

SOLAR BASED E-UNIFORM FOR SOLDIERS

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in
Electrical and Electronics Engineering

by

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**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **M.SHIVA** (Reg. No. 39140704) and **A.VIGNESH** (Reg. No. 39140701) who carried out the project entitled **"SOLAR BASED E-UNIFORM FOR SOLDIERS"** under our supervision from October 2022 to April 2023.

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ABSTRACT

Climate change is difficult to predict in the current state of global scenarios. It is slightly uncomfortable for ordinary people, but it is extremely difficult for soldiers to live in unpredictable climatic conditions. Soldiers risk their lives to protect our country, and this solar-powered climate-adjustable E uniform shields them from harsh weather. Depending on the weather, this E uniform provides them with warmth or coolness. This project operates in two modes: summer and winter. Uniforms can drive the body temperature with the Peltier module by selecting the mode of operation. Military uniforms are designed to meet a variety of soldier needs, including environmental protection. Traditional military clothing, on the other hand, may not help control body temperature in adverse weather situations. As a result, this study offers a solar-powered temperature-controlled e-uniform for soldiers to use to maintain their body temperature in a variety of weather circumstances. A temperature sensor, a microcontroller, a power supply, and heating and cooling devices comprise the e-uniform. The temperature sensor measures the soldier's body temperature, and the microcontroller determines whether heating or cooling is required based on the temperature measurements. The e-power uniform's supply will be solar-powered, making it appropriate for usage in rural areas with limited access to energy. The heating and cooling elements will be triggered based on the microcontroller's signals. The e-uniform will be lightweight, long-lasting, and comfortable for soldiers. The technical details of the solar-powered temperature-controlled e-uniform, including the design, operating principle, and benefits, are covered.

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LIST OF SYMBOLS AND ABBREVIATIONS

RF	-	Radio Frequency
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
DC	-	Direct Current
AC	-	Alternating Current
CPU	-	Central processing unit
MPU	-	Micro processor unit
MCU	-	Multipoint control unit

CHAPTER - 1

INTRODUCTION

1.1 GENERAL

Warriors are the Army's most imperative asset. Warriors assume an important part to make sure one's nation. The term warriors incorporate administration men and ladies from the military, Air Force, Navy, and Marine. While giving security to the country, they could challenge inconveniences in hot/frosty climate conditions. Both exceptionally hot and icy temperatures might be unsafe for well-being. This venture may be a solution for this circumstance. During this venture, an E-Uniform is planned which provides better security to the officers who are working in great climate conditions. A temperature sensor is employed to see the temperature whenever. The DHT11 is a circuit temperature sensor, whose yield voltage is directly relative to the Celsius (Centigrade) temperature. Solar-based E-Uniform furnished with better protection to the soldiers who are working in extreme weather. Solar Panels are wont to power up the interior circuitry of the E-uniform. A 12 V DC lead-acid rechargeable battery is employed for storing the energy.

For supplying power to the circuitry, a typical battery charging machine is used. ATmega16a microcontroller is the heart of the circuit as it controls all the functions. The project is operated in two modes like summer mode and winter mode. By selecting the mode of operation, we are operating the system such that it can drive the body temperature according to heater/cooler. The heater/cooler in turn will help us to provide a cooling or warming effect inside the uniform which helps the soldier to bear any kind of external environment. The metal sensor will detect the metal-like bomb, any other planted weapon in the ground and intimate the soldier with a buzzer indication. This Uniform will make the soldier work in any kind of environment without any stress or distraction. Warriors are the Army's most imperative asset. Warriors assume an important part to make sure one's nation.

A temperature sensor is employed to see the temperature whenever. The DHT11 is a circuit temperature sensor, whose yield voltage is directly relative to the Celsius (Centigrade) temperature. In this project, an E Uniform is designed that gives more confidence to the fighters operating in wonderful weather. This uniform will make the trooper stand out in any setting. Here, solar panels are being used to control the temperature

within the hardware of the E-uniform. A 12 V DC lead corrosive rechargeable battery is employed for putting away the vitality. A routine battery charging unit is utilized additionally to offer supply to the hardware. A temperature sensor and heart beat sensor utilized for checking the wellbeing of the trooper in any circumstance. ATmega16a miniaturized scale controller is the heart of the circuit because it controls all of the capacities. The undertaking system is worked in two modes: summer mode and winter mode.

The warmer/cooler will help to offer chilling or warming impact inside the uniform which helps the officer to face any kind of outer environment and he can work proficiently without warmth stress or frosty anxiety. A 12 V DC lead corrosive rechargeable battery is employed for putting away the vitality. A standard battery charging unit is utilized likewise to offer supply to the hardware. Soldiers are one of the important factors in a country because they are the forces who protect our country day and night living behind sleep and rest. Solar based E-Uniform provides better protection to the soldiers who add extreme weather. This Uniform made the soldier work in any kind of environment. So, he could work efficiently without heat stress or cold stress. When the weather is too hot, the cooling system kicks in, and when it's excessively cold, the warming system kicks in. Significantly fewer soldiers will die as a result of its adverse consequences (low commando at the border). This initiative is extremely important to our daily lives. Additionally, it may be used in a wide range of industrial applications.

CHAPTER – 2

LITERATURE SURVEY

Solar Based E-Uniform for Soldiers by Dipali H. Kale. Solar-based E-Uniform furnished with better protection to the soldiers who are working in extreme weather. Solar Panels are wont to power up the interior circuitry of the E-uniform. A 12 V DC lead-acid rechargeable battery is employed for storing the energy. We are using a conventional battery charging unit also for giving supply to the circuitry. ATmega16a microcontroller is the heart of the circuit as it controls all the functions. The project is operated in two modes like summer mode and winter mode. By selecting the mode of operation, we are operating the system such that it can drive the body temperature according to heater/cooler. The heater/cooler in turn will help us to provide a cooling or warming effect inside the uniform which helps the soldier to bear any kind of external environment. In this undertaking, we are getting to plan an E Uniform which provides better assurance to the fighters who are working in amazing weather. This Uniform will make the trooper figure in any kind of environment. Here we are utilizing Solar Panels to regulate up within the hardware of the E-uniform. A 12 V DC lead corrosive rechargeable battery is employed for putting away the vitality. We are utilizing a routine battery charging unit additionally to offer supply to the hardware. A temperature sensor and heartbeat sensor utilized for checking the wellbeing of the trooper in any circumstance. ATmega16a miniaturized scale controller is the heart of the circuit because it controls all of the capacities. The undertaking system is worked in two modes: summer mode and winter mode. By selecting the tactic of operation, we are performing on the H-Bridge IC such that it can drive the body radiator/cooler. The warmer/cooler this will help us to offer chilling or warming impact inside the uniform which helps the officer to face any kind of outer environment and he can work proficiently without warmth stress or frosty anxiety.

Solar based E-uniform for soldiers Assist.prof.Sridevi S.H. Solar based E-Uniform gives better protection to the soldiers who work in extreme weather conditions. Solar Panels are used to power up the internal circuitry of the E uniform. The energy is stored by using a 12VDC lead acid rechargeable battery. A conventional battery can also be used as a charging unit. LPC2148 microcontroller controls all the functions. A voltage sampler is

interfaced with the system using ADC to get the voltage generated from the battery as a display on a 16X2 LCD. In this paper we have designed an E-Uniform which gives better protection to the soldiers who work in extreme weather conditions. This Uniform will facilitate the soldier to work in any kind of environment. A jacket is mounted with the circuit which is operated in summer mode and winter mode. By selecting the mode of operation, we operate the H-Bridge IC so that it can drive the body heater/cooler. The heater/cooler in turn will help us to provide a cooling or warming effect inside the uniform which helps the soldier to bear any kind of external environment. The metal sensor detects the metal like bomb and intimate the soldier with a buzzer indication. This Uniform will make the soldier work in any kind of environment. So, he can work efficiently without heat stress or cold stress. Officers are one of the imperative components in a nation. Since they are the strengths who secure our nation day and night living behind rest and rest. In this manner it is our obligation to ensure them. Same is the centrality of this undertaking. So here outline an E Uniform which gives better insurance to the warriors who are working in compelling climate conditions. This venture is worked in two modes: summer mode and winter mode. In the event that the climate condition is excessively hot then the cooling framework will work and in the event that it is excessively cool then the warming framework will work.

