistance is measured in ohms (Ω) and is determined by the resistor's material, length, and cross-sectional area.

2. **Types**: There are various types of resistors, including fixed resistors (which have a constant resistance value), variable resistors (such as

potentiometers and rheostats, which allow adjustment of resistance), and specialty resistors (such as thermistors and photo resistors, which change resistance based on temperature or light exposure).

3. **Applications**: Resistors are used in a wide range of applications, including voltage division, current limiting, signal conditioning, and biasing of active components. They are essential in circuit design for ensuring proper operation and protecting sensitive components from excessive current.



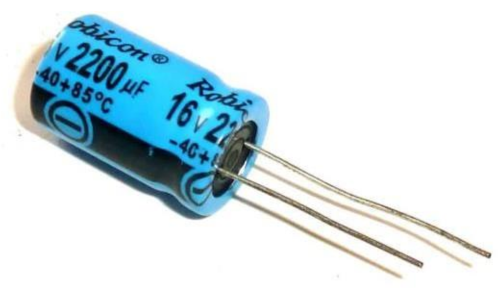
- **Capacitors**

Capacitors are electronic components used to store and release electrical energy. Here are three key points about capacitors:

1. **Function**: Capacitors store electrical charge and release it when needed. They consist of two conductive plates separated by an insulating material (dielectric). The capacitance, measured in farads (F), indicates the amount of charge the capacitor can store per volt applied.

2. **Types**: There are various types of capacitors, including ceramic, electrolytic, tantalum, and film capacitors. Ceramic capacitors are used for high-frequency applications, electrolytic capacitors for bulk energy storage, tantalum capacitors for stable capacitance, and film capacitors for precision and reliability.

3. **Applications**: Capacitors are used in numerous applications, such as smoothing out voltage fluctuations in power supplies (filtering), coupling AC signals between circuit stages, decoupling to reduce noise, and timing applications in oscillators and timers. They play a crucial role in maintaining stable operation and signal integrity in electronic circuits.



- **Diodes**

Diodes are fundamental electronic components that allow current to flow in one direction only. Here are three key points about diodes:

1. **Function**: Diodes are used to control the direction of current flow in a circuit. They conduct electrical current when forward-biased (positive voltage applied to the anode relative to the cathode) and block current when reverse-biased (negative voltage applied to the anode relative to the cathode). This unidirectional behavior is crucial for protecting circuits from reverse polarity and for rectifying AC signals to DC.

2. **Types**: There are several types of diodes, each with specific functions:

   Standard Diodes (e.g., 1N4007) are used for general rectification purposes.

   Zener Diodes are used for voltage regulation and protection by allowing current to flow in both directions but with a controlled breakdown voltage in the reverse direction.

   LEDs (Light Emitting Diodes) emit light when forward-biased, used for displays and indicators.

   Schottky Diodes have a low forward voltage drop and fast switching capabilities, ideal for high-speed and low-voltage applications.

3. **Applications**: Diodes are used in various applications, such as rectifying AC to DC in power supplies, protecting circuits from voltage spikes, regulating voltage in power supplies, and providing visual indicators with LEDs. Their ability to control current direction and manage voltage makes them essential in numerous electronic devices and systems.

- **Arduino Compiler**

The Arduino compiler is a software tool used to translate Arduino code (written in the Arduino programming language, which is based on C/C++) into machine code that can be executed by an Arduino microcontroller. Here are three key points about the Arduino compiler:

1. **Function**: The Arduino compiler takes the human-readable code written in the Arduino Integrated Development Environment (IDE) and converts it into a binary file (hexadecimal format) that can be uploaded to the Arduino board. This process involves compiling the code to ensure it adheres to syntax rules and generating the necessary machine code for the microcontroller.

2. **Integration**: The compiler is integrated into the Arduino IDE, which provides a user-friendly interface for writing, compiling, and uploading code. When you click the "Verify" or "Upload" button in the IDE, the compiler processes the code, checks for errors, and prepares the code for transfer to the Arduino board.

