IOT Based Smart Solider Health Monitoring System

[a]S Rajesh, [b]Dalavaee Swetha, [c]Thiriveedhi Krupamai, [d]Sirimavilla Vineetha, [e]Batta Vamsi, [f]Vetti VishnuPrakash

[a] *Assistant Professor, Department of ECE, Gokula Krishna College of Engineering*

[b-f] *UG Scholar, Department of ECE, Gokula Krishna College of Engineering*

Abstract: **Soldiers operating in remote and high-risk environments often lack an automatic health monitoring system, making it difficult to track their vital signs in real time. This absence of continuous health monitoring can delay medical assistance in critical situations, leading to severe health complications or even fatalities. An efficient, real- time health monitoring solution is essential to enhance soldiers' safety, optimize response times, and improve overall mission effectiveness. The system is designed to generate emergency backup alert to main office when a soldier is in a condition of being unable to save himself/herself. This system will monitor health parameters when it crosses abnormal condition, an emergency alert notification with soldiers GPS location can be sent to main office using Adafruit server.**

Keywords: **Military Monitoring, Health Surveillance, Emergency Alert System, GPS Tracking, Cloud Technology**

I.INTRODUCTION

The IOT based smart solider health monitoring system represents a transformative approach in ensuring the safety and operational efficiency of military personnel under challenging conditions. This innovative system leverages cutting-edge technology to monitor and respond to the health emergencies of soldiers in real time, bridging the gap between remote monitoring capabilities and immediate tactical response. Designed to function seamlessly within the constraints of military operations, the system provides a reliable means of keeping track of vital health parameters such as heart rate, oxygen levels, and body temperature.

At its core, the system utilizes a combination of sensors and cloud-based technology to gather and transmit data continuously. This data is then analyzed to detect any deviations from normal health metrics that might indicate distress or a medical emergency. When such anomalies are detected, the system automatically triggers an alert that is sent to the command center, providing not only the health data but also the precise location of the affected soldier using GPS technology.

The development of this system was motivated by the need to enhance soldier safety, especially in scenarios where individuals might find themselves isolated or in harsh environments. Traditional communication methods can fail under such extreme conditions, and the existing health monitoring technologies lacked the capability to autonomously detect and alert command centers about critical health issues. The IOT based smart solider health monitoring system addresses these challenges by ensuring that no soldier goes unmonitored, and help can be dispatched swiftly when needed.

Another significant feature of this system is its adaptability. While primarily designed for military use, the technology can also be tailored for civilian applications, such as monitoring elderly patients or individuals in critical care settings. This versatility shows the potential of military-developed technologies to have broader applications, providing benefits beyond their initial scope. The system's design allows for integration with various existing health monitoring devices and can be scaled to accommodate different user groups with specific needs.

Finally, the system's reliance on cloud technology not only allows for real-time data processing and alert generation but also ensures that data can be accessed from anywhere, making it an invaluable tool for operations requiring coordination across multiple locations. The cloud platform facilitates a centralized view of all monitored individuals, enhancing the ability to make informed decisions quickly and efficiently. This integration of technology enhances strategic operations, ensuring that military and civilian leaders alike can provide timely responses to health- related emergencies.

II. LITERATURE SURVEY

[1]. Real Time Embedded Electronics System for

Soldiers Security; Suraj Gaikwad, Sonam Rupnar, Sakshi Adhatrao, Yogesh Godake, Ashish Joshi; 2024, International Journal of Advances in Engineering Research

In contemporary conflict scenarios, safeguarding the well-being and operational efficacy of military personnel stands as a pivotal imperative for national defense. This study proposes an innovative framework harnessing M- Health technology to monitor soldiers' whereabouts and oversee their medical condition throughout deployments or specialized missions. Through the amalgamation of GPS tracking and intelligent sensor mechanisms, real-time surveillance of soldiers becomes achievable, fostering heightened situational awareness and expediting responses to critical incidents. Each individual serviceman is outfitted with intelligent sensors affixed to their person, transmitting vital metrics to a dedicated server for seamless mobility and connectivity with a central command post via wireless channels. Moreover, integration of a Wi-Fi or GSM module facilitates direct communication with the command center in instances of injuries or exigencies. Such a system not only augments the operational efficiency but also enhances the safety parameters for soldiers operating in hostile environments, thereby fortifying national security apparatuses.

