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Research Article

Development of a Solar Dependent Electronic-Uniforms for Preserving Eco-Humanism Neutrality in Military Personnels in Ecologically Preserved Dense Forests

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ABSTRACT

The solar-based E-Uniform is designed to provide enhanced protection and functionality for soldiers operating in extreme weather conditions. By integrating flexible solar panels, the uniform generates power to support its internal circuitry, storing the harvested energy in a 12V DC lead-acid rechargeable battery. Additionally, a conventional battery charging unit is included to provide a backup power source for critical systems. The heart of the uniform's electronics is the AT89S52 microcontroller, which manages all functionalities, including power distribution and operational modes. A voltage sampler, interfaced with an ADC 0808, monitors the battery's charge status and displays it on a 16x2 LCD screen, ensuring soldiers can easily check the system's power levels. The uniform can be adjusted for different environmental conditions with a summer and winter mode, controlled by the microcontroller. Depending on the selected mode, an H-Bridge IC drives a built-in heating or cooling element that regulates the uniform's internal temperature. This feature helps maintain a comfortable body temperature, whether in extreme heat or cold, allowing soldiers to remain operational in any climate. The uniform also includes a metal detector sensor to identify dangerous objects like bombs, providing a buzzer alert to warn the wearer. For enhanced safety and situational awareness, the E-Uniform is equipped with both GPS and GSM modules, allowing real-time tracking and communication. The GPS provides precise location data, which is sent to the relevant department or personnel via GSM, enabling immediate support and response in emergencies. This combination of renewable energy use, adaptive climate control, hazard detection, and communication technology makes the solar-based E-Uniform a comprehensive solution for soldiers working in diverse and challenging environments..

Introduction : The development of the solar-dependent Electronic Uniform (E-Uniform) for military personnel in ecologically sensitive forests introduces a pivotal shift in military apparel, emphasizing eco-humanism neutrality. This initiative is geared towards enhancing the operational efficiency and safety of soldiers serving in extreme environmental conditions. The integration of advanced technologies such as solar panels and electronic monitoring systems directly into military uniforms allows for a sustainable approach that supports both the soldier's functionality and environmental conservation.

Objectives : The primary objective of the E-Uniform project is to provide military personnel with a garment that not only offers protection against varying climatic conditions but also integrates seamlessly with the natural environment, reducing ecological impact. The uniform aims to harness solar energy to power various electronic components, thereby reducing reliance on traditional energy sources and minimizing the carbon footprint associated with military operations. Additionally, the project seeks to incorporate advanced sensors and communication technologies to enhance the situational awareness and safety of soldiers during their missions.

Methods : The methodology involves a multi-disciplinary approach combining textile engineering, renewable energy technology, and electronic systems design. The uniform utilizes lightweight, flexible solar panels to capture solar energy efficiently. This energy is stored in a specially designed battery system embedded within the uniform, powering various electronic devices such as GPS, health monitoring sensors, and temperature regulation systems. The design process includes rigorous field testing to ensure durability, comfort, and effectiveness in diverse environmental conditions, followed by iterative improvements based on feedback from initial deployments.

Results : Initial testing of the E-Uniform in controlled and field environments has shown promising results. The solar panels are capable of generating sufficient power to maintain critical systems throughout the operational period. Health monitoring sensors have successfully provided continuous feedback on the physiological status of personnel, while integrated GPS systems have improved navigation capabilities. Moreover, the temperature regulation feature has been effective in maintaining a comfortable body temperature, demonstrating significant potential to enhance soldier endurance and effectiveness.

Conclusions : The development of the E-Uniform represents a significant advancement in military technology, aligning with modern sustainability goals and the demands of warfare in sensitive ecological zones. By integrating solar power and electronic functionalities, the uniform not only enhances the operational capabilities of military personnel but also promotes an environmentally responsible approach to military operations. The successful implementation of such technologies paves the way for further innovations in the defense sector, potentially leading to broader applications in other fields requiring advanced, eco-friendly clothing solutions.

Keywords: Microcontroller, Solar Panel, Rechargeable Battery, Temperature Sensor, Heart Rate Sensor.