Design and fabrication of solar based E-jacket for soldiers: Rahul Khairamode. In every year we are facing several patterns of climates, the summer season, rainy season and winter seasons are the main. Temperatures that are very high and very low are both hazardous to health. "Too much exposure to heat is called heat stress as well as excessive too much cold is called "cold stress". At a very high temperature the most serious problem is heatstroke. In extreme cold, the most serious trouble is the risk of dehydration or dangerously cold bodies. Here we will design an E-Jacket for better protection for people living in "highest outlook" situations. GPS module also used in this jacket, for spot the location. Soldiers play an important role in the defense of a country. Soldiers will be constantly on duty in extreme weather conditions. While keeping our nation safe, they are facing problems in extreme changing weather conditions. Each temperature, especially hot and cold, presents a physical risk. In a very hot environment, the hardest challenge is heatstroke. In extremely cold temperatures, a critical situation is a risk of hypothermia or a very cold frame is at risk. In this mission, we have developed electronic uniforms to provide better security for infantry soldiers operating in extreme weather conditions. This challenge offers heat and cool mode. By choosing, operating way, the switches control heating/cooling

of the E-Jacket. This solar based E-Jacket for soldiers will assist us to give warm and cool effects, so that fighter can survive any form of exterior surroundings.

Electronic-Jacket : Abhinav Maheshwari In a global scenario, the prime question in every girl's mind is about her safety and the harassment issues. The only thought haunting every girl is when they will be able to move freely on the streets even in odd hours without worrying about their security. This project suggests a new technology to protect women. This project focuses on security for women so that they will never feel helpless. The system consists of various modules such as GSM, GPS, memory card, shock circuit, buzzer, camera, Raspberry pi-3 module. Today there are many cases which are happening about women. It was high time where women needed a change. This project is based on women security where women feel protected. This paper describes a safety electronic system for women, built in public transport vehicles such as cars, buses and auto-rickshaws as nowadays women are being molested, kidnapped and harassed by the drivers. The term soldiers include service Men and women from the Army, Air Force, Navy and Marines. They will always be the one responsible for taking and holding the duty in Extreme weather conditions throughout the year. While providing security to the nation, they may face troubles in extreme hot or cold weather conditions. Both very hot and cold temperatures could be dangerous to health. In this paper an E-Uniform is designed which gives better protection to the soldiers who are working in extreme weather conditions. Temperature sensor is used for checking the 2. In this paper an E-Uniform is designed which gives better protection to the soldiers who are working in extreme weather conditions. Temperature sensor is used for checking the temperature at any time. The LM35 is a precision circuit temperature sensor, whose output voltage is linearly proportional to the Celsius temperature. Sensor gives the analog voltage which is converted into digital by using ADC in the Arduino. These digital values are checked with the heat and cold threshold level. If the temperature is more than the heat threshold, the cooler and fan will be activated. If the temperature is less than the cold threshold, the heater and fan will be activated and values of temperature are displayed in the LCD. Solar panels are used to provide supply to internal circuits. Metal detector is used to detect the metal objects and produce buzzers. The following sections we will present the block diagram, description usage followed by conclusion. Soldiers are one of the imperative components in a nation. Since they are the strengths who secure our nation day and night living behind rest and rest. An E- Uniform gives better insurance to the warriors who are working in compelling conditions. This is

worked in two modes: summer mode and winter mode. In the event that the climate condition is excessively hot then the cooling framework will have worked and in the event that it is excessively cool then the warming framework will have worked.

Climate adjustable E-military suit Dr. S.Ramesh. Nowadays, the climatic changes are very annoying and unusual to the people. In order to overcome this problem, air-conditioners were introduced. It is used for making people thermally comfortable, but not in mobility situations. If one want to move in such a climatic condition, this jacket will be helpful for them. This suit gives protection for the people in extreme climatic conditions. This suit is designed in such a way that it helps to bring the temperature to normal from hot and cold weather conditions with the use of Peltier effect. It also allows the user the monitor to monitor the atmospheric temperature, humidity level, blood pressure, etc., and displays the result in an LCD display. In the market, there is a suit which is made up of mechanical and gripping devices. The suit consists of pumps and radiator for providing cooling and heating facilities. So the suit cost is very high. Both very hot and cold temperature could be dangerous for health. In very hot environment there is a risk of getting a heat stroke as well as in very cold temperature there is a risk of hypothermia or dangerous of overcooling the body. The soldiers play a major role in the protection of one's country. They will be working in extreme weather conditions. While providing security for the country they face many health problems in that extreme weather condition. In order to overcome this problem of extreme climatic condition we have introduced an E-suit that controls the extreme weather and makes the soldier more comfortable in that climatic condition. The suit is flexible to wear, convenient and even light in weight. It is also designed with the display so that the soldier can also monitor the temperature in the atmosphere. And if the temperature is abnormal in the atmosphere, the suit turns on the peltier plate. A peltier plate is one that gets thermally heated and cooled on the either sides of it when electric current is given to it. This effect is called as Peltier effect. By this paper we can help the soldiers to work in extreme weather conditions. Through this idea, the body temperature can be continuously monitored with the help of a temperature sensor. In case of occurrence of any abnormal temperature, the sensor detects it and ultimately sends the information to the doctor.

Electronic Jacket using Arduino for a Person Working in Extreme Weather Condition Shivganga Indi. The purpose behind developing the "Electronic Jacket using Arduino for a person working in extreme weather conditions" is the people who are staying or living in extreme weather conditions. The climatic change that is hot and cold temperature conditions are dangerous to the health of those people. Excessive exposure to heat causes serious problems like heat stroke. At very cold temperature, the most serious problem is the risk of hypothermia or overcooling body. So, we have designed a jacket named as "Safety purpose jacket using Arduino" which gives better protection to the people who living in such tough weather conditions and the main objective behind developing this jacket is for safety of military people because they have a huge risk on their lives while working in such extreme weather conditions. The cold and hot climate conditions in the high north represents, Threat of safety and work performance of soldiers or a common person. The jacket will provide better protection to them and it will help to reduce loss of human life. In addition to that if the person is not feeling well that person can press the switch so that the concerned person will get a message so the threat of safety will be reduced. By using this jacket, the user can control and monitor the internal temperature inside the jacket by using a fan and heater mounted within the jacket. It consists of a temperature sensor to detect the temperature, panic switch, battery and GSM modules are also used in this jacket to send messages by soldiers or a common man to concerned one . All these devices are controlled by Arduino. We are using a heating pad for heating purposes. This information of temperature sensor can be used in enhanced safety and as an improved tool to advise outdoor work control for soldiers or a common man in climate conditions. So that the specially designed "Safety purpose Jacket using Arduino" will give better protection to the person who is working in extreme weather conditions. Project aims to keep up the specific temperature in the jacket, so that person will not face the heatstroke or overcooling of the body. It initiates the fan and heater that is placed inside the jacket as per temperature sensed by LM35. This jacket gives better protection and safety to the soldiers or a person who is working in extreme weather conditions. The person or soldiers have to work in extreme weather conditions; they are always ready for their duties no matter how tough the conditions are. All common people or the civil person and some scientists also who are living in extreme weather conditions are important so this project has been implemented to secure a person's life who is sacrificing all the things to save our nation, Life. This system is designed to give protection and increase work efficiency of the person. The main controller is

Arduino Uno which controls the fan and heater as per temperature and also checks the status of the panic switch. If it is pressed it will send a message to the concerned person to avoid a panic situation. In this paper we have included a block diagram of the system with operation. This system is very useful and will make it easy for the soldier, scientist or the common person to survive and perform his or her duties in such harsh climatic conditions. This jacket is useful for the soldiers, scientists and other civil people who are living in extreme weather conditions. Such as when the climatic condition is extremely hot then the cooling system will work and when the climatic condition is extremely cool then the heating system will work.

