

## IoT Based Solar E-Uniform for Soldiers

**Dr. Shaik Mohammad Rasool<sup>1</sup>, Syed Salman<sup>2</sup>, Mohammad Rizwan<sup>3</sup>, Md. Shabazoddin<sup>4</sup>**

Associate professor Department of ECE, Lords Institute of engineering and Technology,  
Hyderabad, India  
Department of ECE, Lords Institute of Engineering and Technology  
Hyderabad, India

### Abstract

The soldiers working in harsh weather conditions are better protected by solar-powered E-Uniforms. The E-internal uniform's electronics is powered by solar panels. 12 V DC lead acid battery, Energy is stored using a rechargeable battery. Additionally, we use a typical battery charging machine to deliver power to the circuits. The ESP32 microcontroller, which manages every function, is the brains of the circuit. In order to display the voltage generated by the battery on a 16X2 LCD, a voltage sampler is interfaced with the system using an ADC inbuilt in the ESP32. Both a summer and a winter operating mode is used for the project. Control operations through advance ICs so that it can drive the body heater/cooler by choosing the mode of operation. To enable the soldier adapt to any type of external climate, we will use the heater or cooler to deliver a warming or cooling effect within the uniform. The metal sensor will alert the soldier with a buzzer indication if it finds a metal-like explosive. The microcontroller and IOT are interfaced, and the GPS is also interfaced, allowing for the tracking of the entire soldier. Additionally, the location is messaged to the department or person of interest. The soldier will be able to work in any area thanks to this uniform.

### Introduction

The aim of the project is to develop an electronic uniform for soldiers. The system has a cooler and warmer system inside it. The cooler/ warmer are powered through a peltier module. To run this system, we are using solar energy is obtained stored into the battery through charging circuit.

Soldiers are very important people who always strive for the security of the country. They are supposed to work at extreme temperatures (very high or very low temperatures). This will lead to health damage. So, a E- uniform is designed to avoid adverse effects caused due to temperature changes.

The controlling device of the project is PIC microcontroller. Metal sensor, GSM, GPS, panic switch, peltier plate, buzzer and Relays along with peltier plate and cooling fan are interfaced to PIC microcontroller. Microcontroller will switch on the peltier plate to provide the hot/cool to the soldier at inside of the jacket. When the person presses the panic switch, microcontroller will take the location from GPS module and sending this location to the predefine mobile number through GSM modem in the form of latitude and longitude values and upload the data into the thing-speak cloud through ESP8266 WI-FI module. The status of the project will display on LCD module. This uniform consist of contains metal detector, if the sensor detects metal this data process to the microcontroller, then microcontroller will activate the buzzer for

alerts. All this equipment is placed in soldier jacket and solar panel on the soldiers cap. solar energy is obtained stored into the battery through charging circuit. Battery power is used to run this system. To achieve this task microcontroller code program written in embedded C language.

### **Literature Review**

The uniform has been tested in Indian military training exercises and has proven to be effective. It has been met with positive feedback from soldiers and is expected to be rolled out to other military forces in the near future. In recent years, the military has been looking for ways to improve soldier comfort and safety in extreme weather conditions. In 2017, a team of engineers from the Indian Defense Research and Development Organisation (DRDO) developed a novel solar-powered uniform for soldiers. The uniform is designed to reduce the burden of carrying and using heavy batteries for powering portable electronic devices. It is also designed to reduce the heat generated by military equipment during hot weather. The study also found that the uniform was cheaper than traditional military uniforms, making it an attractive option for the Ministry of Defence.

In addition, the uniform was found to be durable and long-lasting, providing soldiers with increased protection from the elements. In a recent study conducted by the United Kingdom Ministry of Defence, a solar based e-uniform for soldiers was developed and implemented in 2020. The uniform was designed to be lightweight and breathable, while also providing soldiers with the necessary protection against the elements. The uniform was also designed to incorporate solar powered technology, allowing soldiers to charge their devices while in the field.