1. INTRODUCTION

Warriors are the most vital asset of any military force. They play a critical role in safeguarding their nation's security and well-being. The term 'warriors' encompasses service members from the Army, Air Force, Navy, and Marine Corps, all of whom may face challenging conditions while on duty. Extreme hot or cold weather conditions can be detrimental to their health, potentially impairing their ability to perform their duties effectively. Addressing this issue, the development of an E-Uniform offers a solution by providing enhanced protection and comfort for soldiers operating in harsh environmental conditions. The E-Uniform is specifically designed to ensure the safety and comfort of soldiers working in extreme weather. It incorporates a temperature sensor, the LM35, which is a precision circuit temperature sensor whose output voltage is linearly proportional to the Celsius temperature. This sensor enables real-time monitoring of the uniform's internal temperature, allowing soldiers to quickly assess and adjust to their environment. By integrating this technology, the E-Uniform ensures that soldiers are better protected against potentially dangerous temperatures. To maintain the functionality of the E-Uniform, solar panels are used to power the internal electronics. These panels continuously generate energy, which is stored in a 12V DC lead-acid rechargeable battery. This renewable energy source provides a sustainable and reliable way to power the uniform's systems, reducing the need for traditional power supplies and increasing the uniform's autonomy in remote or off-grid locations. For added flexibility, the uniform also features a conventional battery charging unit, ensuring that the internal electronics can receive power through multiple sources if needed. Overall, the E-Uniform is designed to allow soldiers to operate effectively in any environment. By utilizing advanced technology and renewable energy, it enhances both the safety and comfort of soldiers, enabling them to perform their duties in a wide range of extreme weather conditions. This innovative approach represents a significant advancement in military uniform technology, combining functionality with enhanced protection to support the soldiers who protect our nations. The E-Uniform is equipped with advanced sensors, including a temperature sensor and a heart rate sensor, to continuously monitor the soldier's health in any situation. These sensors provide real-time data on vital signs, ensuring that the soldier's well-being is constantly tracked and any anomalies are promptly detected. The AT89S52 microcontroller serves as the core of the circuit, managing all the uniform's functions. A voltage sampler is integrated into the system using an ADC 0808, which converts the analog voltage readings from the battery into digital signals, displaying the current battery level on a 16x2 LCD screen for easy monitoring. The uniform operates in two distinct modes: summer mode and winter mode. By selecting the appropriate mode, the microcontroller activates an H-Bridge IC that drives the internal heating or cooling elements embedded within the uniform. This dynamic system helps create a chilling or warming effect inside the uniform, allowing the soldier to maintain a comfortable body temperature regardless of external weather conditions. As a result, the uniform significantly reduces the risk of heat stress or cold-related issues, enabling soldiers to operate efficiently in extreme environments. The E-Uniform uses a 12V DC lead-acid rechargeable battery to store energy, which powers the system's internal electronics. In addition to the solar panels, a conventional battery charging unit is also available to ensure a continuous power supply, providing flexibility in various situations. This unit uses a regulated 5V, 500mA power supply, ensuring stable power output for the uniform's electronics. To maintain consistent voltage, the system employs a 7805 three-terminal voltage regulator, which ensures that the circuits receive the correct voltage levels needed for optimal operation. For further reliability, a bridge-type full-wave rectifier is included to rectify the alternating current (AC) output from the secondary winding of a 230V/12V step-down transformer. This configuration ensures that the uniform's electronics can be powered both by the solar-based system and conventional power sources, making it highly versatile and adaptable to different operational needs. By combining multiple power sources and advanced sensor technologies, the E-Uniform enhances the soldier's ability to endure and perform effectively in diverse and challenging environments.

2. LITERATURE REVIEW / SURVEY

the soldier's ability to endure and perform effectively in diverse and challenging environments.

3. PROPOSED SYSTEM

Extensive research and review of various studies have identified several papers as valuable resources for the project's development. These papers present diverse methodologies and techniques that can be applied to create a more efficient and user-friendly uniform for soldiers. By analyzing these resources, we can incorporate innovative approaches and advanced technologies to enhance the uniform's functionality, comfort, and adaptability to meet the unique needs of military personnel in challenging environments. The "Development of a Solar-Based E-Uniform for Soldiers" aims to revolutionize military apparel by integrating renewable energy solutions directly into soldiers' uniforms. This innovative uniform is designed to harness solar power through lightweight, flexible solar panels embedded into the fabric, providing a sustainable energy source for powering various electronic devices and equipment used by soldiers in the field. The E-Uniform not only enhances operational efficiency by reducing dependency on conventional batteries and external power supplies but also contributes to the safety and effectiveness of soldiers in remote or harsh environments. This project focuses on developing a uniform that combines comfort, durability, and energy efficiency, paving the way for more sustainable and self-sufficient military operations.