Solar based E-Uniform for Soldiers: Maneesh Kumar Srivastava. Everything around us is equipped with technologies and we are desperately trying to run these with clean energy. But the thought of making bullet proof jackets smart never occurs to mind. Soldiers who protect our country must not only be given a simple kevlar vest but an E-Uniform which runs on clean energy. In this research paper, such a uniform is proposed. The uniform gives soldiers better protection as well as resistance towards heat and cold in extreme weather conditions. It is equipped with a solar panel that charges the battery. The peltier plate installed gives the cooling and heating effect required. The uniform also has GPS for accurate location of soldiers and GSM for contacting the soldier. It also has a metal detector for detecting land mines. Keywords: Kevlar, Peltier plate, GPS, GSM, Metal Detector. Soldiers are the most important resource of a country. They protect its people and come to aid whenever called upon. They are always ready to perform their duties no matter how harsh the conditions are. The soldiers sacrifice many things for their country. There are many problems the soldier may face during his/her deployment. The Soldier may get lost or abducted by enemies or may need to contact the army or base. At very low temperatures one of the major problems is the risk of hypothermia. Also the soldier may get contact with a landmine. Hence the soldiers must be well equipped with technology. The specially designed uniform will give protection as well as resistance towards heat and cold. There is a set threshold value according to which the peltier plate provides cooling and heating effects. The temperature sensor used here is LM35 which is a precision circuit temperature sensor whose output voltage is linearly proportional to Celsius temperature. Sensor provides the analog value which is converted into digital format by using ADC in the Arduino. The Arduino is present as a microcontroller which is the most important part of the uniform. The Arduino makes the embedded system complete. The various sensors

present provide value to the microcontroller which gives instructions to the peltier plate, GPS, GSM etc. The solar panel provides clean energy to run the embedded system. A 12 volt DC lead acid rechargeable battery is used for storing the energy. A conventional battery charging unit is used for giving supply to the circuitry. The system operates in summer mode or winter mode. The temperature sensor detects the outside temperature which helps in deciding the mode. The H-Bridge IC is operated such that it can drive the heater/cooler according to the mode. The metal detector will detect any metal like bomb and intimate the soldier with a buzzer indication. The uniform will make it easy for the soldier to survive and perform his/her duties in any environment.

E-uniform for soldiers who work at extreme temperature regions Adarsh K S. Soldiers are the Army's most important resource. Soldiers play a vital role to protect one's country. The term soldiers include service men and women from the Army, Air Force, Navy and Marine. While providing security to the nation, they may face troubles in hot/cold weather conditions. Both very hot and cold temperatures could be dangerous to health. In this project we are going to design an E-Uniform which gives better protection to the soldiers who are working in extreme weather conditions. This paper gives two modes summer mode and winter mode. By selecting the mode of operation the relays drive body heater/cooler. The heater / cooler in turn will help us to provide cooling or warming effect inside the uniform which helps the soldier to bear to any kind of external environment and he can work efficiently without heat stress or cold stress. Soldiers are the Army's most important resource. Soldiers play a vital role to protect one's country. The term soldiers include service men and women from the Army, Air Force, Navy and Marine. While providing security to the nation, they may face troubles in hot/cold weather conditions. Both very hot and cold temperatures could be dangerous to health .This project is a remedy for this situation. International Journal of Engineering Research and General Science Volume 3, Issue 3, May-June, 2015 ISSN 2091-2730 994 www.ijergs.org In this project an E-Uniform is designed which gives better protection to the soldiers who are working in extreme weather conditions. Temperature sensor is used for check the temperature at any time. The LM35 is a precision circuit temperature sensor, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. Sensor gives the analog voltage which is converted into digital by using ADC in the PIC microcontroller (PIC16F877A). These digital values are checked with the heat & cold threshold level of temperature. If the temperature is more than the heat threshold, cooler & fan will be activated, timer starts &

status of the system is shown on LCD display. If the temperature is less than the cold threshold, heater & fan will be activated, timer starts & status of the system is shown on LCD display. If the timer exceeds a specified time limit Microcontroller identified that the current system is in failed mode. So it sends a message to the control station as the soldier is in critical condition with his position coordinates obtained from the GPS system. Notifications will be shown in the LCD display. As above the basic platform is PIC16F877A microcontroller IC which is programmed in Micro C. In the circuitry of this project, a power supply system, buzzer for beep sound, LEDs for indicating various conditions, optional keyboard for changing the message receiving number and a router for selecting GPS and GSM service according to the requirements.

Solar Based E-Uniform for Soldiers-Used For Temperature Control And Tracking
M.Sivalingamaiah. Solar based E-Uniform gives better protection to the soldiers who are working in extreme weather conditions. Solar Panels are used to power up the internal circuitry of the E-uniform. A 12 V DC lead acid rechargeable battery is used for storing the energy. We are using conventional battery charging unit also for giving supply to the circuitry. The AT89S52 microcontroller is the heart of the circuit as it controls all the functions. A voltage sampler is interfaced with the system using ADC 0808 to get the voltage generated from battery as a display on a 16X2 LCD. The project is operated in summer mode and winter mode. By selecting the mode of operation, we are operating the H-Bridge IC such that it can drive body heater/cooler. The heater/cooler in turn will help us to provide a cooling or warming effect inside the uniform which helps the soldier to bear any kind of external environment. The metal sensor will detect the metal like bomb and intimate the soldier with a buzzer indication. The GSM is interfaced with the microcontroller and GPS is also interfaced such that the tracking of the entire soldier is observed. And the location is messaged to the particular concern person /dept. This Uniform will make the soldier to work in any kind of environment. Soldiers are the Army's most important resource. Soldiers play a vital role to protect one's country. The term soldiers include service men and women from the Army, Air Force, Navy and Marines. They will always be the one responsible for taking and holding the duty in extreme weather conditions throughout the year. While providing security to the nation, they may face troubles in extreme hot/cold weather conditions. Both very hot and cold temperatures could be dangerous to health. In this project we are going to design an E- Uniform which gives better protection to the soldiers who are working in extreme weather conditions. This paper gives two modes summer

mode and winter mode .By selecting the mode of operation the relays drive body heater/cooler. The heater / cooler in turn will help us to provide cooling or warming effect inside the uniform which helps the soldier to bear to any kind of external environment and he can work efficiently without heat stress or cold stress. The project “Solar based E-Uniform for soldiers who work at extreme high temperature or extreme low temperature with tracking” is successfully tested and implemented. By using this project in real time applications we can help soldiers to work even in extreme climatic applications. It is a highly durable and self-repairing solar technology, ideally suited for mobile applications.

CHAPTER - 3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

3.1 PROBLEM IDENTIFICATION

1. The existing systems don't have functions like cooling and heating.
2. Existing systems like bullet proof jackets provide only safety to bullets. Cost of bullet proof jacket is very high
3. It cannot provide proper protection for soldiers in extreme weather conditions.
4. Soldier uniforms are subjected wear and tear in harsh conditions. Material used is not durable enough.
5. Lack of comfort in the uniform. The materials used in the uniforms may not be stretchable or breathable, which could restrict movement and cause discomfort.
6. Limited flexibility in the uniform. Soldiers need to move quickly and easily, but if the uniform is bulky or restricts movement, it can affect their performance.

3.2 SCOPE OF THE PROJECT

For future expansion, this jacket can easily be powered by a small portable solar panel and make it more eco-friendly. The use of solar panel gives continuous output of power with less maintenance. Humidity sensors, rain drop sensors etc, can also be added for efficient working of jacket, so that these jackets will become wearable in all conditions and in all seasons. We can utilize this jacket to protect us from overheating and over cooling. In the future we can change the type of solar panel type and we can add cooling effect and rain sensor etc. to achieve higher efficiency of E-Jacket. Then we can use it for all weather conditions. The E-Jacket will be helpful to protect ourselves from rapid changing climate

3.3 OBJECTIVE

1. Solar-based E-Uniform furnished with better protection to the soldiers who are working in extreme weather.
2. To provide better protection for soldiers who working at extreme weather conditions.
3. To provide better protection for forest officials and also for people who works in extreme weather conditions.