[2]. Real Time Embedded Electronics using wireless connection for soldier Security; C. Ashok Kumar, Sudhakar Ajmera, Bittu Kumar, D. Srikar; 2022, International Conference on Advancements in Smart, Secure and Intelligent Computing

One of the essential and important roles in a country's protection is performed with the aid of the navy squaddies. Every year squaddies get strayed or injured and it's time consuming to do seek and rescue operations. In this paper, we present a WSN-primarily based environmental and fitness tracking technique wherein sensor information is processed using sturdy and solid algorithm carried out in controller. The observed data or information is shared to control room or base station using Internet of Think (IoT) technology. The developed mythologies are worked with excellent feaster using some peripheral devices like as tiny wearable psychological devices, sensors and transmission modules. Using these peripheral gadgets, it is viable to put into effect a low- cost mechanism to guard precious human life on the battlefield.

[3]. Iot based Soldier Status Monitor Using Sensors and SOS switch; M. Sabari Muthu, MP Krishna, P Mala Sundari, L. Aarthi, P. Muhamad Juhair, G. Gowtham Raj; 2022, Institute of Electrical and Electronics Engineers

The battleground is now an important aspect of every country’s security. Army soldiers have a crucial role to perform. The protectors are injured during combat and search missions, and many of them are lost from their battalion. Several efforts have been made to ensure the safety of soldiers. The main aim of this paper is to track the location of the soldier and using sensors it will alert the soldier during dangerous times. This system has some smart sensors attached to the helmet and boots of the soldier. Each soldier has an IoT module that allows them to communicate with the base station in case of injuries. Once any other enemy enters the territory, it is very difficult to know the location of the soldiers. The proposed idea is to monitor the soldiers through the communication module and give them the status of soldiers during the war. Gas sensors and motion sensors are implemented to notify and alert the soldiers in case of any danger. A metal detector was implemented so that it could be able to identify metal inclusions hidden within things. It features a GPS module that broadcasts the soldier’s current location to the access point through IoT, allowing them to communicate with the primary controller.

[4]. Smart Monitoring for Soldier Health and Location; Eman Serag, Mohamed Ahem Sayed, Mohamed Hanafy; 2017, American Journal of Embedded Systems and Applications

The people around the world live a safe life due to the sacrifices of the brave soldiers, in order repay the favor, so we must shield them from risks because they face in the warfare by equipping them with advanced technology. Equipping people especially soldiers to guarantee the security of the state and its stability. Terrorism in a lot of area around the world is represented threat on people life. This work designed smart monitoring system for soldiers who protecting the homeland so, it is necessary to help them by using smart monitoring system to avoid any terrorist attack or know their places when the abduction of any one of these soldiers. Supply soldier with modern technological devices makes it easy for us to know the health status and their location and this makes the control rooms in the military full- time to monitor the enemy rather than preoccupation with monitoring soldiers. Wireless

communications devices play an important role in monitoring the soldiers through the use of the devices Global Positioning System (GPS) system, and also SOS messages that help the soldier to adapt with different situation. All the data collected from the sensors and send to the web server to make analysis also statistics depending on these information Base Stations can make the right decision and send it to the soldier to follow thanks to this smart control system.

III. DESIGN OF HARDWARE

3.1 Arduino UNO

ATmega328P is a very advance and feature rich microcontroller. It is one of a famous microcontroller of Atmel because of its use in Arduino UNO board. It is a microcontroller from the Atmel's megaMVR microcontrollers family (Later in 2016 the Atmel is obtained by Microchip Technology Inc, the microcontrollers manufactured in megaMVR family are designed for handling larger program memories and each microcontroller in this family contains different amount of ROM, RAM, I/O pins and other features and also they are manufactured in different output pins which are from 8 pins to hundreds of pins.

The internal circuitry of ATmega328P is designed with low current consumption features. The chip contains 32 kilobytes of internal flash memory, 1 kilobyte of EEPROM and 2 kilobytes of SRAM. The EEPROM and the flash memory are the memories which saves information, and that information still exits the power is disconnected or off, but the SRAM is a memory which only saves the information until the power is supplied and when the power is disconnected all the information saved in SRAM will be erased.

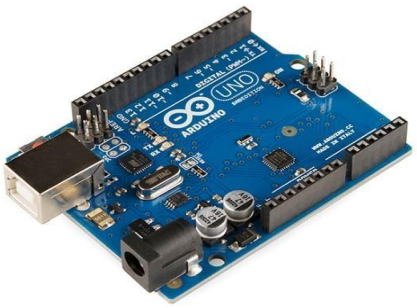

Fig: Arduino UNO

3.2 NODEMCU:

The NodeMCU is a low-cost open-source IoT platform that is widely used for projects requiring Wi-Fi connectivity and simple programming. It is based on the ESP8266 Wi-Fi SoC (System on Chip) from Espressif Systems and offers a robust framework for Internet of Things applications. Here's a detailed explanation of its specifications and features: Microcontroller: NodeMCU integrates the ESP8266 Wi-Fi SoC which comes with a powerful L106 32-bit RISC microprocessor, which operates at a frequency of 80 MHz to 160 MHz It features 128 KB of RAM and up to 4 MB of flash memory for storing code and data. The high capacity and powerful processor make it suitable for handling complex and multiple tasks in connected applications.