3. **Toolchain**: The Arduino compiler is part of a larger toolchain that includes a tool called AVR-GCC (GNU Compiler Collection) for compiling code for AVR microcontrollers. The toolchain also includes linker and assembler tools that work together to produce the final executable code that runs on the Arduino microcontroller.

- **MC Programming Language: C**

The C programming language is a widely used language in embedded systems and microcontroller (MC) programming. Here are three key points about using C for microcontroller programming:

1. **Efficiency and Performance**: C provides a high level of control over hardware resources and memory, making it ideal for programming microcontrollers. Its ability to directly manipulate hardware registers and perform bit-level operations allows for efficient use of system resources and precise control over the microcontroller's functions.

2. **Portability**: C is known for its portability across different platforms. Code written in C for one microcontroller can often be adapted for use with another microcontroller with minimal changes. This is particularly useful in embedded systems where different hardware might be used across various projects.

3. **Standard Libraries and Tools**: C supports a rich set of standard libraries and tools that facilitate development. In the context of microcontroller programming, many development environments and toolchains, such as those provided by GCC (GNU Compiler Collection) or proprietary vendors, offer libraries and functions specifically designed for interfacing with hardware components and peripherals, streamlining the development process.

COMPARISION

(Shraddha Mahale et.al, 2022) submitted a work named GPS and GSM modem are employed by the ARM7-LPC2148-based soldier position tracking and health monitoring system. we can able to track the position of soldier in the battlefield and can be offer medical treatment to soldier in emergency as early as feasible with comparison with this our real time IoT activation system enhance battery life for wearable and sensor devices. Adding other biometrics and health data can improve authentication accuracy even more.

(Shital Shinden et.al, 2024) have proposed the project named as Soldier Health Monitoring and Position Tracking System. This System measures health parameters such as heart rate ,body temperature and also tracks the location using global positioning system(GPS).So this paper focuses on tracking the location of the soldier from GPS which is beneficial for control room to grab position of the soldier GPS module also provides latitude and longitude values with comparison with this our real time IoT activation system enhance battery life for wearable and sensor devices. Adding other biometrics and health data can improve authentication accuracy even more.

(Pavan Mankal et.al, 2023) completed the work that was recommended was dubbed "IOT Based Soldier Position Tracking and Health Monitoring System". He offers a strategy devised expressly to fulfil the expectations placed on battlefield safety by armed troops. Finding soldiers' specific locations on the battlefield is the key purpose of the offered strategy. Numerous physiological indications and vital signs, including heart rate, temperature and saturation of oxygen, are used to predict an individual's life expectancy with comparison with this our real time IoT activation system enhance battery life for wearable and sensor devices. Adding other biometrics and health data can improve authentication accuracy even more.

(Pavan Kumar et.al, 2022) "Health Monitoring and Tracking of Soldier Using GPS" was the study that he was suggested. He put a lot of stress on recognizing the soldier's location and physical condition in their advised strategy. The base station will be able to detect the soldier's exact position using GPS-provided SMSs, and their health condition will be established using GSM-provided SMSs. Additionally, they utilized a Google Map, which reveals the soldier's whereabouts, with comparison with this our real time IoT activation system enhance battery life for wearable and sensor devices. Adding other biometrics and health data can improve authentication accuracy even more.

(Pratik Kanani et. al,2023) suggested a paper named "GPS Neo6m, Arduino, and GSM Sim800L for Real-time Location Tracking in Healthcare: A Use for Critical Health Patients the IOT gadget at the heart of their planned project would precisely pinpoint the latitude and longitude that is, the patient's location in relationship to the base station room. Medical staff and center personnel may also determine the patient's exact location and provide the necessary medical care by using Google Maps and online apps on the server, with comparison with this our real time IoT activation system enhance battery life for wearable and sensor devices. Adding other biometrics and health data can improve authentication accuracy even more, this paper provides practical insights by highlighting real-world applications of IoT in healthcare sector.