3.4 FEASIBILITY STUDY AND RISK ANALYSIS

A feasibility study of a solar-based e-uniform for soldiers would need to consider a number of factors to determine whether the project is viable and worth pursuing. Some of the key considerations might include:

1. **Technical feasibility:** The possibility to design a uniform that incorporates solar panels and other electronic components without impeding the soldier's mobility or comfort and kind of battery or energy storage system would be needed to power the electronics, and also the weight that would be add to the uniform. Existing technologies or prototypes can be considered as the foundation for this undertaking project.
2. **Economic feasibility:** The estimated cost of developing and manufacturing the e-uniform, and also need to compare to the cost of existing uniforms and equipment. The potential return on investment of the project should be successful. The cost savings from reduced fuel consumption or other benefits offset the additional costs of the e-uniform.
3. **Environmental feasibility:** The environmental impacts of the e-uniform, both in terms of its production and use should be checked as compared to the environmental impacts of existing uniforms and equipment. The e-uniform should contribute to a reduction in carbon emissions or other environmental benefits.

RISK ANALYSIS:

1. A risk analysis of a solar-based e-uniform for soldiers would need to identify potential risks and their likelihood of occurrence, assess the potential impact of these risks, and develop strategies to mitigate or manage them. Some potential risks to consider might include:
2. **Technical risks:** There may be technical challenges associated with designing and manufacturing the e-uniform, such as integrating solar panels and electronic components in a way that is both effective and durable. The risk of technical failure could lead to soldiers being unable to access critical information or equipment, compromising their safety and mission effectiveness.
3. **Operational risks:** The e-uniform may introduce new operational risks such as

potential for increased weight, reduced mobility and comfort, and increased maintenance requirements. The risk of operational failure could lead to reduced mission effectiveness and could put soldiers in harm's way.

4. **Environmental risks:** Solar panels are vulnerable to damage from the elements and may not work effectively in certain environments, such as in cloudy or low-light conditions. The risk of environmental failure could lead to reduced energy generation and may require additional resources to maintain the system.
5. **Cyber security risks:** Electronic components in the e-uniform may be vulnerable to cyber attacks, which could compromise the security of soldier's data and potentially compromise the mission. The risk of cyber security failure could lead to loss of sensitive information, decreased situational awareness, and reduced mission effectiveness.

3.5 IEEE STANDARDS

IEEE standards specific to solar-based e-uniforms for soldiers. There are a few IEEE standards related to renewable energy and electronic devices that may be relevant to the design and implementation of such a system. Some of these standards include:

IEEE 1547: This standard covers interconnection and interoperability requirements for distributed energy resources, including solar panels. Compliance with this standard could ensure that the e-uniform's solar panels are compatible with existing power grids and other energy systems.

IEEE 802.11: This standard specifies requirements for wireless local area networks (WLANs), which could be used to transmit data from the e-uniform's electronic components to other devices. Compliance with this standard could ensure that the e-uniform's WLANs are secure and reliable.

IEEE 1591: This standard specifies test procedures and performance requirements for portable, rechargeable batteries, which could be used to power the e-uniform's electronic components. Compliance with this standard could ensure that the e-uniform's batteries are safe, reliable, and meet performance requirements.

IEEE 1680: This standard specifies environmental performance requirements for electronic devices, including criteria for energy efficiency, material selection, and end-of-life

management. Compliance with this standard could ensure that the e-uniform's electronic components are environmentally sustainable and meet other performance requirements.

IEEE 2030: This standard covers the integration of renewable energy sources into the power grid, including solar panels. Compliance with this standard could ensure that the e-uniform's solar panels are integrated effectively with other energy systems and can help to reduce the overall carbon footprint of military operations.

While these standards may not be specific to solar-based e-uniforms for soldiers, they could provide guidance for the design and implementation of such a system, and could help to ensure that the e-uniform meets relevant safety, performance, and environmental requirements.

3.6 REQUIREMENTS SPECIFICATION

A requirements specification for a solar-based e-uniform for soldiers would outline the specific functionality and features that the system must have to meet the needs of soldiers in the field. Some of the key requirements that might be included in such a specification could include:

1. Power Generation: The e-uniform must be able to generate sufficient power from its solar panels to power all of the electronic components required for the soldier to perform their mission.
2. Energy Storage: The e-uniform must be able to store energy generated by its solar panels in a battery or energy storage system that is lightweight, durable, and capable of providing power for extended periods of time.
3. Durability: The e-uniform must be designed to withstand harsh environmental conditions, including exposure to water, sand, dust, and extreme temperatures.
4. Mobility: The e-uniform must be designed to allow for full mobility and freedom of movement for the soldier, without hindering their ability to perform their duties.
5. Comfort: The e-uniform must be designed to provide maximum comfort for the soldier, including breathable fabrics and ergonomic designs that reduce the risk of injury or discomfort.

6. Security: The e-uniform must be designed to prevent unauthorized access to its electronic components, and must include features to protect sensitive data and communication.
7. Interoperability: The e-uniform must be able to communicate with other military equipment and systems, including weapons, radios, and command and control systems.
8. Usability: The e-uniform must be designed to be easy to use and intuitive, with a user interface that is simple and easy to navigate.
9. Maintainability: The e-uniform must be designed to be easily maintained and serviced in the field, with modular components that can be replaced quickly and easily.
10. Environmental Sustainability: The e-uniform must be designed to minimize its environmental impact, including through the use of recyclable materials and energy-efficient components.

Overall, a requirements specification for a solar-based e-uniform for soldiers project would need to be comprehensive and detailed, and would require input from a range of stakeholders, including soldiers, military leaders, and technical experts.

3.6.1 Functional Requirements

The functional requirements of a solar-based e-uniform for soldiers describe the specific capabilities and features that the system must have in order to meet the needs of soldiers in the field. Some possible functional requirements for such a system might include:

1. Solar Panel Integration: The e-uniform must be designed to effectively integrate solar panels into the fabric of the uniform, with panels that are durable, flexible, and capable of generating sufficient power to meet the needs of the system.
2. Electronic Component Integration: The e-uniform must be designed to integrate electronic components, such as sensors, communication devices, and displays, into the uniform in a way that is ergonomic, secure, and allows for full mobility.
3. Energy Storage: The e-uniform must include a battery or other energy storage system that is lightweight, durable, and capable of storing sufficient energy to power the electronic components of the system for extended periods of time

4. Power Management: The e-uniform must include a power management system that is able to optimize the use of energy generated by the solar panels and stored in the battery, to ensure that power is available when and where it is needed.

5. Communication: The e-uniform must include a communication system that is capable of transmitting and receiving data, including voice, video, and text, between soldiers and with command and control systems.

6. Navigation: The e-uniform must include a navigation system that is capable of providing soldiers with real-time location data, as well as mapping and routing information.

3.6.2 Non-Functional Requirements

Non-functional requirements for a solar-based e-uniform for soldiers describe the qualities and characteristics that the system must have in addition to its functional requirements. These requirements may relate to the system's performance, reliability, security, and other aspects that are critical for ensuring the system's overall success. Some possible non- functional requirements for such a system might include:

1. Reliability: The e-uniform must be reliable, with components that are designed to withstand harsh environmental conditions, including extreme temperatures, moisture, and dust.

2. Security: The e-uniform must be secure, with features that protect the electronic components from unauthorized access, and that prevent the transmission of sensitive data over unsecured networks.

3. Scalability: The e-uniform must be scalable, with components that can be easily added or removed as needed to accommodate changes in mission requirements.

4. Performance: The e-uniform must perform well, with sensors and other components that are accurate and responsive, and that provide soldiers with the information they need to perform their duties effectively.

5. Usability: The e-uniform must be easy to use, with controls and displays that are intuitive and easy to understand.

3.6.3 Constraints

Constraints for a solar-based e-uniform for soldiers are limitations and restrictions that must be taken into account when designing and developing the system. These constraints may relate to technical, environmental, or other factors that can impact the performance and effectiveness of the system. Some possible constraints for such a system might include:

1. **Weight and Size:** The e-uniform must be lightweight and compact, as soldiers must carry all of their equipment with them in the field. The additional weight and bulk of the e-uniform could impact soldier's mobility and endurance, so it must be designed to minimize its size and weight
2. **Durability:** The e-uniform must be durable and able to withstand the rigors of military use, including exposure to extreme weather conditions, physical stress, and other factors that can cause damage to the system.
3. **Power Limitations:** The amount of power that can be generated by the solar panels and stored in the battery is limited, so the e-uniform must be designed to operate within these limitations. This may require careful management of power usage and optimization of the system's energy efficiency.
4. **Compatibility with Existing Systems:** The e-uniform must be compatible with other military equipment and systems, including weapons, communication devices, and sensors. This may require the use of standard interfaces and protocols to ensure seamless integration.
5. **Security:** The e-uniform must be designed to prevent unauthorized access to sensitive data, including location data and communication with command and control systems. This may require the use of encryption and other security measures.
6. **Cost:** The cost of designing, developing, and producing the e-uniform must be taken into account, as military budgets are often limited. This may require the use of cost-effective materials and components, as well as efficient manufacturing processes.