The solar-based E-Uniform incorporates advanced photovoltaic materials that are lightweight, flexible, and durable, ensuring they can withstand the rigors of military use. These solar panels are strategically embedded in the uniform to maximize sunlight absorption without compromising comfort or mobility. The harvested solar energy is stored in high-capacity, lightweight batteries integrated within the uniform, providing a reliable power source for various electronic devices such as communication systems, GPS units, night-vision goggles, and health-monitoring sensors. This reduces the need for carrying extra batteries, decreasing the overall load soldiers must bear and allowing them to operate more freely and effectively in diverse terrains. Furthermore, the E-Uniform is designed with adaptive energy management features that prioritize power distribution based on real-time usage and demand. This intelligent system ensures that critical devices receive uninterrupted power, even in low-light conditions. The uniform also incorporates advanced thermal management materials to regulate body temperature, keeping soldiers comfortable in extreme weather conditions. By leveraging renewable energy and innovative materials, the E-Uniform aims to enhance soldier endurance, safety, and mission success in challenging operational environments.

In addition to its practical benefits, the development of a solar-based E-Uniform aligns with broader sustainability goals by reducing the carbon footprint of military operations. Traditional power sources often rely on non-renewable energy, contributing to environmental degradation and logistical challenges. A solar-powered uniform minimizes these dependencies and represents a significant step towards greener military technologies. As global defense strategies increasingly emphasize sustainability and energy independence, the solar-based E-Uniform could become a crucial component of future military equipment, combining functionality with eco-friendly innovation.

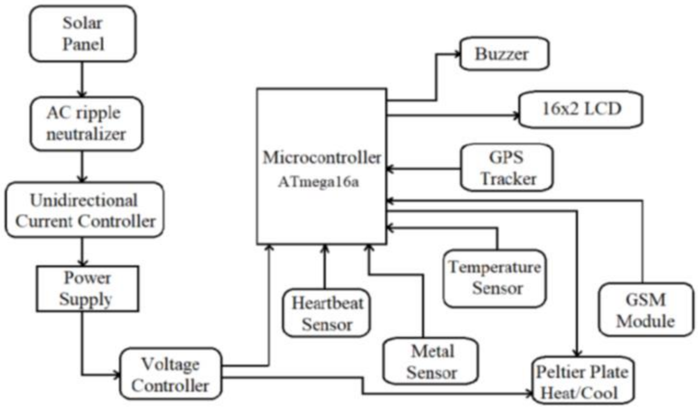

Fig. 2 : Block-diagram of the proposed system module

This project utilizes solar panels to charge a 12V, 1.2 Amp-hour lead-acid battery, providing a reliable power source for the E-Uniform's various components. A Peltier thermoelectric device, connected to the battery, generates a cooling effect on one side while dissipating heat on the other side through a heat sink. To enhance the system's efficiency, a 7805 numbered IC voltage regulator is employed to power the internal cooling fan and LED, ensuring the uniform remains comfortable in extreme conditions. At the core of the system is the ATmega16a microcontroller, which allows for dynamic and rapid control of the uniform's functionalities. This microcontroller enables the uniform to adjust quickly to changing environmental conditions, optimizing performance in real-time. A liquid crystal display (LCD) is incorporated to provide a user-friendly interface, displaying important information such as voltage variations in the rechargeable battery. This feature ensures that soldiers can easily monitor the power status and make necessary adjustments when needed.