CONCLUSION & FUTURE SCOPE

The biggest problem in the military is the lack of proper communication between the soldier and the command room. The proposed system, we can conclude that various biomedical sensors detect body parameters in real time and transmit the data to the control room, where it checks the current location of the soldier using LoRa and GPS technology. The goal is to secure the lives of soldiers using various sensors to assess health and track location very precisely. This study presents a wireless body area network-based framework for assisting soldiers in emergency scenarios, including field operations. The suggested framework incorporates a variety of military network applications. Health data and biometrics are now used in multifactor authentication to identify personnel. Multilayer inference methods enhance accuracy and efficiency, reducing power usage. The future of military health monitoring and location tracking with ESP32 is vast and promising. This opens up opportunities to monitor more accurate health metrics, such as stress levels, hydration and fatigue, and provides a more comprehensive view of a soldier's health. The system could also be integrated with other military equipment such as body armor and helmets, enabling seamless data collection and potentially providing additional capabilities such as collision detection. This integration would improve the functionality and efficiency of the system. To ensure interoperability, future research could investigate centralizing power supplies and battery types for all troop equipment. LPWAN requires lightweight security measures because to limited computational and battery power. Enhanced sensors and gadgets can reduce power usage and improve security.

REFERENCE

[1] Sweta Shelar, Nikhil Patil, Manish Jain, Sayali Chaudhari, SmitaHande "Soldiers Tracking and Health MonitoringSystems". Proceedings of 21st IRF International Conference, Pune India, 8th March 2015.

[2] Dineshwar Jaiswar, Sanjana S. Repal, "Real Time Tracking and Health Monitoring of Soldier using Zigbee Technology," International Journal of Innovative Research in Science, Engineering and Technology, July 2015.

[3] Angave S M, Choudhary Sohanlal& Pathak Bhavik. "Real Time Soldier Tracking System", IOSR Journal of Electronics and Communication Engineering (ISOR-JECE), Nashik, Maharastra 2015.

[4] V Ashok, T. Priyadharshini and S. Sanjana, "A Secure Freight Tracking System in Rails Using GPS Technology," Second International Conference on Science Technology Engineering and Management (ICONSTEM), Chennai, India, 2016.

[5] M. Jassas, A. Abdullah and H. Mahmoud, "A Smart System Connecting e-Health Sensors and the Cloud" IEEE 28thCanadian Conference on Electrical and Computer Engineering Halifax, Canada, May 2015.

[6] [6] S. Dixit and A. Joshi, "A Review Paper on Design of GPS & GSM Based Intelligent Ambulance Monitoring" International Journal of Engineering Research and Applications, July 2014.

[7] HKedar, K. Patil and S. Bharti, "Soldier Tracking and Health Monitoring System", March 2017.

[8] The Military Balance 2014, London: Routledge, pp. 245-246, ISBNISB 9781857437225, February 2014.

[9] P. Kumar, G. Rasika, V. Patil and S. Bobade, "Health Monitoring and Tracking of Soldier Using GPS", International Journal of Research in Advent Technology, vol. 2, no. 4, pp. 291-294, April 2014.

[10] S. Sharma, S. Kumar, A. Keshari, S. Ahmed, S. Gupta and A. Suri, A Real Time Autonomous Soldier Health Monitoring and Reporting System Using COTS Available Entities, pp. 683-687, May 2015.

[11] R. Kumar and M. Rajasekaran, "An IoT based patient monitoring system using raspberry Pi," Jan. 2016.

[12] R. Shaikh, "Real Time Health Monitoring System of Remote Patient Using Arm 7", International Journal of Instrumentation Control and Automation (IHCA), vol. 1, no. 8-4, pp. 102-105, 2012.

[13] Shruti Nikam, Supriya Patil, Prajkta Powar, V.S.Bendre- "GPS Based Soldier Tracking and Health Indication

System", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 2, Issue 3, March 2013.

[14] M.V.N.R. Pavan Kumar,Ghadge Rasika Vijay ,Patil Vidya Adhikrao,Bobade Sonali Vijaykumar- "Health Monitoring and Tracking of Soldier Using GPS", International Journal of Research in Advent Technology, Vol.2, No.4, April 2014 E- ISSN: 2321-9637.

