SOLDIER HEALTH AND POSITION MONITORING SYSTEM USING GPS AND IOT TECHNOLOGY

By

R. BHAVANI * C. NITHYASRI **

*-** Department of Electronics and Communication Engineering, K. Ramakrishnan College of Technology (Autonomous), Samayapuram, Trichy, Tamil Nadu, India.

Date Received: 11/10/2023 Date Revised: 02/11/2023 Date Accepted: 30/11/2023

ABSTRACT

The fighter Wellbeing and Position Global Positioning Framework allows the military to track the current GPS position of officers and also monitors their health status, including internal temperature and heartbeat. This system also includes an additional feature that enables a soldier to request physical assistance or send a distress signal to the military if needed. The GPS modem transmits the latitude and longitude positions in a connected pattern, aiding the military in tracking the officer's current location. The system is highly beneficial for obtaining real-time health status information and providing immediate assistance to soldiers. In today's world, all nations prioritize their security, and soldiers, as the backbone of any armed forces, often lose their lives due to lack of medical aid during emergencies. Furthermore, soldiers engaged in missions or special operations might become disoriented on war fields, losing contact with authorities. To address these concerns, we developed this project. By utilizing a Wireless Body Area Sensor Network (WBANS) consisting of temperature and heartbeat sensors, we can monitor the soldiers' health status whenever necessary. Additionally, through GPS, we can track the precise location of the soldiers as needed. The use of an oxygen level sensor enables us to monitor the environmental conditions so that necessary aid can be provided by medical professionals. Communication between the soldiers and medical personnel is established via the Internet of Things (IoT). Any anomalies detected by the Remote Body Area Sensor Network (WBASNs) act as triggers for the IoT device to establish a connection between the soldier and the base unit, transmitting current location and health status to the receiver. To effectively convey this data, we have employed this equipment to create a cost-effective, lightweight, portable, and accurate defense system for soldiers.

Keywords: Arduino Board, Temperature Sensor, Pulse Rate Sensor, GPS and NODEMCU Modem, Gyro Sensor and Oxygen Saturation.

INTRODUCTION

In hostile areas, troopers not only need to manage the actual danger but also cope with stress and fatigue caused by extended operations or lack of rest. For security reasons, a device for remote warrior performance and health monitoring is required (Madhyan & Kadam, 2014). Thus, in this project, a tool is implemented using biosensors for monitoring purposes. Wars are fought for land, water, and achieving the status of the most powerful nation. A nation's armed forces consist of three professional uniformed services: the military, the navy, and the air force. Warriors, being the backbone of any armed force, typically lose their lives due to lack of medical assistance during emergencies. Moreover, soldiers involved in missions or special operations often become stranded on warfields and lose contact with the authorities (Pangavne et al., 2015).

The country's security is ensured by the armed force, naval force, and air force. The significant and essential role is played by fighters who sacrifice their lives for their country.

i-manager Publications
Member of:
This paper has objectives related to SDG
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

There are numerous concerns regarding the security of the officers. Officers entering enemy lines often lose their lives due to a lack of communication. It is essential for the military base station to know the location as well as the safety status of all personnel.

Indian warriors are, for the most part, known for their fortitude. Despite scant ammunition and health measures, they have numerous victories to their credit. India has tragically lost many warriors in warfields due to a lack of proper health reinforcement and communication between the soldiers on the battlefield and the authorities at the military base stations. Everyone should be genuinely concerned about the soldiers' well-being. Therefore, we have decided to undertake a project that will efficiently monitor the health status of the soldier and accurately track their location (Sharma et al., 2015). This initiative aims to provide them with necessary medical treatments as quickly as possible.

The GPS is utilized to give a remote correspondence framework. For checking the wellbeing of the officer, we are utilizing bio-clinical sensors like a temperature sensor and a heart rate sensor. An oxygen level sensor is utilized to screen air oxygen, so if there are any climatic changes, the troopers will be prepared appropriately by using Head protector-mounted visors, fitted for displaying guides and streaming constant video from other crew members, feature scopes of physiological sensors showing the heartbeat, internal heat level, air pressure, surrounding oxygen level, and so forth. These gadgets will improve awareness for military personnel's protection, as well as enable the exchange of data using remote networks. The challenge was to integrate these piecemeal components into a lightweight package that could achieve the desired result without being excessively bulky and unwieldy or requiring too much power. Communicating with the base (control room) station became the central challenge in military operations. Additionally, the proper coordination between soldiers' connections plays a significant role in defensive planning and coordination.