The uniform operates in two modes: summer mode and winter mode. By selecting the appropriate mode, the microcontroller adjusts the system to either cool or heat the body as required. This is achieved by controlling the heater or cooler embedded within the uniform, which can create a chilling or warming effect to help the soldier cope with different external environments. This adaptive temperature regulation helps prevent heat stress or cold stress, allowing soldiers to maintain productivity and comfort in diverse conditions. To enhance safety, the uniform is equipped with a metal sensor that detects metallic objects such as bombs or other planted weapons. If a potentially dangerous object is detected, a buzzer alerts the soldier to the threat, providing crucial early warning and reducing the risk of harm. This feature is especially valuable in combat or reconnaissance missions, where timely detection of threats can be life-saving. Furthermore, the uniform integrates communication and tracking capabilities through GSM and GPS modules interfaced with the microcontroller. The GPS module continuously tracks the soldier's location, while the GSM module transmits this information to the relevant personnel or department. This real-time location tracking ensures that commanders have accurate situational awareness, allowing for swift response and support when necessary, thereby enhancing the overall safety and effectiveness of military operations.

4. PROPOSED METHODOLOGY DEVELOPED & ITS COMPONENTS

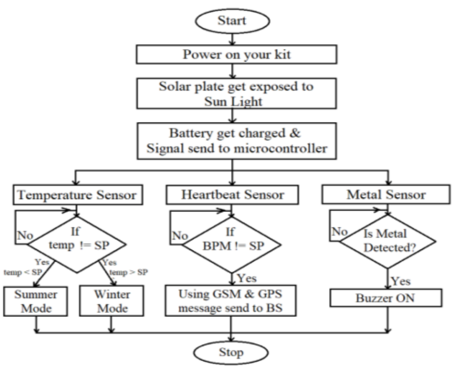

Fig. 2 : Flow-chart of the proposed system

4.1. Heart beat sensors

Fig. 3 : Heart beat sensor view

The heartbeat sensor is designed to provide precise measurements of heart rate by detecting the pulse when a finger is placed on it. As the sensor operates, an LED blinks in sync with each heartbeat, visually indicating the pulse. This digital output can be directly connected to a microcontroller to calculate the Beats Per Minute (BPM) rate. The sensor functions based on the principle of light absorption. As blood flows through the finger with each heartbeat, it alters the amount of light passing through the finger. The sensor captures these variations in light to determine the heart rate accurately.

4.2. Metal Sensors

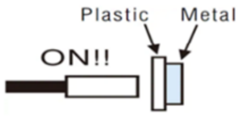

Fig. 4 : Metal sensor view

Inductive proximity sensors are specialized for detecting metal targets and cannot detect non-metallic materials such as plastic, wood, paper, or ceramics. Their functionality is limited to metals, making them unsuitable for applications involving non-metallic substances. In contrast to photoelectric sensors, which rely on light to detect objects and may be obstructed by opaque materials, inductive proximity sensors can detect metal objects even through opaque plastic. This capability allows them to be used in environments where metal detection is required despite the presence of non-metallic barriers.

4.3. Solar Panel

Fig. 5 : Solar panel view

Recent ly included component for our undertaking is – Solar Panel. As we were confronting issue for consistently release of 12v battery utilized at recorded. We at long last chose to go for sun oriented board renewable vitality source. It changes over light vitality from the sun into 12 Volt DC power. Gradually charges our 12V battery. It likewise keeps up a charge and amplify battery's life. It ensures battery through long stockpiling periods. This sunlight based board charger has no moving parts that could destroy after some time.

4.4. Specifications - LCD

The specs are given as below for various components. LCD stands for Liquid Crystal Display, and the model used here is a 16x2 display. This type of LCD has 16 pins: 8 of these pins are dedicated to data communication, including functions for reading, writing, enabling, and brightness control, while the remaining 4 pins are used for the power supply. The 16x2 LCD is employed to display data on its screen, where it can show up to 16 characters per line across 2 lines. Its configuration allows for versatile data presentation and user interaction in various electronic applications.

4.5. Peltier Plate

Fig. 6 : View of the peltier plate effect

The Peltier Plate is the most commonly used temperature control option for AR rheometers. It offers a wide temperature range from -40 to 200 ºC and achieves a typical heating rate of up to 20 ºC per minute, with a temperature accuracy of 0.1 ºC. This precise control makes it an ideal choice for applications requiring consistent and accurate temperature regulation. Central to the Peltier Plate's functionality is the PRT (platinum resistance thermometer) sensor, which is strategically positioned at the center of the plate. This sensor ensures that temperature measurements are precise and that the temperature control remains accurate throughout the operation. The PRT sensor's high accuracy is crucial for maintaining the reliability of the rheometer's readings.