[15] The Clock Generator [Online], Internet: http://chipmk.ru/index.php/2014-08-100551-44/41-samouchitel- pic18-asm-2-chast/187- taktovyj-generator. [4] Hock Beinge Limn "A Soldier Health Monitoring System for Military Applications" 2010 International Conference on Body Sensor Networks (BSN).

[16] D. Kumar and S. Repal, "Real Time Tracking and Health Monitoring of Soldiers using ZigBee Technology: A Survey", International Journal of Innovative Research in Science Engineering and Technology, vol. 4, no. 7, pp. 5561-5574, Jul. 2015.

[17] G. Raj and S. Banu, "GPS Based Soldier Tracking and Health Indication System with Environmental Analysis", International Journal of Enhanced Research in Science Technology& Engineering, vol. 2, no. 12, pp. 46-52, Dec. 2013.

[18] V.Ashok, T. Priyadarshini and S. Sanjana, A Secure Freight Tracking System in Rails Using GPS Technology, pp. 47-50, 2016.

[19] M. Jassas, A. Abdullah and H. Mahmoud, A Smart System Connecting e-HeaIth Sensors and the Cloud, pp. 712-716, May 2015.

[20] S. Dixit and A. Joshi, "A Review Paper on Design of GPS and GSM Based Intelligent Ambulance Monitoring", International Journal of Engineering Research and Applications, vol. 4, no. 7, pp. 101-103, Jul. 2014.

[21] H. Kedar, K. Patil and S. Bharti, Soldier Tracking and Health Monitoring System, vol. 2m, no. 17, Mar. 2015.

[22] H. Furtado and R. Trobec, "Applications of wireless sensors in medicine", MIPRO 2011 Proceedings of the 34th International Convention Opatija-Croatia, pp. 257-261, Jul. 2011.

[23] "IOT BASED HEALTH AND POSITION TRACKING SYSTEM FOR SOLDIER SECURITY SYSTEM" rajitha m, s. madhav rao 1. vol 13,issue 06, june,2022,issue no : 0377-9254

[24] Tushar Samal, Saurav Bhondave, Suraj masal, Sagar gite and Prof.Sushma B. Akhade, "SOLDIER HEALTH MONITORING AND TRACKING SYSTEM USING IOT", International Journal of Advance Scientific Research, Volume No:5,Issue :4, pp:13-16, 2019-2020.

[25] Mrs. Pallavi Kulkarni and Mrs. Tripti Kulkarni, "SECURE HEALTH MONITORING OF SOLDIERS WITH TRACKING SYSTEM USING IOT", International Journal of Trend in Scientific Research and Development (IJTSRD), Volume No:3 ,Issue: 4, pp:693-696, May June-2019.

[26] Heart Beat Sensor Using Fingertip through Arduino P. Srinivasan1, A. Ayub Khan2, T. Prabu3, M. Manoj4, M. Ranjan5, K. Karthik6/ Journal of Critical Reviews (2020), ISSN- 2394-5125 Vol 7, Issue 7, P:1058-1060.

[27] R.S.Sabeenian, K.R.Kavitha "Long Term Monitoring of Sleep Disordered Breathing Using IOT Enabled Polymer Sensor Embedded Fabrics", International Journal of Psychosocial Rehabilitation, ISSN: 1475-7192, 24 & 7093-7010, May 16, 2020.

[28] Fernando Seoane, Javier Ferreira, Lorena Alvaretz, Ruben Buendia, David Ayllo´n, Cosme Llerena and Roberto Gilpita, Sensorized Garments and Textrode-Enabled Measurements In- strumentation for Ambulatory Assessment of the Autonomic Nervous System Response in the ATREC Project, Sensors 13(7), 8997-9015, 2019.

[29] P. Kumar, G. Rasika, V.Patil, and S. Bobade, "Health Monitoring and Tracking of Soldier Using GPS," International Journal of Research in Advent Technology, vol.2, no.4, pp. 291- 294, Apr. 2019.