The intention of this paper is to follow the area of officers using GPS. It is helpful for the control room station to know the specific area of the officer. They will control them, and it is rapid, with short fury, warrior-to-trooper remote correspondence to transfer data on situational mindfulness with bio-average sensors and GPS route.

1. Literature Review

Kulkarni and Kulkarni (2019) report an IoT-based system for health monitoring and tracking of soldiers. Biomedical sensors provide heartbeat, body temperature, and environmental parameters for every soldier to the control room. This technology can be helpful in accurately locating missing soldiers in critical condition and overcoming the drawback of soldiers missing in action. The addressing system also improves communication between soldiers in emergency situations and provides proper navigation to the control room. Thus, we can conclude that this system will act as a lifeguard for army personnel worldwide. In the future, a portable handheld sensor device with more sensing options may be developed to aid soldiers. Additionally, Grove gas sensors can be placed to measure oxygen concentration in the environment, medical instructions can be given to soldiers to overcome situations, and Zigbee technology can extend the range of the network for communication.

Sharma and Aggarwal (2022), explain the real-time health monitoring system for soldiers using IoT. This system combines various wearable biosensors, control units comprising distributed communication systems, and user-friendly interfaces. The goal of the soldier health monitoring system is to examine and provide the health status to the control unit, enabling them to send the required medical help to the soldier. The control unit acquires the soldier's health status and coordinates their current position using the Global Positioning System (GPS) module. The GPS module performs real-time search and rescue operations for soldiers efficiently. This paper proposes a system capable of monitoring the soldier's health and providing real-time signals to the control unit. In emergencies, the system triggers an alarm to prompt necessary actions.

2. Proposed System

Subsequent to considering the advances, the following

system traces a route between the fighters to trooper, understanding their speed, distance, stature, as well as their health status during the WA, enabling the military individual to design conflict strategies. The base station obtains the warrior's location from GPS. The base station can access the current status of the trooper, displayed on the device, with the assistance of IoT, and hence, appropriate actions can be taken (Kulkarni & Kulkarni, 2019).

3. Hardware Requirements

3.1 Arduino Uno

Arduino is an open-source gadget platform dependent on easy-to-use hardware and software. Arduino boards are capable of reading inputs, light on a sensor, a finger on a button, or a Twitter message and transforming them into an output, activating a motor, turning on LEDs, or controlling something online. Figure 1 shows the Arduino Uno.

Microcontrollers are one of the significant segments in any implanted framework. A microcontroller is a little PC on a solitary incorporated circuit containing a processor center, memory and programmable info or yield peripherals. Microcontrollers work as indicated by the program composed inside its program memory. The significant utilization of these single chip PCs is in programmed reacting gadgets. The capacity of this part is to gather the data about heartbeat of the trooper, climatic temperature and area of the fighter in every moment. At that point it sends this data to the base unit.

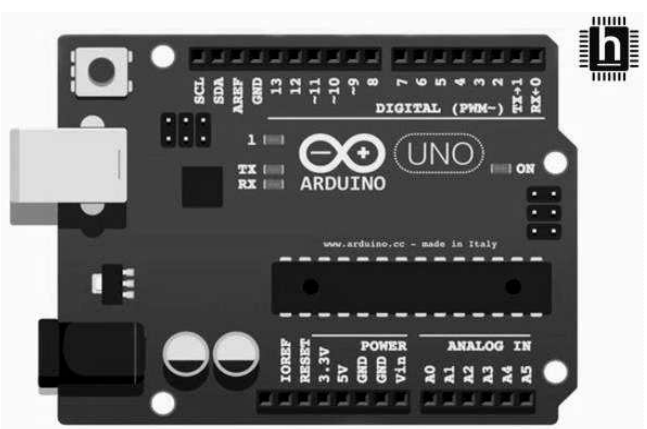

Figure 1. Arduino Uno

3.2 Temperature Sensor

The DHT11 course of action is a precision consolidated circuit temperature device with an output voltage directly proportional to the Centigrade temperature. It is a small and inexpensive IC that can be used to measure temperature. It can easily be interfaced with any Microcontroller that has ADC function or any development platform like Arduino. The DHT11 device has an advantage over a straight temperature sensor changed in Kelvin, as the user isn't required to convert a large constant voltage for the value gain centigrade scaling. To determine the health status of the trooper base station, one should know the internal heat level and pulse speed. Therefore, we are using the DHT11 temperature and humidity sensor. The DHT11 is a basic, super low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and emits a digital signal on the data pin (no analog data pins required). It's quite simple to use but requires careful planning to obtain data. Figure 2 shows the temperature sensor.