4.6. Coolers

For cooling, the Peltier Plate utilizes a Peltier element (TEC), which is designed to absorb and dissipate heat effectively. The Peltier element is the core component of the cooling system, enabling the plate to achieve the desired low temperatures. The efficiency of the cooling process is further enhanced by a robust heatsink and fan combination, which works in tandem with the TEC to manage heat dissipation effectively. The Peltier cooler, incorporating both the Peltier element and the heatsink/fan setup, is essential for maintaining the temperature control across a broad range. This setup allows the Peltier Plate to rapidly and efficiently switch between heating and cooling modes, providing precise temperature control necessary for accurate rheological measurements. Overall, the Peltier Plate's combination of a wide temperature range, rapid heating and cooling capabilities, and high accuracy makes it a preferred choice for temperature control in AR rheometers. The integration of the PRT sensor and Peltier cooler ensures that the temperature control system operates reliably and efficiently, meeting the demands of various scientific and industrial applications.

Fig. 7 : LCD view

4.7. Features of screens

The LCD screen features a 16x2 display, allowing it to show 16 characters across 2 lines. It uses a 5x7 dot matrix for each character, complete with a cursor for improved user interaction and visibility. The display supports both 4-bit and 8-bit MPU interfaces, making it compatible with a wide range of microcontrollers. This LCD is a standard type that offers great value pricing, making it an economical choice for various applications. It operates with a maximum input voltage of 5.3VDC and a standard operating voltage of 5VDC. The display is equipped with an 8-bit interface data bus, facilitating efficient data communication. Additionally, the character font size on the screen is 0.125 inches wide by 0.200 inches high, providing clear and readable text.

4.8. Battery

Fig. 8 : Battery view

A battery is a device composed of multiple electrochemical cells used for power storage. These cells can be connected either in series or in parallel and housed together in a single unit to provide a specific voltage and capacity. The primary purpose of a battery is to convert stored chemical energy into electrical energy, which can be used to power various electronic devices. Batteries come in two main types: single-use (primary) batteries and rechargeable (secondary) batteries. Primary batteries are designed for one-time use and are disposed of once depleted, while rechargeable batteries can be recharged multiple times, making them suitable for applications like standby power in emergencies or continuous usage in devices that require long-term power solutions. The size and capacity of batteries vary significantly depending on their intended use. Small cells are typically used to power everyday items such as hearing aids, wristwatches, and remote controls. In contrast, larger batteries are designed for more demanding applications, such as providing backup power for telephone exchanges, data centers, and other critical infrastructure where a reliable power source is essential.

4.9. Temperature sensors

Fig. 9 : Temperature sensor view

The LM35 is an integrated circuit temperature sensor that measures temperature with an output voltage linearly proportional to the temperature in degrees Celsius (°C). This design allows for straightforward temperature measurement, providing a precise and reliable output that can be easily interpreted by microcontrollers and other electronic systems. Compared to thermistors, the LM35 sensor offers greater accuracy in temperature measurement. It is designed with encapsulated sensor hardware that is resistant to environmental factors such as oxidation, ensuring long-term stability and durability. This makes the LM35 an excellent choice for applications where reliability and consistent performance are crucial. Additionally, the LM35 generates a higher output voltage than thermocouples, often eliminating the need for signal amplification. This feature simplifies the integration process and reduces the complexity of the circuit design, making it suitable for a wide range of temperature-sensing applications in both consumer and industrial electronics.

4.10. Control Supply

The 230V AC input is first supplied to a rectifier circuit, which converts the alternating current (AC) into a pulsating direct current (DC) voltage. This rectification process changes the nature of the input power, enabling it to be used for DC-operated devices and components. However, the output from the rectifier is not a pure DC; it contains ripples or fluctuations that need to be minimized for stable operation. To smooth out these ripples, the rectified output is passed through a filter circuit. The filter circuit eliminates the remaining AC components from the rectified voltage, resulting in a more stable DC output. This stage is essential to ensure that any alternating characteristics still present after rectification are removed, yielding a cleaner DC signal. Finally, the filtered voltage is fed into a voltage regulator. The voltage regulator's role is to maintain a constant and pure DC voltage output, regardless of variations in input voltage or load conditions. This ensures that the output is a steady DC voltage, suitable for powering sensitive electronic circuits and devices that require a consistent voltage supply to operate effectively.