[30] Monika V. Bhivarkar,Anuja G. Asole and P. B. Domkondwar, "IOT AND GPS BASED SOLDIER POSITION TRACKING AND HEALTH MONITORING SYSTEM", International Journal of Emerging Technologies in Engineering Research (IJETER),Volume No:6,Issue: 4,pp:147-150,January-2018

Additional Reading

[1] Jasvinder Singh Chhabra, Akshay Chhajed, Shamlee Pandita and Suchita Wagh, "GPS AND IOT BASED SOLDIER TRACKING & HEALTH INDICATION SYSTEM", International Research Journal of Engineering and Technology (IRJET), Volume No:04,Issue:06, pp:1228-1238,June- 2017

[2] N. Patii and B. Iyer, "Health monitoring and tracking system for soldiers using Internet of Things (IoT)," 2017 International Conference on Computing, Communication and Automation(ICCCA), Greater Noida, 2017.

[3] T. Dharsni, H. Zakir, P. Naik, M. Mallikarjuna and R. M, "Soldier Security and Health Monitoring," 2018International Conference on Design Innovations for 3Cs Compute Communicate Control (ICDI3C), Bangalore, 2018.

[4] A. Pantelopoulos and N. G. Bourbakis, "Prognosis: A Wearable Health-Monitoring System for People atRisk: Methodology and Modeling," in IEEE Transactions on Information Technology in Biomedicine, vol. 14, no. 3, pp. 613-621, May 2010.

[5] P. S. Kurhe, S. S. Agrawal, "Real Time Tracking & Health Monitoring System of Remote Soldier Using Arm7" International Journal of Engineering Trends and Technology Volume 4 Issue 3-2013.

[6] Pankaj Verma, J.S Bhatia, "Design and Development of GPS-GSM Based tracking System With Google Map Based Monitoring", International Journal of Computer Science, Engineering and Applications. (IJCSEA) Vol.3, No.3, June 2013

[7] Subhani Sk. M. Sateesh G.N.V, Chaitanya Ch. And Prakash Babu G., "Implementation of GSM Based Heart Rate and Temperature Monitoring System", Research Journal of Engineering Sciences ISSN 2278 – 9472 Vol. 2(3), 43-45, April (2013)

[8] Sweta Shelar, Nikhil Patil, Manish Jain, SayaliChaudhari, SmitaHande (8th March, 2015)." Soldier Tracking and Health Monitoring Systems". Proceedings of 21st IRF International

Conference, Pune India.ISBN :978-93-82702-75-7 pages: 82-87.

[9] Dineshwar Jaiswar, Sanjana S. Repal (2015, July).”Real Time Tracking and Health Monitoring of Soldier using ZigBee Technology”. International Journal of Innovative Research in Science, Engineering and Technology: a Survey. Vol 4, Issue 7 pages 5560-5574.

[10] Pangavne S. M. ,Choudhary Sohanlal & Pathak Bhavik (2015).”Real Time Soldier Tracking System”. IOSR Journal of Electronics and Communication Engineering (IOSR- JECE), Nashik, Maharashtra: pp. 21-24.

[11]. Study of Health Monitoring System Megha Chavan; Prajakta Pardeshi;S.A.Khoje;Manasvi Patil 2018 Second International Conference on Intelligent Computing and Control Systems(ICICCS).

[12]. International Journal of Engineering Research thiab Technology (IJERT) ISSN: 2278-0181 Publisher, www.ijert.org NCESC - 2018 Special Issue of Conference Proceedings - 2018.

[13]. International Journal of Research in Engineering, Science and Management Volume 4, Issue 7, July 2021.

[14]. Soldiers Health Monitoring and Position Tracking System International Conference on Innovative Computing and Communication (ICICC) 2022 17 Feb 2022.

[15]. International Research Journal of Modernization in Engineering Technology and Science Soldiers Health Monitoring and Position Tracking System: A Wearable Sensor Based Approach Rakesh Jija, Shivani Sugandhi, Yuvraj Kone, Seema Deshmukh Volume-05,Issue:-06/June-2023