3.3 Pulse Oximeter (SpO2)

SpO2 is measured at the periphery, usually a finger, and it assesses the health of the cardiovascular and respiratory systems. A pulse oximeter noninvasively measures the oxygen saturation of a patient's blood (Mukherjee et al., 2014). This device consists of a red and an infrared light source, photodetectors, and a probe to transmit light through a translucent, pulsating arterial bed, typically a fingertip or earlobe. Oxygenated blood (O_2Hb) and deoxygenated blood (HHb) absorb red and infrared light differently. The percentage of hemoglobin saturation in

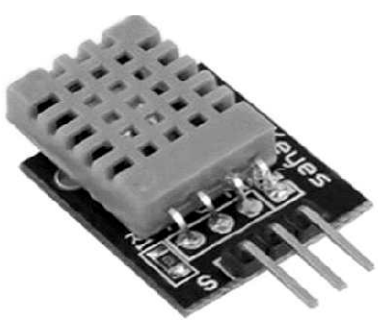

Figure 2. Temperature Sensor

arterial blood can be calculated by measuring light absorption changes caused by arterial blood flow pulsations. It determines the pulse rate and oxygen saturation of a person. Figure 3 shows the pulse oximeter.

3.4 Power Supply

The main segment in each electronic circuit is the power supply. For the proper functioning of all components, an unaltered power supply is required. The supply should be capable of providing the necessary power to every component while ensuring protection against overvoltage. The primary step in designing any system is to determine the power supply required for that system. Designing a power supply involves calculating the total current that the system draws from the supply and the voltage rating required for the various components. This project uses the following power supplies: 1. A 5V constant power supply for the GPS, NodeMCU, and LCD sections. AC adapters are used with electrical devices that require power but do not internally regulate the required voltage and power from mains power. The internal workings of an external power supply closely resemble the design used for an internal supply. External power supplies are used with equipment that lacks another power source and with battery-powered devices, where the supply, when connected, sometimes charges the battery as well as powers the equipment. Using an external power supply allows for the portability of equipment powered by either mains or battery without the added bulk of internal power components. It also eliminates the need to develop equipment for use only with a specific power source; the same device can be powered from 120 VAC or 230 VAC mains, vehicle, or airplane battery by using a different adapter. Another advantage of these designs can be increased safety, as the potentially hazardous 120 or 240-volt mains power is converted to a lower, safer voltage at the wall outlet and the appliance that is handled by the user.

Figure 3. Pulse Oximeter (SpO2)

3.5 GPS Modem

The Global Positioning System has been established to enable precise determination of geographical locations by military and civilian users. It relies on the utilization of satellites in Earth's orbit that transmit data allowing for the measurement of distances between the satellites and the user. The operation of the Global Positioning system is based on the 'trilateration' mathematical principle. Positions are determined from distance measurements to satellites. The Global Positioning System is a space-based global navigation satellite system that provides reliable location and time information across the entire globe, at all times and in any location on or near the Earth where there is an unobstructed view of at least four GPS satellites. Figure 4 shows the GPS modem.

3.6 NODEMCU

NodeMCU is what could be compared to Ethernet module. It joins the highlights of Wi-Fi passageway and station + microcontroller. These highlights make the NodeMCU very integral asset for Wi-Fi organizing. It very well may be utilized as passage or potential station, have a web worker or interface with web to get or transfer information. Figure 5 shows the NODEMCU.

It is an open source firmware for which open source prototyping board plans are accessible. The name "NodeMCU" consolidates "hub" and "MCU" (miniature regulator unit). The expression "NodeMCU" carefully talking alludes to the firmware instead of the related

Figure 4. GPS Modem

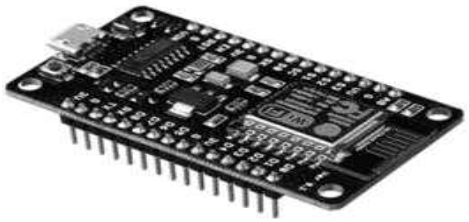

Figure 5. NODEMCU

advancement packs.