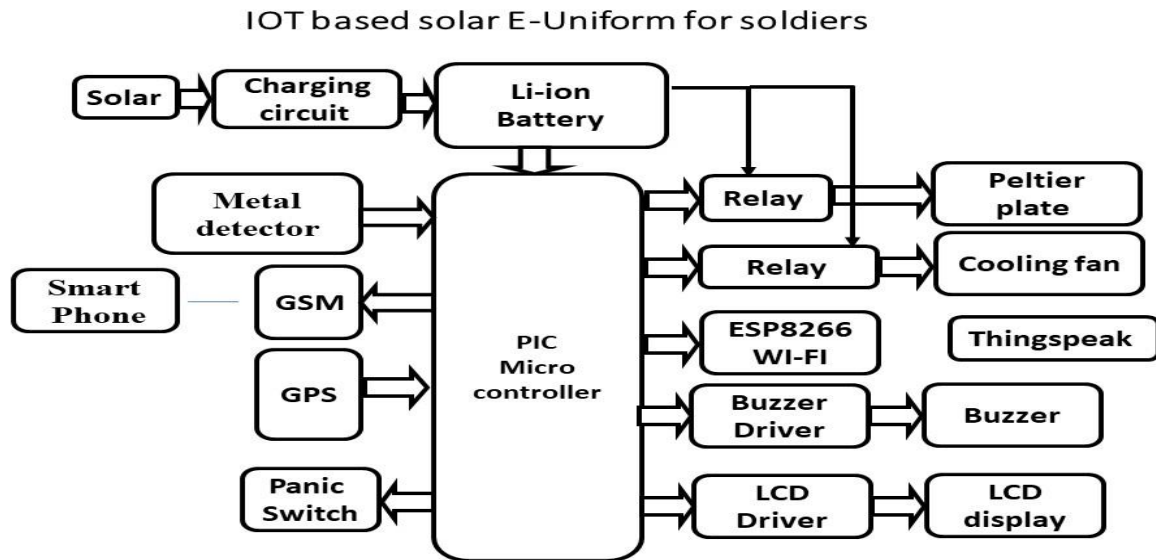
In recent years, the use of solar-based e-uniforms for soldiers has been gaining traction. Such uniforms offer a range of benefits, including improved durability, advanced thermal and moisture management, and superior flame resistance. In 2017, the British Army implemented a solar-based e-uniform for its soldiers, designed by UK-based textile manufacturer Bergans. The e-uniform was composed of a two-layer fabric, with the outside layer providing a protective shell and the inside layer providing thermal and moisture management.

The fabric was also designed to be highly flame resistant, allowing soldiers to operate in potentially hazardous environments. Adarsh K S, Arun Dinesh, Jyouthy Elizebeth D [1], they designed a jacket, named as “E-Uniform”, which gives better protection to the people living in extreme weather conditions. This jacket maintains the desired temperature inside the jacket. This jacket is powered up by solar panel. By using this uniform we can monitor the body temperature of the soldier.

Prof. Varsha Bendre [2] This paper concentrate on tracking the location of soldier from GPS, which is useful for control room station to know the exact location of soldier and accordingly they will guide them also soldier-to-soldier wireless communications to relay information on situational awareness and GPS navigation, Bio-medical sensors, Wireless communication Somali Kavitate, Onkar Jallapelli, Hanumant More, Assistant Prof. S.A.Nirve, Department of Electronics & Telecommunication.[3].they designed a jacket, named as “E-Jacket”, which

gives better protection to the people living in extreme weather conditions. This jacket maintains the desired temperature inside the jacket and help to monitor the body temperature of the soldier

## Block Diagram



## Hardware Required

**Microcontroller PIC16F73:** The PIC16F73 CMOS FLASH-based 8-bit microcontroller is upward compatible with the PIC16C73B/74B/76/77, PIC16F873/874/876/877 devices. It features 200 ns instruction execution, self programming, an ICD, 2 Comparators, 8 channels of 8-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 2-wire I2C bus, a USART, and a Parallel Slave Port.

**Solar cell/Plate:** A solar cell or photovoltaic cell is a device that converts solar energy into electricity by the photovoltaic effect. Sometimes the term solar cell is reserved for devices intended specifically to capture energy from sunlight, while the term photovoltaic cell is used when the source is unspecified. Assemblies of cells are used to make solar panels, solar modules, or photovoltaic arrays. Photovoltaic is the field of technology and research related to the application of solar cells for solar energy. Solar cell efficiencies vary from 6% for amorphous silicon-based solar cells to 40.7% with multiple junction research lab cells and 42.8% with multiple dies assembled into a hybrid package. Solar cell energy conversion efficiencies for commercially available multi-crystalline Si solar cells are around 14-19%.