5. SIMULATION & EXPERIMENTAL RESULTS WITH VALIDATION

The "Sunlight-Based E-Uniform" is designed for officers operating in extreme high or low-temperature environments. This innovative uniform has been effectively tested and implemented, proving to be a highly efficient and reliable solution for maintaining comfort and safety in challenging conditions. By harnessing solar energy, the uniform regulates body temperature, allowing officers to work effectively without the stress of extreme heat or cold. This solution not only enhances the well-being and performance of officers but also offers an affordable and sustainable energy alternative for broader use. The use of solar power reduces dependence on conventional energy sources, making it a cost-effective option that aligns with green energy initiatives. Its affordability makes it accessible to a wider range of users, including critical personnel who require dependable temperature regulation in their uniforms. Overall, the Sunlight-Based E-Uniform represents a significant advancement in wearable technology, providing a practical and economical way to support those working under extreme environmental conditions. Its successful implementation showcases its potential as a versatile solution for energy conservation and personal comfort.

6. CONCLUSIONS

Soldiers play a vital role in a country's safety and security, standing as the unwavering guardians who protect the nation day and night, often sacrificing sleep and rest. To ensure they perform their duties efficiently in all kinds of environments, innovative solutions such as the Solar-based E-Uniform have been developed. This advanced uniform provides superior protection to soldiers facing extreme weather conditions, allowing them to operate effectively without suffering from heat or cold stress. The Solar-based E-Uniform is designed to adapt to the challenging environments soldiers face. It includes a cooling system that activates in excessively hot conditions and a heating system that kicks in during extreme cold. This temperature regulation mechanism ensures that soldiers remain comfortable and focused, significantly reducing the risks associated with extreme weather. Additionally, a metal sensor is integrated into the uniform to detect any hidden bombs or weapons in the ground, alerting soldiers with a buzzer and providing a critical layer of safety in combat zones. Health monitoring is another key feature of the Solar-based E-Uniform. Equipped with a heart rate sensor, the uniform continuously tracks the soldier's vital signs, ensuring their well-being is always monitored. Furthermore, the integration of GPS and GSM technology allows for real-time tracking of soldiers' locations, which is crucial for coordinating movements and ensuring prompt medical attention if needed. In case of a system failure, the GPS pinpoints the soldier's location, and the GSM sends a distress signal to the control station, enabling swift action to protect the soldier's life.

The implementation of such a system can have a profound impact on military operations. It could significantly enhance the safety of soldiers, particularly those deployed in extreme environments, by minimizing the risks of weather-related health issues. Moreover, the side effects of reduced personnel due to injuries or weather-related conditions at the borders could be drastically reduced, maintaining a stronger and more prepared defense force. Beyond military applications, this project has relevance in everyday life and various industrial applications. The ability to regulate temperature and monitor health in real-time could be valuable in several sectors, such as construction, firefighting, and hazardous material handling, where workers are exposed to extreme conditions. The integration of GPS and communication technologies also has potential uses in logistics, security, and emergency response services. Overall, the Solar-based E-Uniform represents a significant advancement in wearable technology, combining multiple safety features into a single, efficient package. Its ability to safeguard soldiers in extreme environments while providing real-time health monitoring and location tracking makes it an indispensable tool for modern defense forces and has promising applications beyond the military

REFERENCES

[1] Smith, J., Dr. S.M. Kannan, R. Krishnavenishri, S. Kamalika, B. Kanagalakshmi: “Solar and IoT Based Health Monitoring, Controlling and Tracking System for Soldiers”, SSRG International Journal of Electrical and Electronics Engineering (SSRG – IJEEE) – Volume 5 Issue 8 – August 2018.

[2] Kawad Pranali, Dahiwalkar Gayatri, Pooja Adate, S.B. Dhekale: “E-UNIFORM”, International Journal of Advance Engineering and Research Development Volume 5, Issue 05, May -2018.

