



SOLAR BASED E-UNIFORM FOR SOLDIERS

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Abstract:

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. A12V 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. PIC16F877A micro controller is the heart of the circuit as it controls all the functions. A voltage sampler is interfaced with the system using ADC 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 chilling or warming effect inside the uniform which helps the soldier to bear to any kind of external environment. 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.

Key Words: E-Uniform, Wearable Technology, Solar Based

Introduction:

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 condition.

This paper is 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 chilling 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. Node mcu IOT technology with haptic feedback system is used to know whether the soldier is in friendly area or out of friendly area so that the operation becomes easier.

Through this device, we continuously transfer the data wirelessly to the website using mobile as a server through IoT. Hence with the help of these components we have built the basic lifeguarding system for soldier in low cost and high reliability that reports the health status, environmental conditions, emotional state and indications if any threat to life. This paper covers about the materials and methodology, hardware and software description, validation study and also the final outcome of the project. Figure 1 shows block diagram of the solar based e-uniform.

Description:

E-jacket, with a printed circuit board (PCB) and a lithium ion battery reside in the pocket firmly. The temperature sensor is placed on the inner wall of the jacket, near left arm shoulder joint. The sensor carries four wires that are mostly hidden inside the stitches of the inner lining, as depicted.

The local host is equipped with a telemedicine support through a modem link to a remote server. The physical status of the subject is monitored continuously and relayed to the local host wirelessly, which in turn, passes to the remote patient database. The physician may retrieve and analyze the stored data at the remote end, whereas, the patient may be at home.

This is the way the body controls the rate of heat exchange with the environment by regulation of the skin blood flow. The perceived thermal sensation correlated well with the measured temperatures of the body. Also, a more integrated and robust electronic system was necessary to enable more excessive testing including field testing. This paper presents the development of an improved demonstrator jacket with added functionality.

A. Block Diagram of Solar Based E-Uniform:

In this section we are going to see about the various materials incorporated in this project. The e-uniform is designed of a micro controller, solar pv panel, lead acid rechargeable battery, body temperature sensor, environmental temperature sensor, heart beat sensor, SPO2 sensor, peltier plate, GPS, GSM, IOT node mcu, emergency key, LCD.

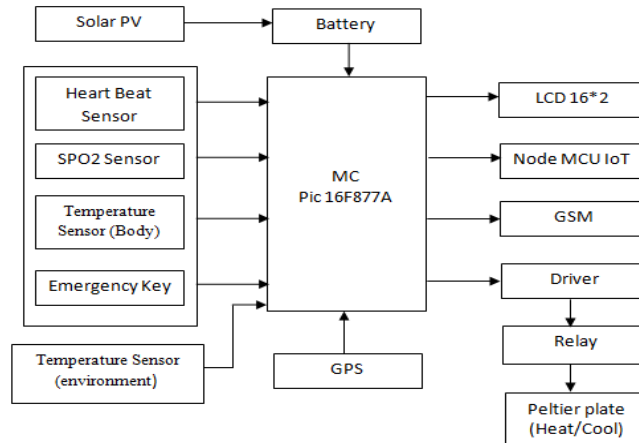


Figure 1: Block Diagram of Solar Based E-Uniform

Battery Cells:

Battery Cells are the most basic individual component of a battery. They consist of a container in which the electrolyte and the lead plates can interact. Each lead-acid cell fluctuates in voltage from about 2.12 Volts when full to about 1.75 volts when empty.

Lead Acid Battery:

A lead-acid battery is an electrical storage device that uses a reversible chemical reaction to store energy. It uses a combination of lead plates or grids and an electrolyte consisting of a diluted sulphuric acid to convert electrical energy into potential chemical energy and back again.

Solar Panel:

We know that solar panels can be designed with a number of solar cells. The main function of solar cells or PV cells is to generate electricity with a specific amount because each cell in the solar panel works individually. So by collecting the electricity from each cell, solar panel generates electricity. These panels used in homes to provide electricity for different needs. Once a number of panels are connected then it is known as a solar array. In this array, the electricity from each panel can be transmitted to an inverter. So this inverter converts the electricity from DC to AC to use in homes. Solar energy is not possible without the proper design of solar cells.