**Metal Sensor:** This Tube Type Inductive Proximity Sensor Detection Switch NPN DC6-36V 4mm Normally Open switch LJ12A3-4-Z/BX is a component widely used in automatic control industry for detecting, controlling, and non-contact switching. When the proximity switch is close to some target object, it will send out control signal. When the metal approaches the proximity switch sensing area, an Eddy Current is induced in metal. Which in turn disturbs the

magnetic field produced by the Inductive Proximity Sensor This change is sensed by the sensor This inductive proximity switches can be noncontact, no pressure, no spark, quickly issued the electrical command Accurately reflect the position and the stroke movement mechanism Positioning accuracy, operating frequency, service life Easy to install and suitable for harsh environments

**Peltier Module** A Peltier module (Peltier cooler) is the opposite of a thermoelectric generator In a peltier module / Peltier cooler, electric power is used to generate a DS18B20 temperature difference between the two sides of the device, while in a thermoelectric generator, a DS18B20 temperature difference between the two sides is used to generate electric power The operation of both is closely related (both are manifestations of the thermoelectric effect), and therefore the devices are generally constructed from similar materials using similar designs

**Buzzer** Basically, the sound source of a piezoelectric sound component is a piezoelectric diaphragm A piezoelectric diaphragm consists of a piezoelectric ceramic plate which has electrodes on both sides and a metal plate (brass or stainless steel, etc) A piezoelectric ceramic