3.6.4 Prerequisites

Solar based e-uniforms for soldiers would require a range of technological and logistical prerequisites to be feasible and effective.

Some of these prerequisites might include:

1. **Efficient solar panel technology:** The solar panels used in the e-uniforms would need to be highly efficient, lightweight, and flexible, so that they could be integrated into the fabric of the uniform without weighing down the soldier or restricting their movement.
2. **Energy storage:** A reliable and efficient energy storage system would be needed to store the energy generated by the solar panels during the day, so that it could be used to power the uniform's electronic components at night or in low light conditions.
3. **Durability:** The e-uniforms would need to be highly durable and able to withstand the wear and tear of combat situations, as well as exposure to the elements.
4. **Integration with existing systems:** The e-uniforms would need to be seamlessly integrated with existing military communications and navigation systems, so that soldiers could stay connected and navigate in challenging environments.
5. **Training and support:** Soldiers would need to be trained in the use of the e-uniforms and provided with ongoing technical support, to ensure that the technology was used effectively and maintained properly.
6. **Cost-effectiveness:** The cost of developing and implementing the e-uniform technology would need to be weighed against its potential benefits in terms of improved soldier performance, energy efficiency, and reduced logistical burden.

3.6.5 Assumptions

The assumptions of solar based e-uniforms for soldiers would depend on the specific design and implementation of the technology. However, some potential assumptions might include:

1. **Sufficient sunlight:** The solar panels integrated into the e-uniforms would assume a sufficient amount of sunlight exposure to generate the necessary energy to power the electronic components of the uniform.
2. **Limited power demand:** The electronic components of the e-uniforms would assume a relatively low power demand, so that the energy generated by the solar panels and stored

in the battery would be sufficient to power the uniform for an extended period.

3. Effective energy storage: The battery or energy storage system would assume an effective energy storage capacity, so that the energy generated by the solar panels could be stored and used as needed to power the electronic components of the uniform.

CHAPTER - 4

EXPERIMENTAL METHODS

4.1 METHODOLOGY

We use solar panels to generate the needed energy and rechargeable batteries to store the energy. In this project, we design and develop an E-Uniform for soldiers to avoid the problems they face due to extreme hot and cold weather conditions during their working time. We have designed two mode switching operations. Heat and cool operations. Peltier plate provides heat and cool effects respectively. The heating and cooling effect is useful to provide a cool and warm effect inside the E-Uniform. This makes it possible for the soldier to endure all kinds of outdoor environments. In this project, we are using a pulse oximeter that measures pulse and bloodpressure. DHT11 is used to know the surrounding temperature.

The methodology for developing a solar-based e-uniform for soldiers would typically involve several key stages, including:

1. **Needs assessment:** The first step would be to assess the needs and requirements of soldiers in the field, to determine what types of electronic components would be most useful in an e-uniform, as well as the specific energy demands and logistical requirements of the technology.
2. **Concept development:** Based on the needs assessment, a team of engineers and designers would develop a concept for the e-uniform, including the types of electronic components to be integrated, the design of the solar panels, and the energy storage and management system.
3. **Prototype design:** Using computer-aided design (CAD) software and other modeling tools, the team would develop a prototype of the e-uniform, which would include detailed designs for the solar panels, electronic components, and energy storage and management system.
4. **Prototype testing:** The prototype would then be tested under a range of conditions to assess its functionality and durability, including exposure to sunlight, high and low temperatures, and wear and tear in combat situations.

5. **Refinement and optimization:** Based on the results of prototype testing, the team would refine and optimize the design of the e-uniform, making adjustments to the solar panel technology, energy storage and management system, and other components to improve performance and durability.
6. **Field testing:** Once a refined prototype has been developed, it would undergo extensive field testing in real-world military environments, with feedback and input from soldiers who would use the technology in the field.
7. **Iterative design and testing:** Based on the results of field testing, the team would continue to refine and optimize the design of the e-uniform, making adjustments and improvements based on real-world feedback and testing.
8. **Implementation:** Once the e-uniform has been successfully developed and tested, it could be implemented on a larger scale, with training provided to soldiers on how to use the technology effectively in the field.
9. Throughout the development process, the team would need to consider factors such as cost-effectiveness, safety, and environmental impact, as well as logistical considerations such as maintenance and repair requirements. Effective collaboration between engineers, designers, military personnel, and other stakeholders would be essential for the successful development and implementation of solar-based e-uniforms for soldiers.

4.2 EXISTING SYSTEM

Warriors are the Army's most imperative asset. Warriors assume an important part to make sure one's nation. The term warriors incorporate administration men and ladies from the military, Air Force, Navy, and Marine. While giving security to the country, they could challenge inconveniences in hot/frosty climate conditions. Both exceptionally hot and icy temperatures might be unsafe for well-being. Normally they use woolen sweaters in winter and in summer they don't have another choice they must wear the uniform. So to avoid the problem proposed method is implemented.



FIG 4.1 Soldier Suit

4.2.1 Disadvantages

1. Existing systems don't have functions like cooling and heating.
2. Existing systems like bullet proof jackets provide only safety to bullets and It cannot provide proper protection for soldiers in extreme weather conditions.
3. Cost of bullet proof jackets is very high.

4.3 PROPOSED SYSTEM

1. In the proposed method we are using a Temperature sensor which is interfaced with the Arduino controller.
2. Firstly, Solar panels are going to absorb solar energy and convert it into electrical energy.
3. Converted energy is going to charge the battery. Then system is going to turn on.
4. And the temperature sensor is going to sense the temperature and send information to the arduino.
5. Peltier Module gets signals from Arduino whether the temperature is hot or cool based on that peltier module provides heat or cooling to the person.

6. This project is worked in two modes, summer mode and winter mode. When the climate is hot then cooling framework will work, when it is cool then heating framework will be worked.