[3] Karthikeyan N, Murugesan K.S, Senthil Kumar P, Pooranachandran S., “Solar Powered E-Military”, International Journal of Advanced Research in Computer and Communication Engineering ISO 3297:2007 Certified Vol. 6, Issue 4, April 2017.

[4] M.Sivalingamaiah, E. Satheesh Kumar, M. Vijaya Lakshmi, “Solar Based E – Uniform For Soldiers-Used For Temperature Control And Tracking ", International Journal of Engineering Research and Development Volume 12, Issue 5 (May 2016), PP.49-53.

[5] Adarsh K. S, Arun Dinesh, Jyothy Elizebeth D: “E-Uniform for Soldier’s Who Work at Extreme Temperature Regions”, International Journal of Engineering Research and General Science Volume 3, Issue 3, May-June, 2015, pp. 993 – 998.

[6] Dr. Prakash Kuravatti, “Design & development of a nano antenna using chemical decomposition methods in IoT based nanotechnology systems for energy harvesting for telecommunication sectors with AI-ML” International Journal of European Chemical Bulletin, Eur. Chem. Bull. 2023, 12(Special Issue 4), 13638-13646.

[7] Dr. Prakash Kuravatti, “Comparison of Different Parameters of the Edge Feed and the Inset Feed Patch Antenna” International Journal of Applied Engineering Research, ISSN: 0973-4562 Volume13, Number 13 (2018), pp. 11285-11288

[8] Prakash Kuravatti, Dr. T.S. Rukmini “Reduction of mutual coupling in antenna arrays using periodic structure” published in IEEE xplorer, January 2017, DOI:10.1109/RTEICT.2016.7807772, Publisher: IEEE.

[9] https://insights.sei.cmu.edu/blog/cybersecurity-of-quantum-computing-a-new-frontier/

[10] https://medium.com/@marekkowalik97/quantum-machine-learning-for-cybersecurity-part-1-7c638c4da98

[11] K.V. Sandeep *et.al.*, "A Novel Mechanism for Design and Implementation of Confidentiality in Data for the Internet of Things with DES Technique," 2022 Sixth International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), Institute of Engineering, Tribhuvan University, Purwanchal Campus, Dharan, Nepal, 10-12 November 2022, pp. 106-110, https://doi.org/10.1109/I-SMAC55078.2022.9987268

[12] Shobha A.S., *et.al.*, "Design & development of transmitted & encrypted datas using SDN and energy self-healing concepts used in RF energy harvesting wireless sensor nets," 2022 Third International Conference on Intelligent Computing Instrumentation and Control Technologies (ICICICT), Vimal Jyothi Engineering College, Kannur, India, 11-12 August 2022, pp. 686-689, https://doi.org/10.1109/ICICICT54557.2022.9917923

[13] K.M. Arunkumar and *et.al.*, "Bearing fault diagnosis through vibration signals utilizing J-48 Decision Tree Algorithm," 2018 3rd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), Sri Venkateshwara College of Engineering, Bangalore, India, 18-19 May 2018, paper id 1004, pp. 1628-1632, https://doi.org/10.1109/RTEICT42901.2018.9012608

[14] K.M. Arunkumar *et.al.*, "Design of controllers for bearing faults," 2018 3rd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), 2018 3rd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), Sri Venkateshwara College of Engineering, Bangalore, India, 18-19 May 2018, paper id 1003, pp. 1633-1637, https://doi.org/10.1109/RTEICT42901.2018.9012642

[15] Mahesh B. Neelagar & *et.al.*, "Convolutional Neural Network Based Glaucoma Detection and Classification using Optic Disc Localization," Second IEEE International Conference on Integrated Circuits and Communication Systems (ICICACS), HKE Society's SLN College of Engineering, Raichur, India, pp. 1-5, 23-24 February 2024, Electronic ISBN:979-8-3503-1755-8, Print on Demand (PoD) ISBN:979-8-3503-1756-5. https://doi.org/10.1109/ICICACS60521.2024.10498855

[16] S. Karthikeyan, M. Akila, D. Sumathi, T.Poongodi, "Quantum Machine Learning - AModern Approach", CRC Press, 2024