4. Working Principle

The fundamental principle of this work is to discover the specific area of the harmed trooper on the conflict field. Figure 6 shows the soldier health and position monitoring using GPS and IOT. Figure 7 shows the flow chart of GPS and NODEMCU.

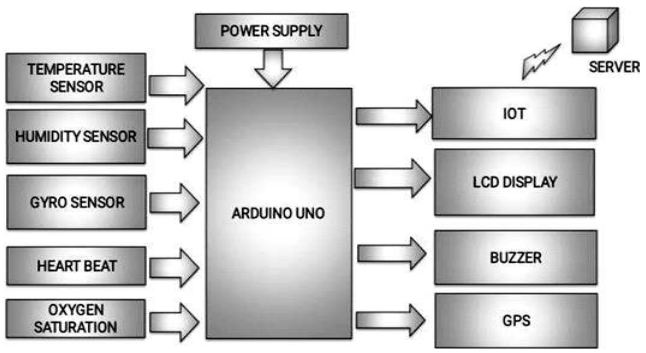

Figure 6. Soldier Health and Position Monitoring using GPS and IoT

5. Method of Navigation using GPS

A powerful, precise framework with consistent indoor and outside inclusion is exceptionally useful for expanding security in crisis reaction and military activity. GPS-based situating strategies are primarily used to handle rescue operations. The position and direction of the rescuer and the caught are obtained utilizing a GPS chip. Utilizing the GPS information of both units, the relative distance, stature, and direction between them are determined through mathematical connections dependent on a progression of equations in Geographic Information Systems (GIS). Using this innovation, we navigate between two soldiers. The information will be sent remotely via RF Handset. This device can achieve precise coordination through wireless communication, aiding officers in situational awareness. The GPS module has a serial interface. A robust, accurate positioning system with seamless indoor and outdoor coverage is a highly useful tool for increasing safety in emergency response and military operations. GPS-based positioning methods are mainly used in field rescue. The position and orientation of the rescuer and the trapped individual are acquired using a GPS chip. Using the GPS data of both units, the relative distance, height, and orientation between them are calculated from the geometric relationships based on a series of formulas in

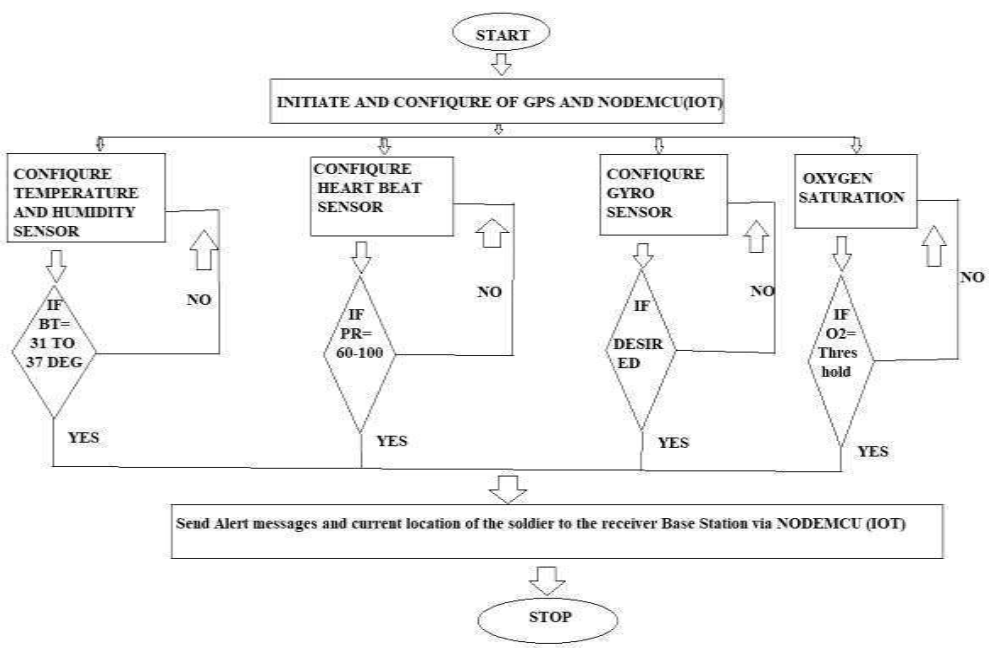

Figure 7. Flow chart of GPS and NODEMCU

Geographic Information Systems (GIS).