Arduino:

Arduino board is an open-source hardware and software platform that is designed with a circuit board including a microcontroller and other interfaces supporting different components connecting to it. This board can be simply programmed with the help of an Integrated Development Environment (IDE) which is used for writing & uploading the code to the board. Arduino is a flexible microcontroller board used for developing different electronics projects. There are different types of Arduino boards like Arduino Uno, Nano, Micro, Leonardo, nano Every, MKR Zero, Uno WiFi, Due, Mega 2560, Lilypad, etc. So this article provides information on one of the types of Arduino board namely Arduino Due – working with applications.

Node USB:

Node USB is an open IoT platform about the size of a standard USB stick. It was designed to leverage Node MCU (Lua) for easy programming and has the extra feature of USB capability. It is ideal for Plug-n-Play solutions, allowing easy prototyping for developers Node MCU provides access to the GPIO (General Purpose Input / Output) and for developing purposes below pin mapping table should be referenced.

IO Index	ESP8266 Pin	IO Index	ESP8266 Pin
0 [*]	GPIO16	7	GPIO13
1	GPIO5	8	GPIO15
2	GPIO4	9	GPIO3
3	GPIO0	10	GPIO1
4	GPIO2	11	GPIO9
5	GPIO14	12	GPIO10
6	GPIO12		

Node MCU is an open source IoT platform based on the ESP-12E module. The version 1.0 is the 5th design of Node MCU devkit. This uses CP2102 as UART Bridge, and can flash firmware automatically by using node mcu-flasher. Also it has a voltage regulator to convert from 5v to 3.3v which is the required by the esp21e module. The ESP8266 series, or family, of Wi-Fi chips is produced by Espressif Systems, a fabless semiconductor company operating out of Shanghai.

	Node MCU v1.0	Arduino MKR1000
Microcontroller	ESP-12E module, with Express if ESP8266 32 bits	ARM Cortex M0+ 32bits
Board Power Supply	5V	5V
Circuit Operating Voltage	3.3V	3.3V
Flash Memory	4MB	256KB
Digital I/O Pins	10	8
PWM Pins	10	12
UART	1 (+ TX only on pin GPIO2)	1
LED built-in	D0 / GPIO 16	GPIO 6
Programming Languages	C++ / Python / Lua / Javascript	C++
Flashing	Locally / OTA	Locally / OTA

B. Hardware Description:

The hardware, sensor and software descriptions are mentioned in Table I, Table II and Table III respectively.

S.No	Hardware	Description
1	Micro Controller	The Arduino Mega 2560 is a microcontroller board based on the ATmega2560
2	Emergency Key Push Button	An Emergency key-Push button is an electronic device that can easily be activated to request help during an emergency situation where danger to the soldier exists.
3	Global Positioning System (GPS)	The Global Positioning System (GPS) is a U.S.-owned utility that provides users with positioning, navigation, and timing (PNT) services
4	Peltier Plate	Peltier module (thermoelectric module) is a thermal control module that has both "warming" and "cooling" effects. By passing an electric current through the module, it is possible to change the surface temperature and keep it at the target temperature.

Table 1: Hardware Used

C. Sensor Description:

S.No	Sensor	Description
1	SPO2 - Max 30100	Sensor SpO2, also known as oxygen saturation, is a measure of the amount of oxygen-carrying haemoglobin in the blood relative to the amount of haemoglobin not carrying oxygen.
2	Heart Beat - Max 30100 Sensor	Heart beat sensors are designed to give digital output heart beat when a finger is placed on it. When the heart beat detector starts working, the light emitting detector (LED) blinks simultaneously for every heart beat.
3	Temperature Sensor (LM35)	The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature.

Table 2: Sensor Used

D. Software Description:

S.No	Software	Description
1	IoT	It is used to remote health monitoring and emergency notification system and it is a real time analytics.

Table 3: Software Used

Sketch:

In the getting started guide (Windows, Mac OS X, Linux), you uploaded a sketch that blinks an LED. In this tutorial, you'll learn how each part of that sketch works. Arduino is an open source, computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

Sketch Files:

Writing custom code for devices connected to an Arduino is accomplished using sketch files. By writing your code in the sketch file, you have complete control over how your data is sent to Cayenne.