Digital I/O Pins: NodeMCU board typically includes up to 17 GPIO pins which can be used for various digital input and output functions. These pins support various functions such as PWM, I2C, SPI, and one-wire protocols, making it highly versatile for connecting a wide range of sensors, actuators, and other devices.

Analog Input: Unlike Arduino Uno, the NodeMCU has a single analog-to-digital converter (ADC) channel with a 10-bit resolution. It is primarily used for reading analog sensors. The input voltage range for ADC is 0 to 1V, but this can be extended using external components.

Fig: NodeMCU (ESP8266)

3.3 PULSE OXIMETER SENSOR:

The sensor consists of a pair of Light-emitting diode which emits monochromatic red light at a wavelength of 660nm and infrared light at a

Fig: Pulse oximeter sensor (MAX30100)

wavelength of 940 nm. These wavelengths are particularly chosen as at this wavelength oxygenated and deoxygenated haemoglobin have very different absorption properties., it can be seen that there is a difference between HbO2 (oxygenated Hb) and Hb (deoxygenated Hb) when subjected to these specific wavelengths.

Sensor part:
There are two parts to the sensor, an emitting diode, and a photoreceiver. As the photodiode emits the light, it falls over the finger which has to be placed steadily. The light emitted gets absorbed by the oxygenated blood and the rest of the light is reflected through the finger and falls over the detector whose output data is then processed and read through a microcontroller.

3.4 MQ2 sensor

The MQ2 sensor is a versatile gas sensor used in various applications for detecting a wide range of gases, including LPG, propane, methane, alcohol, smoke, and hydrogen. It is commonly utilized in safety systems for gas leakage detection in both residential and industrial settings. Using an MQ sensor to detect a gas is very easy. You can either use the digital pin or the analog pin to accomplish this. Simply power the module with 5V and you should notice the power LED on the module to glow and when no gas it detected the output LED will remain turned off meaning the digital output pin will be 0V. Remember that these sensors must be kept on for pre-heating time (mentioned in features above) before you can work with it. Now, introduce the sensor to the gas you want to detect and you should see the output LED to go high along with the digital pin, if not use the potentiometer until the output gets high. Now every time your sensor gets introduced to this gas at this particular concentration the digital pin will go high (5V) else will remain low (0V). You can also use the analog pin to achieve the same thing. Read the analog values (0-5V) using a microcontroller, this value will be directly proportional to the concentration of the gas to which the sensor detects. You can experiment with these values and check how the sensor reacts to different concentration of gas and develop your program accordingly.

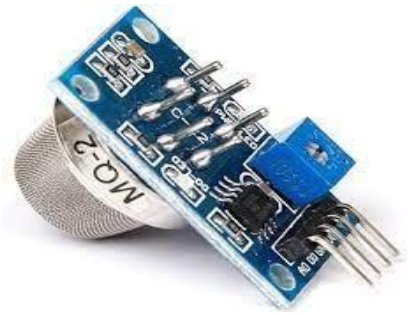

Fig: MQ-2 Sensor

3.5 DS18B20 TEMPERATURE SENSOR

The DS18B20 is a digital temperature sensor that offers high precision and easy interfacing capabilities, making it widely used in various applications ranging from environmental sensing to medical and consumer electronics. The sensor works with the method of 1- Wire communication. It requires only the data pin connected to the microcontroller with a pull up resistor and the other two pins are used for power. The pull-up resistor is used to keep the line in high state when the bus is not in use. The temperature value measured by the sensor will be stored in a 2-byte register inside the sensor. This data can be read by the using the 1- wire method by sending in a sequence of data. There are two types of commands that are to be sent to read the values, one is a ROM command and the other is function command. The address value of each ROM memory along with the sequence is given in the datasheet below. You must read through it to understand how to communicate with the sensor.
If you are planning to interface it with Arduino, then you need not worry about all these. You can develop the readily available library and use the in-built functions to access the data.

Fig: DS18b20 temperature sensor

3.6 METAL DETECTOR SENSOR

Proximity sensors play a crucial role in modern industries, enabling automation, safety, and efficiency in various applications. These sensors are designed to detect the presence or absence of objects within a certain range without physical contact.