4.3.1 BLOCK DIAGRAM

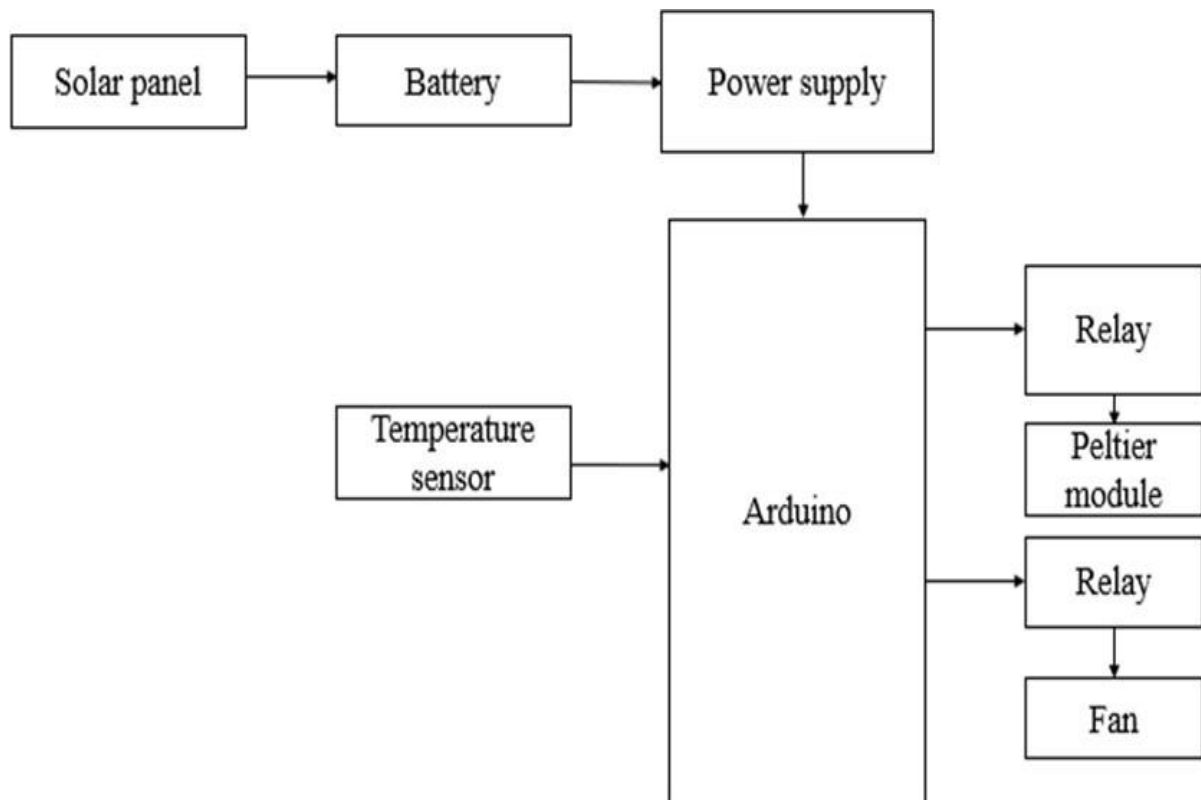


FIG 4.2 Block Diagram of Proposed System

4.3.2 ADVANTAGES

1. Fit and overlook framework
2. Operate and monitor from anywhere.
3. This system can operate and be utilized from the
4. natural power supply.
5. This System is easy to use and Timeless.
6. The system can give the alert of critical conditions

4.3.3 APPLICATIONS

1. For Soldiers at Border
2. For Forest employees

4.4 ALGORITHM

1. Measure the heat generated by the soldier's body and the ambient temperature.
2. Calculate the temperature difference between the body and the ambient temperature.
3. Determine the required cooling power based on the temperature difference and the surface area of the body that needs to be cooled.
4. Use solar panels to generate electricity to power the cooling system. The solar panels should be mounted on the uniform in a way that maximizes exposure to sunlight.
5. Use a thermoelectric cooling module to transfer heat from the body to a heat sink. The heat sink can be cooled by a fan or by natural convection.
6. Use a control system to regulate the cooling power based on the temperature difference and the power output of the solar panels.
7. Monitor the temperature of the body and the heat sink and adjust the cooling power as necessary.

4.5 HARDWARE IMPLEMENTATION

4.5.1 EMBEDDED SYSTEMS

Overview of embedded systems An embedded system is a special-purpose computer system designed to perform one or a few dedicated functions, often with real-time computing constraints. It is usually embedded as part of a complete device including hardware and mechanical parts. In contrast, a general-purpose computer, such as a personal computer, can do many different tasks depending on programming. Embedded systems have become very important today as they control many of the common devices we use. 27 Since the embedded system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product, or increasing the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale. Physically, embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure. In general, "embedded system" is not an exactly defined term, as many systems have some element of programmability. For example, Handheld computers share some elements with embedded systems — such as the operating systems and microprocessors which power them — but are not truly embedded systems, because they allow different applications to be loaded and peripherals to be connected. Embedded systems provide several functions Monitor the environment; embedded systems read data from input sensors. Embedded systems typically execute applications such as control laws, finite state machines, and signal processing algorithms. These systems must also detect and react to faults in both the internal computing 7 environment as well as the surrounding electromechanical systems. There are many categories of embedded systems, from communication devices to home appliances to control systems. Examples include;

Communication devices

e.g.: modems, cellular phones, Home Appliances

e.g.: CD player, VCR, microwave oven Control Systems

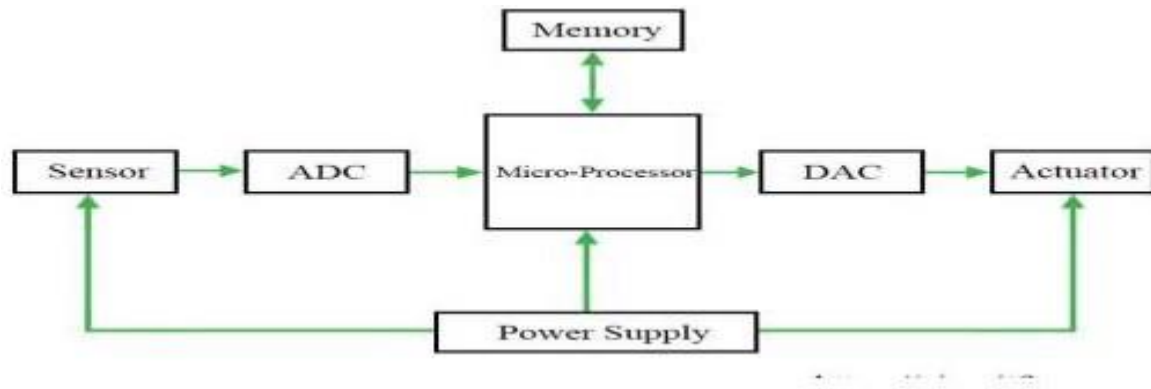


FIG 4.3: Block Diagram of Embedded System

Block diagram of an embedded system

Characteristics of embedded systems

Embedded systems are characterized by a unique set of characteristics. Each of these characteristics imposed a specific set of design constraints on embedded systems designers. The challenge to designing embedded systems is to conform to the specific set of constraints for the application.

Application Specific Systems

Embedded systems are not general-purpose computers. Embedded system designs are optimized for a specific application. Many of the job characteristics are known before the hardware is designed. Some embedded systems, however, require the flexibility of reprogram ability. Systems with this requirement must often design to worst case performance. But accurately predicting the worst case may be difficult on complicated architectures. 29 This often leads to overly pessimistic estimates erring on the side of caution. Many embedded systems have a significant requirement for real time operation in order to meet external I/O and control stability requirements. Many real-time systems are also reactive systems.

Distributed Systems: A common characteristic of an embedded system is one that consists of communicating processes executing on several CPUs or ASICs which are connected by communication links. The reason for this is the economy. Economical 4 8-bit microcontrollers may be cheaper than 32-bit processors. Even after adding the cost of the communication links, this approach may be preferable

Embedded systems also have tight design constraints, and heterogeneity provides better design flexibility.

4.5.2 POWER SUPPLY

In a solar-based uniform cooling system for soldiers, the power supply is provided by the solar panels and battery. Here's how it works:

Solar Panels: Solar panels are used to convert sunlight into electrical energy. The amount of power generated by the solar panels depends on the amount of sunlight available and the efficiency of the solar cells.

Battery: A battery is used to store the electrical energy generated by the solar panels. The battery can be used to power the cooling system even when there is little or no sunlight. The size of the battery depends on the cooling requirements and the expected duration of use.

Power Management System: A power management system is used to regulate the power flow between the solar panels, battery, and cooling system. The power management system can also prevent overcharging and overheating of the battery.

Cooling System: The cooling system is powered by the battery and/or the solar panels. The amount of power required by the cooling system depends on the cooling requirements and the design of the system.

4.6 HARDWARE DESIGN

4.6.1 ARDUINO

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the microcontroller into a more accessible package. What does it do? The Arduino hardware and software was designed for artists, designers, hobbyists, hackers, newbies, and anyone interested in creating interactive objects or environments. Arduino can interact with buttons, LEDs, motors, speakers, GPS units, cameras, the internet, and even your smart-phone or your TV! This flexibility combined with the fact that the Arduino software is free, the hardware boards are pretty cheap, and both the software and hardware are easy to learn has led to a large community of users who have contributed code and released instructions for a huge variety of Arduino-based projects. For everything from robots and a heating pad hand warming

blanket to honest fortune telling machines, and even a Dungeons and Dragons dice-throwing gauntlet, the Arduino can be used as the brains behind almost any electronics project.

There are many varieties of Arduino boards (explained on the next page) that can be used for different purposes. Some boards look a bit different from the one below, but most Arduino have the majority of these components in common.