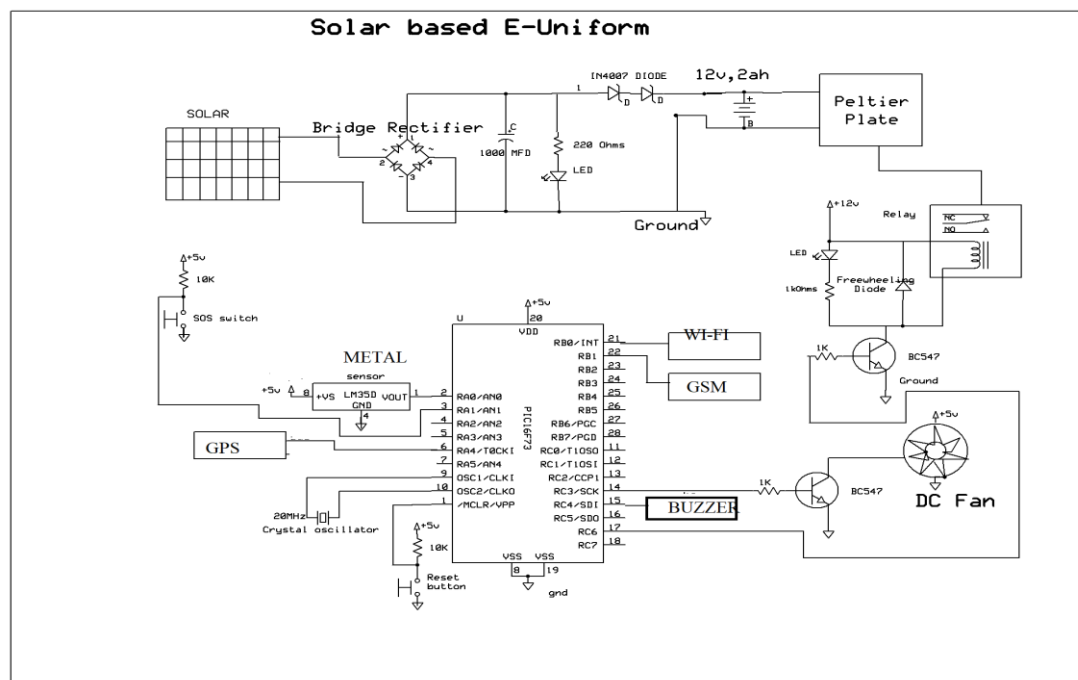


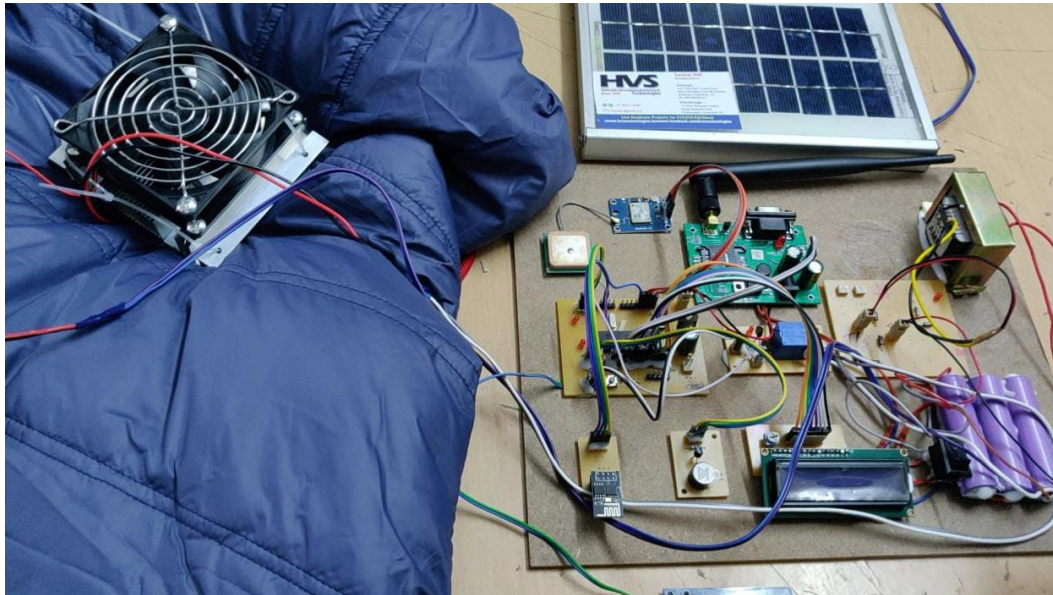
FIG 1.2: schematic diagram IOT based solar E-Uniform for soldiers

The features of the project are:

1. Storage of solar energy to a rechargeable battery.
2. Using peltier module for generating the cool/warm.
3. SOS based alerting system
4. GSM based SMS alerting system.
5. GPS based location tracking system.
6. IOT based monitoring system.

7. Visible alerts using LCD display.

### Result



### Conclusion

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

### Future Scope

This project can be extended in a way such that the output from the solar plate is increased. This can be done by increasing the dimensions of the solar plate. We can also extend the project by adding high rated coolants fans for spreading the cool air to the more space inside the refrigerator device.

### Results & Analysis

The controlling device of the project is PIC microcontroller. Metal sensor, GSM, GPS, panic switch, peltier plate, buzzer and Relays along with peltier plate and cooling fan are interfaced to PIC microcontroller. Microcontroller will switch on the peltier plate to provide the hot/cool to the soldier at inside of the jacket. When the person presses the panic switch, microcontroller will take the location from GPS module and sending this location to the predefine mobile number through GSM modem in the form of latitude and longitude values and upload the data into the thingspeak cloud through ESP8266 WI-FI module. The status of the project will display on LCD module. This uniform consist of contains metal detector, if the sensor detects metal this data process to the microcontroller, then microcontroller will activate the buzzer for alerts. All this equipment is placed in soldier jacket and solar panel on the soldiers cap. solar

energy is obtained stored into the battery through charging circuit. Battery power is used to run this system. To achieve this task microcontroller lode program written in embedded C language.

## REFERENCES

- [1] 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] 1Kawad Pranali, 2Dahiwalkar Gayatri, 3Pooja Adate, 4Prof.S.B. Dhekale: “E-UNIFORM”, International Journal of Advance Engineering and Research Development Volume 5, Issue 05, May -2018.
- [3] Karthikeyan N1, Murugesan K.S2, Senthil Kumar P3, Pooranachandran S4: “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] Dhabliya, D., & Dhabliya, R. (2019). Key characteristics and components of cloud computing. International Journal of Control and Automation,12(6 Special Issue), 12-18. Retrieved from [www.scopus.com](http://www.scopus.com)
- [6] 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.
- [7] Aoudni, Y., Donald, C., Farouk, A., Sahay, K. B., Babu, D. V., Tripathi, V., & Dhabliya, D. (2022). Cloud security based attack detection using transductive learning integrated with hidden markov model. Pattern Recognition Letters, 157, 16-26. doi:10.1016/j.patrec.2022.02.012