Inductive proximity sensors are widely used in industrial environments for their robustness and reliability. They operate on the principle of electromagnetic induction. When an object approaches the sensor's electromagnetic field, it induces eddy currents, leading to a change in the sensor's output.

Fig: metal detector sensor

3.7 GPS MODULE

The NEO-6M GPS module is a compact and versatile GPS receiver module that offers high-performance navigation and positioning solutions. It is widely used in various applications such as drones, vehicle tracking systems, and personal navigation devices due to its reliability and precision. It can track up to 22 satellites over 50 channels and achieve the industry's highest level of tracking sensitivity i.e. -161 dB, while consuming only 45 mA current.

Unlike other GPS modules, it can perform 5 location updates in a second with 2.5m horizontal position accuracy. The U-blox 6 positioning engine also has a Time-To-First Fix (TTFF) of less than 1 second. One of the best features offered by the chip is Power Save Mode (PSM). This allows a reduction in system power consumption by selectively switching certain parts of the receiver on and off. This dramatically reduces the power consumption of the module to just 11mA making it suitable for power sensitive applications such as GPS wristwatches. The required data pins of the NEO-6M GPS chip are broken out to 0.1″ pitch headers. It contains the pins needed for communication with the microcontroller over the UART. The module supports baud rates from 4800bps to 230400bps with a default baud of 9600.

Fig: NEO-6M GPS module

3.8 LCD Display

The 16x2 I2C LCD is a popular display module used in electronics projects for displaying textual information over two lines, with each line capable of showing up to 16 characters. It is based on the standard 16x2 LCD panel but includes an I2C interface for communication, which simplifies the connection to microcontrollers and reduces the number of required I/O pins. I2C Interface: The inclusion of an I2C interface module is what sets this LCD apart from standard 16x2 LCDs. I2C, or Inter-Integrated Circuit, is a serial bus interface connection protocol that allows multiple slave devices to be controlled by a single master device on just two wires: one for clock (SCL) and one for data (SDA). This simplifies the wiring significantly, as traditional LCD connections without I2C require many more GPIO pins to operate, often up to 6-11 pins depending on the configuration.

Fig:16x2 LCD Display

3.9 Push Buttons

Push Buttons are normally open tactile switches. Push buttons allow us to power the circuit or make any connection only when we press the button. Simply, it makes the circuit connected when pressed and breaks when released. A push button is also used for triggering of the SCR by gate terminal. These are the most common buttons which we see in our daily life electronic equipment's. Some of the applications of the Push button are mentioned at the end of the article. The mini 4-pin push button switch is a simple, yet versatile component widely used in electronic circuits for manual input or control. This type of switch is commonly found in consumer electronics, prototyping, and various interactive projects.

Fig: Push Buttons

3.10 Buzzer

An audio signalling device like a beeper or buzzer may be electromechanical or piezoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren. It includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the '- 'symbol or short terminal and it is connected to the GND terminal.

Fig: Buzzer

IV. PROJECT DESCRIPTION

This chapter deals with working and circuits of "IOT based smart solider health monitoring system". It can be simply understood by its block diagram &circuit diagram.

BLOCK DIAGRAM:

The proposed IOT based smart solider health monitoring system is an advanced health and location monitoring solution designed to enhance the safety and operational efficiency of soldiers in the field. Building on the limitations of existing systems, this new model incorporates several innovative features that automate and streamline the monitoring process. . Central to its functionality is the integration of GPS tracking and an emergency SOS button, which together ensure that soldiers can be quickly located and assisted in crisis situations. The system also includes additional sensors for monitoring oxygen levels and detecting toxic gases, broadening the scope of health parameters being observed.