Custom Widgets:

For greater control of hardware that is not in the device library, you can use Custom Widgets and add the custom code you need to example sketch files. Sketch file samples are available in Git Hub.

Location Monitoring:

Need to locate a lost device or monitor the movement of your devices during the day? See the past and present location of all of your devices connected to Cayenne.

Asset Tracking Types:

Depending upon the type of device added, there are several location settings available to enable asset tracking. These include devices that are stationary or mobile and connected or wireless sensors.

Readings:

In this section we have collected data for nearly forty subjects but provided with few limited examples regarding parameter on SPO2, Heart Rate, Temperature, Sweat, Position, LIFI module. The collected readings are given in Table IV.

S.No	SPO2	Heart Rate	Temperature	Position
1	94	82	25.9	Standing
2	97	87	26.88	Standing
3	95	72	27.86	Standing
4	95	76	27.38	Standing

Table 4: Collected Readings

LCD Display:

The display here is used to visualize the parameters such as temperature, sweat value, heart rate, and position of the soldier along with the step counts.

PCB Designing:

Arduino mega 2560 is connected to several sensors such as sweat sensors, temperature sensor, GPS, accelerometer, GPS, proximity sensors, gas sensor, spo2, Arduino uno is connected to an LIFI system which has transmitter and receiver part with it.

Validation:

In this section we are going to compare the previously done paper's drawback and how we overcome with our new Additional technology to be implemented in real-time.



Figure 1 and 2: Hardware Image

Conclusion:

This paper summarizes that smart jackets developed in the previous years for military purpose are limited to experience in wide range. The primary aim is to increase the protection and survivability of the soldiers. The proposed framework covers information on soldiers in multiple aspects, including motion, physiology, emotion, fatigue, environment and location, and allows for the addition of other types of sensors and systems. This lifeguarding system specially designed for soldiers consumes low power, so it is more convenient, cost-effective and has high efficiency in the military field. 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 worked and in the event that it is excessively cool then the warming framework will worked. 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. This Uniform made the soldier work in any kind of environment. So, he could work efficiently without heat stress or cold stress. If this project is implemented, it would help the soldier to survive intense battle and may help to save the lives of wounded soldiers.

References:

1. 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, 2019,, pp. 993 - 998.
2. Muhammad Ali Mazidi, Rolin D. McKinlay, Danny Causey PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18.
3. Sheikh, H R; Dept. of Electr. & Comput. Eng., Univ. of Texas, Austin, TX, USA; Bovik, A C; de Veciana, G. "An information fidelity criterion for image quality assessment using natural scene statistics"
4. Han-ShueTan and Jihua Huang, "DGPS-Based Vehicle-to-Vehicle Cooperative Collision Warning: Engineering Feasibility Viewpoints", IEEE Transactions on Intelligent Transportation Systems, vol.7, No. 4, December 2020, pp. 415 - 428.
5. Pertijs, M.A.P. ; Electron. Instrum. Lab., Delft Univ. of Technol., Netherlands ; Makinwa, K.A.A. ; Huijsing, J.H. "A CMOS smart temperature sensor with a 3σ inaccuracy of $\pm 0.1^{\circ}\text{C}$ from -55°C to 125°C ".
6. Adams, W. 2019. The action of light on selenium. Proc R Soc, 25: 113-117. Armstrong, S. and Hurley, W.G. 2019. A new methodology to optimize solar energy extraction under cloudy conditions. International Journal of Renewable Energy, 35: 780-787.
7. Avdic, V.; Zecevic, S.; Pervan, N.; Tasic, P. and Muminovic, A.J. 2019. Different design solutions of solar tree in urban environment. In: GDC 2019 2nd Green Design Conference, Green Cities, Building and Products, Sarajevo, International Council for Research and Innovation in Building and Construction (CIB), Working Commission W115 and The University of Twentes, The Netherland. pp. 40-45.
8. V. Zecevic, S.; Pervan, N.; Tasic, P. and Muminovic, A.J. 2021. Implementation of solar tree project in Sarajevo. In: GDC 2nd Green Design Conference, Green Cities, Building and Products, Sarajevo, International Council for Research and Innovation in Building and Construction (CIB), Working Commission W115 and The University of Twentes, The Netherland. pp. 60-67.