5.1 Physiological Signal and Biosensors

With ongoing advances in innovation, various wearable sensors have been developed for monitoring human physiological factors (Sharma & Aggarwal, 2022). The estimation of these vital bio signals and their subsequent processing for feature extraction lead to a variety of real-time accumulated vitals that can provide a general assessment at any given moment. There are various clinical factors that can be monitored, such as ECG, EEG, Mind Mapping, etc. Yet, these require complex hardware and advanced clinical facilities and thus cannot be easily carried around by the trooper.

6. Software Requirements

- Compiler
- Proteus software
- Arduino Uno Software

6.1 Advantage

- Provides high level safety to human life.
- Suitable for Indian Conditions.
- Easy retrieval of data.
- Low cost and less complex system for installing.

7. Result

A message is sent to the registered number confirming the IOT and GPS configuration. Later, as the normal body parameters deviate, an alert message is sent to the base station along with the precise location of the soldier. Figure 8 shows the output observation. Figure 9 shows the abnormal condition detection for GYRO. Figure 10 shows the normal condition of GYRO.

8. Discussion

The integration of biosensors and GPS technology within the fighter Wellbeing and Global Positioning Framework marks a significant advancement in military monitoring and assistance systems. This discussion delves into the comprehensive functionality, technical intricacies, advantages, and potential enhancements of this system.

Temperature, pulse rate, and oxygen sensors empower the system to track vital body signs, crucial for soldiers'

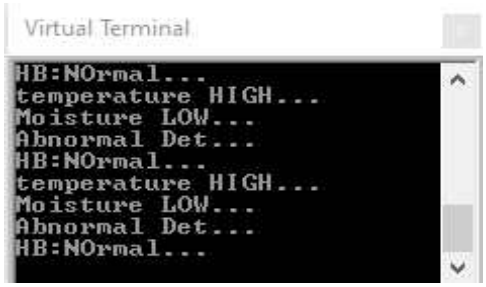

Figure 8. Output Observation

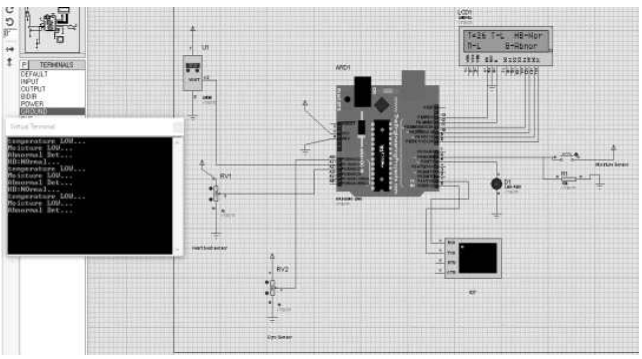

Figure 9. Abnormal Condition Detection for GYRO

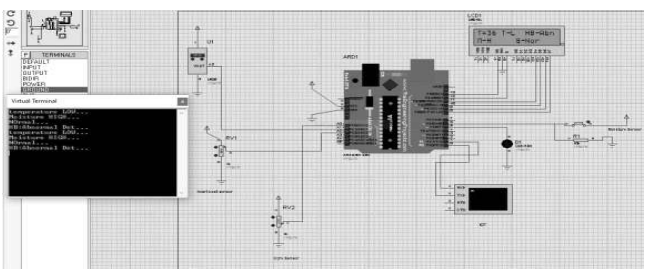

Figure 10. Normal Condition of GYRO

health in tough conditions. Wireless Body Area Sensor Networks (WBANS) with an oxygen level sensor not only monitor health but also facilitate rapid responses to environmental shifts, enabling faster medical help (Chakravarth et al., 2017). The framework's GPS feature enables precise soldier tracking in remote or hostile areas, ensuring quick response during emergencies or combat scenarios when contact might be lost or soldiers disoriented (Nikam et al., 2013).