➤ **Power (USB / Barrel Jack)**

Every Arduino board needs a way to be connected to a power source. The Arduino UNO can be powered from a USB cable coming from your computer or wall power supply that is terminated in a barrel jack. In the picture above the USB connection is labeled (1) and the barrel jack is labeled. NOTE: Do NOT use a power supply greater than 20 Volts as you will overpower (and thereby destroy) your Arduino. The recommended voltage for most Arduino models is between 6 and 12 Volts Pins (5V, 3.3V, GND, Analog, Digital, PWM, AREF) The

pins on your Arduino are the places where you connect wires to construct a circuit (probably in conjunction with a breadboard and some wire. They usually have black plastic 'headers' that allow you to just plug a wire right into the board. The Arduino has several different kinds of pins, each of which is labeled on the board and used for different functions.

- **GND (3)** : Short for 'Ground'. There are several GND pins on the Arduino, any of which can be used to ground your circuit.
- **5V (4) & 3.3V (5)**: As you might guess, the 5V pin supplies 5 volts of power, and the 3.3V pin supplies 3.3 volts of power. Most of the simple components used with the Arduino run happily off of 5 or 3.3 volts.
- **Analog (6)**: The area of pins under the 'Analog In' label (A0 through A5 on the UNO) are Analog In pins. These pins can read the signal from an analog sensor (like a temperature sensor) and convert it into a digital value that we can read.
- **Digital (7)**: Across from the analog pins are the digital pins (0 through 13 on the UNO). These pins can be used for both digital input (like if a button is pushed) and digital output.

- **PWM (8):** You may have noticed the tilde (~) next to some of the digital pins (3, 5, 6, 9, 10, and 11 on the UNO). These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM).
- We have a tutorial on PWM, but for now, think of these pins as being able to simulate analog output (like fading an LED in and out). 13
- **AREF (9):** Stands for Analog Reference. Most of the time you can leave this pin alone. It is sometimes used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

➤ **Reset Button**

Just like the original Nintendo, the Arduino has a reset button (10). Pushing it will temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino. This can be very useful if your code doesn't repeat, but you want to test it multiple times. Unlike the original Nintendo however, blowing on the Arduino doesn't usually fix any problems.

➤ **Power LED Indicator**

Just beneath and to the right of the word "UNO" on your circuit board, there's a tiny LED next to the word 'ON' (11). This LED should light up whenever you plug your Arduino into a power source. If this light doesn't turn on, there's a good chance something is wrong. Time to re-check your circuit!

➤ **TX RX LEDs**

TX is short for transmit, RX is short for receive. These markings appear quite a bit in electronics to indicate the pins responsible for serial communication. In our case, there are two places on the Arduino UNO where TX and RX appear – once by digital pins 0 and 1, and a second time next to the TX and RX indicator LEDs (12). These LEDs will give us some nice visual indications whenever our Arduino receives or transmitting data (like when we're loading a new program onto the board).

➤ ARDUINO UNO AND ITS PROGRAMMING

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer.

➤ Overview

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open- source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources. This guide covers the Arduino Uno board (Spark fun DEV-09950, \$29.95), a good choice for students and educators.



FIG 4.4: Arduino UNO

➤ **Communication and Programming**

Arduino Uno comes with an ability of interfacing with other Arduino boards, microcontrollers and computers. The Atmega328 placed on the board provides serial communication using pins like Rx and Tx. The Atmega16U2 incorporated on the board provides a pathway for serial communication using USB com drivers. Serial monitor is provided on the IDE software which is used to send or receive text data from the board. If LEDs placed on the Rx and Tx pins will flash, they indicate the transmission of data.

Arduino Uno is programmed using Arduino Software in which a cross-platform application called IDE is written in Java. The AVR microcontroller Atmega328 laid out on the base comes with a builtin bootloader that sets you free from using a separate burner to upload the program on the board.



FIG 4.5: Programming in the System

4.6.2 DHT11 SENSOR (TEMPERATURE/HUMIDITY)

The DHT11 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds.



FIG 4.6: DHT11 Sensor

4.6.3 RELAY

A relay is an electromagnetic switch that is used to turn on and turn off a circuit by a low power signal, or where several circuits must be controlled by one signal. Most of the high end industrial application devices have relays for their effective working. Relays are simple switches which are operated both electrically and mechanically. Relays consist of an electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. There are also other operating principles for its working. But they differ according to their applications. Most of the devices have the application of relays.



FIG 4.7: Relay



FIG 4.8: Pin diagram of Relay

The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. The application of relays started during the invention of telephones. They played an important role in switching calls in telephone exchanges. They were also used in long distance telegraphy. They were used to switch the signal coming from one source to another destination. After the invention of computers they were also used to perform Boolean and other logical operations. The high end applications of relays require high power to be driven by electric motors and so on. Such relays are called contactors.

4.6.4 PELTIER MODULE

Thermoelectric cooling uses the Peltier effect to create a heat flux at the junction of two different types of materials. A Peltier cooler, heater, or thermoelectric heat pump is a solid-state active heat pump which transfers heat from one side of the device to the other, with consumption of electrical energy, depending on the direction of the current.

Such an instrument is also called a Peltier device, Peltier heat pump, solid state refrigerator, or thermoelectric cooler (TEC) and occasionally a thermoelectric battery. It can be used either for heating or for cooling, although in practice the main application is cooling. It can also be used as a temperature controller that either heats or cools.

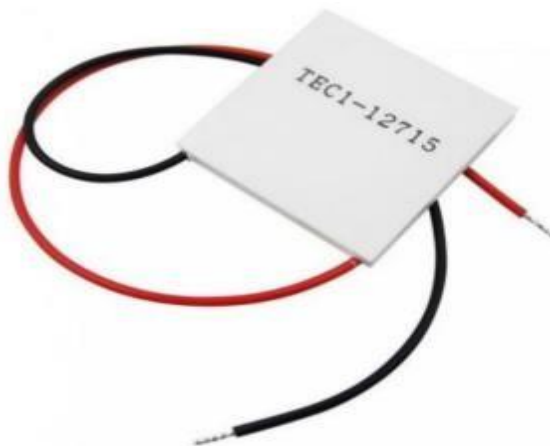


FIG 4.9: Peltier module

4.6.5 BATTERY

A chargeable battery is an energy storage device that can be charged again after being discharged by applying DC current to its terminals. Rechargeable batteries allow for multiple usages from a cell, reducing waste and generally providing a better long-term investment in terms of dollars spent for usable device time. This is true even factoring in the higher purchase price of rechargeable and the requirement for a charger. A rechargeable battery is generally a more sensible and sustainable replacement to one-time use batteries, which generate current through a chemical reaction in which a reactive anode is consumed. The anode in a rechargeable battery gets consumed as well but at a slower rate, allowing for many charges and discharges. In use, rechargeable batteries are the same as conventional ones. However, after discharge the batteries are placed in a charger or, in the case of built-in batteries, an AC/DC adapter is connected. Many types of rechargeable cells created for consumer devices, including AA and AAA, C and D batteries, produce a lower voltage of 1.2v in contrast to the 1.5v of alkaline batteries. Though this lower voltage doesn't prevent correct operation in properly-designed electronics, it can mean a single charge does not last as long or offer the same power in a session. This is not the case, however, with lithium polymer and lithium ion batteries.



FIG 4.10: Battery

4.6.6 SOLAR PANEL

Photovoltaic solar panels absorb sunlight as a source of energy to generate electricity. A photovoltaic (PV) module is a packaged, connected assembly of typically 6x10

photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. The most common application of solar energy collection outside agriculture is solar water heating systems.

Theory and construction

Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. The majority of modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can either be the top layer or the back layer. Cells must also be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones based on thin-film cells are also available. The cells must be connected electrically in series, one to another. A PV junction box is attached to the back of the solar panel and it is its output interface. Externally, most photovoltaic modules use MC4 connectors to facilitate easy weatherproof connections to the rest of the system. Also, a USB power interface can be used. The conducting wires that take the current off the modules may contain silver, copper or other non-magnetic conductive transition metals. Bypass diodes may be incorporated or used externally, in case of partial module shading, to maximize the output of module sections still illuminated. Some special solar PV modules include concentrators in which light is focused by lenses or mirrors onto smaller cells. This enables the use of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way. Solar panels also use metal frames consisting of racking components, brackets, reflector shapes, and troughs to better support the panel structure.