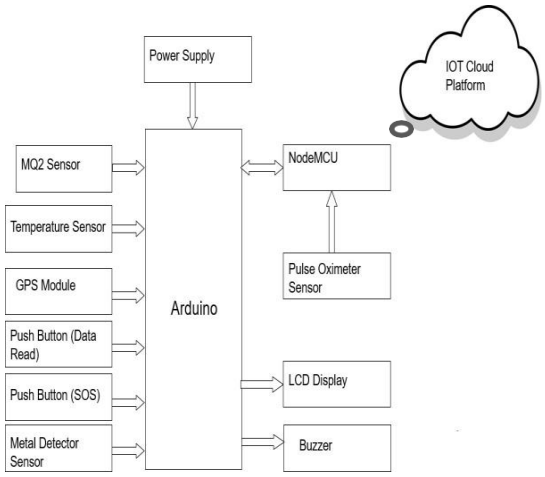

Fig: Transmitter block diagram

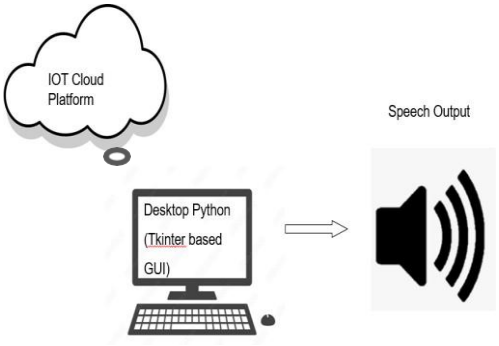

Fig: Receiver block diagram

This enhanced system operates by continuously gathering data from various sensors attached to each soldier, including those for heart rate, body temperature, oxygen saturation, and the presence of hazardous gases. This data is transmitted at regular intervals—ranging from every 10 to 30 seconds—to a cloud-based server via a robust Internet of Things (IoT) platform. The integration with cloud technology not only allows for real-time data analysis and storage but also ensures that the data can be accessed remotely from any location. When any of the monitored parameters crosses a predefined threshold, the system automatically generates an alert that is sent to the command center. This alert includes the soldier's current health data and precise GPS location, facilitating a rapid response.

Moreover, the proposed system features a user-friendly graphical user interface (GUI) at the command center, implemented using desktop Python and Tkinter. This GUI displays all critical information in an easily digestible format, allowing command personnel to monitor the health status and location of soldier in real time. Visual and auditory alerts are generated in the command center when a

soldier's health parameters indicate an emergency or when the SOS button is activated. This immediate feedback loop is crucial during complex military operations where quick decision-making can save lives. The proposed system not only significantly reduces the reliance on continuous human monitoring but also enhances the capability to provide timely medical and logistical support to soldiers in distress. On addition to these, we do have mine detection feature using a metal detector sensor that generates buzzer alert when a metal is identified before the soldier keeps his foot on ground.

V. RESULT

In the results section, the whole kit and the results on display and the tkinter gui is shown:

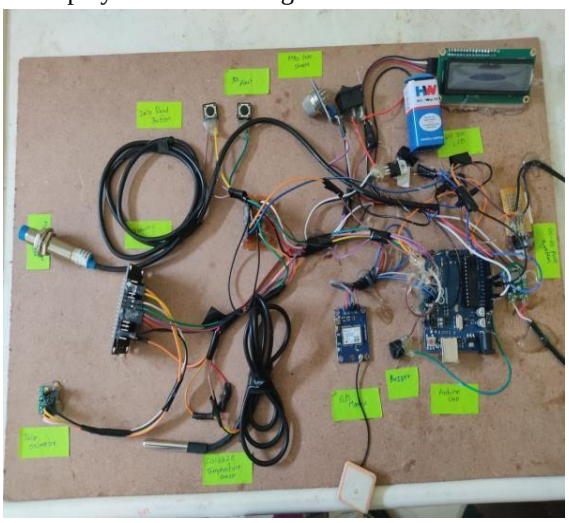

Fig: Hardware Kit

Fig: Title display

Fig: Toxic gas alert notification

Fig: SOS Alert Notification

Fig: Health Parameter readings

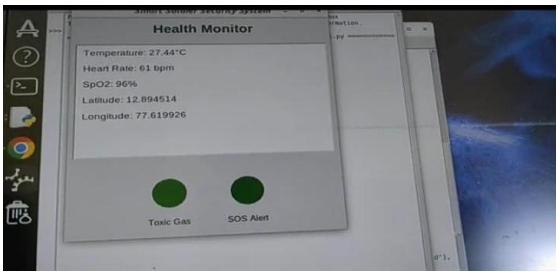

Fig: Tkinter GUI python results

IV.CONCLUTION

The IOT based smart solider health monitoring system provides a robust solution for military applications, ensuring the safety and security of soldiers in critical situations. By utilizing cloud-based monitoring, IoT connectivity, and real-time alerts, the system offers significant advantages over traditional monitoring methods. Speech alerts and GPS tracking enable swift intervention, preventing loss of life and enhancing operational efficiency. Beyond military applications, the system can be adapted for healthcare and elderly monitoring, showcasing its versatility and potential for broader applications.

FUTURE WORK

More sensors like EDA (electrodermal activity), EEG (Electroencephalography) and biochemical sensors can be integrated with the system. The soldier’s unit can be integrated to the wearable clothing using flexible electronics to make it more convenient for the soldiers.

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