IoT tech links soldiers to base, swiftly relaying health and location data via WBASNs for quick aid during anomalies. Efforts are underway to develop a compact, robust monitoring system for versatile military use by incorporating Arduino boards, NodeMCU, and diverse

sensors, prioritizing portability and reliability. The system has improved, but there are limits and room for enhancement, especially regarding accuracy affected by weather and soldier environments. Future versions could concentrate on improving precision in diverse conditions. Future enhancements include integrating more biometric sensors for improved soldier safety and efficiency. Proposals for adding cameras or automatic surveillance robots could expand the system beyond health monitoring to comprehensive battlefield surveillance and support (Patii & Iyer, 2017).

The Fighter Wellbeing and Global Positioning Framework is a groundbreaking system for monitoring military health and tracking location. By combining biosensors, GPS tech, and IoT communication, it boosts soldier safety during combat. Ongoing improvements will make it even more crucial for ensuring soldier well-being and mission success.

Conclusion

From the planned task, it can be inferred that we can communicate the information detected from the soldier to control room by utilizing IoT remote transmission technology. It is fully integrated so that tracking is feasible anytime, anywhere. It possesses real-time capability. The accuracy of the system is influenced by certain factors such as weather, climate around the mobile fighter unit, and GPS receiver. Despite these influences, the integrated nature of the technology ensures reliable tracking capabilities regardless of location, offering an unprecedented level of accessibility and control over the transmitted data.

Future Scope

There is consistently opportunity to improve any framework as exploration and advancement is a perpetual interaction. Soldier Voice Recognition framework: IC HM2007 can be utilized to perceive the voice tests of the officer, for better security reason.

- A Camera can be fitted into the framework in order to empower the base station to get an ongoing perspective on combat zone.
- Automatics Surveillance Robot: A Robot with all the medical features as well as advanced features like ammunition can be build.

References

[1]. Chakravarth, P., Natarajan, S., & Bennet, M. A. (2017). GSM based soldier tracking system and monitoring using wireless communication. *International Journal on Smart Sensing and Intelligent Systems*, 10(5), 259-270. https://doi.org/10.21307/ijssis-2017-250

[2]. Kulkarni, M., & Kulkarni, M. T. (2019). Secure health monitoring of soldiers with tracking system using IoT: A survey. *International Journal of Trend in Scientific Research and Development*, 3(4), 693-696.

[3]. Madhyan, E., & Kadam, M. (2014). A unique health care monitoring system using sensors and ZigBee technology. *International Journal of Advanced Research in Computer Science and Software Engineering*, 4(6), 183-189.

[4]. Mukherjee, S., Dolui, K., & Datta, S. K. (2014, February). Patient health management system using e-health monitoring architecture. In 2014 *IEEE International Advance Computing Conference (IACC)* (pp. 400-405). IEEE. https://doi.org/10.1109/IAdCC.2014.6779357

[5]. Nikam, S., Patil, S., Powar, P., & Bendre, V. S. (2013). GPS based soldier tracking and health indication system. *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, 2(3), 1082-1088.

[6]. Pangavne, S. M., Sohanlal, C., & Bhavik, P. (2015). Real Time Soldier Tracking System. *IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)*, (pp. 21-24).

[7]. Patii, N., & Iyer, B. (2017, May). Health monitoring and tracking system for soldiers using Internet of Things (IoT). In 2017 *International Conference on Computing, Communication and Automation (ICCCA)* (pp. 1347-1352). IEEE. https://doi.org/10.1109/CCAA.2017.8230007

[8]. Sharma, A., & Aggarwal, S. (2022). Real-Time Health Monitoring System of Soldiers using IoT. In *Advanced Computational Paradigms and Hybrid Intelligent Computing: Proceedings of ICACCP 2021* (pp. 285-296). Springer Singapore. https://doi.org/10.1007/978-981-16-

4369-9_29

[9]. Sharma, S., Kumar, S., Keshari, A., Ahmed, S., Gupta, S., & Suri, A. (2015, May). A Real Time Autonomous Soldier Health Monitoring and Reporting System Using COTS Available Entities. In 2015 *Second International Conference on Advances in Computing and Communication Engineering* (pp. 683-687). IEEE. https://doi.org/10.1109/ICACCE.2015.84

ABOUT THE AUTHORS

R. Bhavani, Department of Electronics and Communication Engineering, K. Ramakrishnan College of Technology (Autonomous), Samayapuram, Trichy, Tamil Nadu, India.

C. Nithyasri, Department of Electronics and Communication Engineering, K. Ramakrishnan College of Technology (Autonomous), Samayapuram, Trichy, Tamil Nadu, India.