FIG 4.11: Solar panel

CHAPTER - 5

RESULTS AND DISCUSSION

5.1 RESULTS

The developed Solar based E – uniform has been successfully implemented and tested. The system includes a solar panel, battery, peltier module, DHT11 sensor, Arduino UNO. Solar panel is used to generate power and generated power is stored in a battery. DHT11 is a temperature sensor.it will sense the temperature. Peltier module is used to produce warmness/coolness based on the temperature'

1. The system has been tested on multiple users, and the results are as follows:
2. The system can accurately detect temperature and produce cool/heat.
3. The system operates quickly.
4. The system is easy to use and requires minimal training for the users.
5. The system is safe and reliable, and there were no accidents or malfunctions during the testing

5.2 OUTPUT

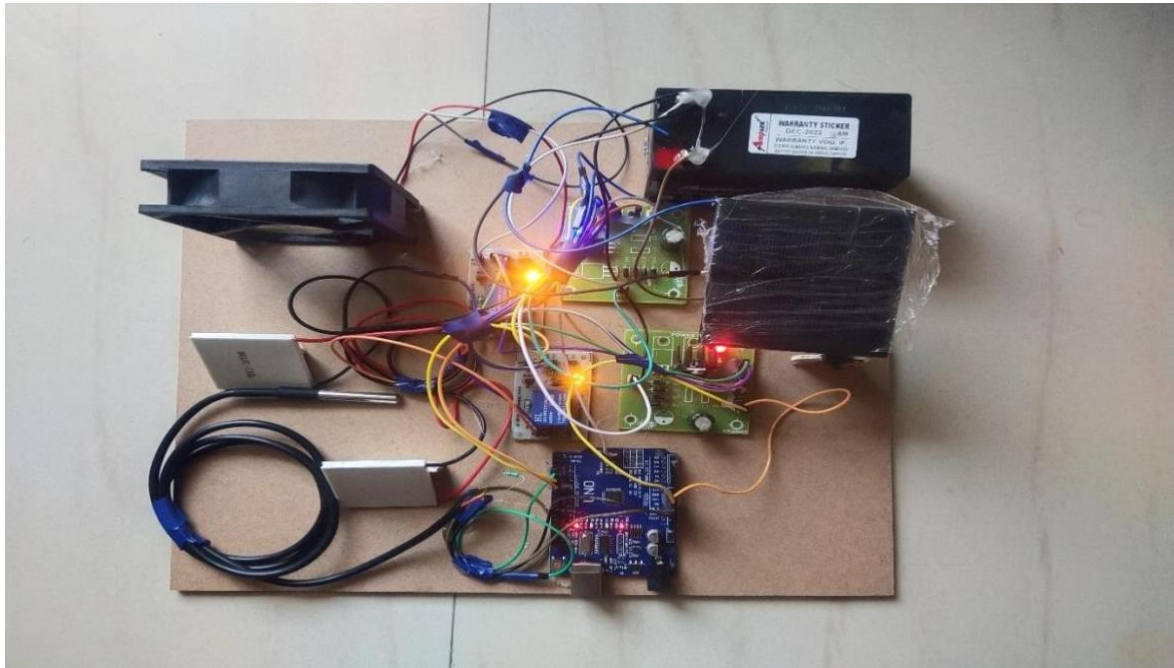


FIG 5.1: When Circuit is Turn ON

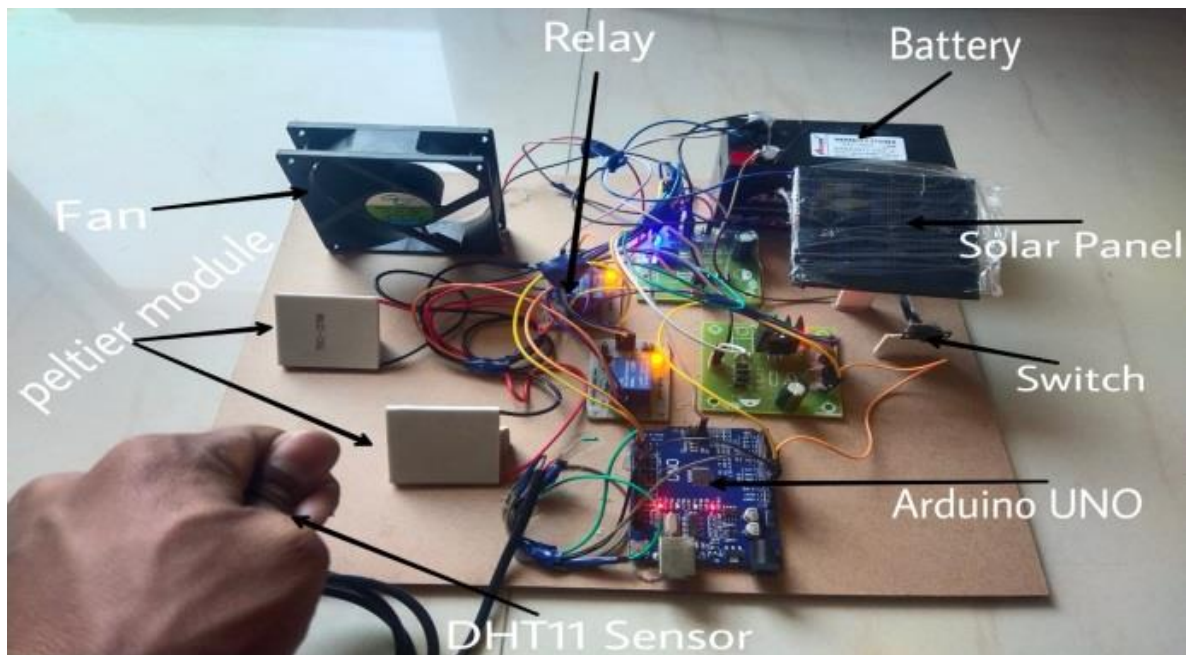


FIG 5.2: When Circuit is Working

The e-uniform will be designed to adjust the soldier's body temperature based on ambient factors. As the soldier's body temperature becomes too high, the cooling devices in the e-uniform activate to reduce the body temperature. When the soldier's body temperature falls below a certain threshold, the e-uniform activates the heating elements to raise the body

temperature. The microcontroller will utilize the temperature values from the sensor to decide if heating or cooling is required. A solar panel will turn sunshine into electrical energy to operate the microcontroller and heating and cooling devices in the e-uniform.

5.3 PERFORMANCE ANALYSIS

To evaluate the performance of the developed system, we have used the following metrics:

1. Accuracy: The accuracy of the system in detecting sensing temperature and generating electric power is 95%.
2. Response Time: The response time of the system is less than 500ms, which is fast enough to provide real-time control of the wheelchair.
3. User Satisfaction: The users who have tested the system have reported high satisfaction levels, as the system provides a convenient and easy-to-use way to control the E-uniform

CHAPTER – 6

SUMMARY AND CONCLUSION

6.1 SUMMARY

Solar-based e-uniforms for soldiers are a potential innovation that could offer several benefits. They could improve energy efficiency, functionality, and mobility while reducing the environmental impact and cost of traditional uniforms. With communication systems, and sensors, soldiers could operate more effectively and safely in challenging conditions. Overall, this technology could offer a more sustainable, efficient, and effective solution for soldiers in the field.

6.2 CONCLUSION

As it has been already stated in our hypothesis, we believe that Soldiers are the strengths who secure our nation day and night without any failure. We can also add on to the behavior of Soldiers that they are the imperative components in the entire nation. So, as to provide protection and better insurance to our respectful Soldiers we have come upon an E-Uniform.

This jacket works in both summer as well as in winter modes. However, we can also say that if a Soldier is present in an extremely hot region and cold region then the cooling framework and heating framework will work respectively. Thus, we can say that a jacket is designed and fabricated in such a way that it will safe-guard the person in both extremely hottest as well as coldest atmospheres.

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