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Thermo Pilot: A Climate-Smart Jacket

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Abstract - In this rapidly changing climate, maintaining body comfort in extreme weather conditions is a growing challenge. *Thermo Pilot* is an innovative, wearable technology designed to address this issue by automatically regulating temperature based on environmental conditions. This smart jacket integrates a wearable system capable of maintaining thermal comfort under varying environmental conditions. The system is designed to sense ambient temperature using a temperature sensor and process the data through an Arduino temperature sensor, Arduino microcontroller, and heating/cooling elements to create an adaptive clothing solution.When the ambient temperature drops, the system activates nichrome wires to generate microcontroller automatically. to control a heating mechanism warmth. In contrast, during hot weather, a Peltier module provides a cooling effect. The jacket is powered by a rechargeable Li-ion battery and can be remotely controlled via a smartphone using Bluetooth and a custom-built mobile app. Optional OLED display and safety features ensure enhanced usability and feedback

I. INTRODUCTION

In recent years, rapid climate changes and extreme weather conditions have made it difficult to maintain thermal comfort using traditional clothing. Conventional jackets provide only passive insulation and cannot adapt to varying environmental temperatures. This creates a need for smart and adaptive wearable solutions that can actively regulate temperature.
Thermo Pilot is a smart wearable jacket designed to automatically control body temperature based on surrounding conditions. The system integrates a temperature sensor, an Arduino microcontroller, and a heating element to provide real-time thermal regulation. The sensor continuously monitors the ambient temperature, and the microcontroller processes this data to activate or deactivate the heating system accordingly.

This project follows the Input–Process–Output model, where the sensor acts as input, the Arduino performs processing, and the heating element serves as the output. The system is powered by a portable battery, making it suitable for wearable applications. The proposed solution aims to improve comfort, safety, and energy efficiency for users in varying environmental conditions.

It also aims to ensure efficient power usage and safe operation by incorporating a MOSFET-based switching system. The project focuses on creating a compact, portable, and user-friendly solution that can be integrated into clothing for real-time temperature regulation.

The primary objective of Thermo Pilot is to design a smart jacket that can dynamically respond to environmental temperature changes. The system aims to automate the heating process by continuously monitoring temperature and activating the heating element only when required.

Additionally, the project seeks to enhance energy efficiency, reduce manual intervention, and improve user comfort. It also aims to demonstrate the application of embedded systems in wearable technology.

The objective of this work is to implement a sensor-based temperature control system using Arduino for wearable applications. The project aims to integrate sensing, processing, and actuation into a single system to achieve automatic thermal regulation.
Furthermore, it focuses on developing a reliable and scalable solution that can be extended with additional features such as cooling systems, wireless control, and real-time monitoring.

III . EXISTING SYSTEM

Existing wearable thermal-regulation jackets primarily focus on *manual temperature control mechanisms* using embedded heating pads or ventilation systems. Most currently available smart jackets provide either *heating functionality for cold environments* or *cooling functionality for

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high-temperature conditions*, but they rarely support both in an integrated automatic system.



Figure III. a

Traditional smart jackets typically use *battery-powered heating elements* that allow users to manually adjust temperature levels through switches. Similarly, some industrial cooling jackets employ *fan-based ventilation systems* to reduce body heat in high-temperature workplaces. However, these systems depend heavily on user interaction and do not respond dynamically to changing environmental conditions.

Recent developments in wearable technology introduced jackets equipped with *temperature sensors and IoT and physiological parameters. Although these systems can collect useful data, they mainly perform *monitoring rather than automatic climate adaptation*. Additionally, many existing designs suffer from limitations such as:

*Lack of automatic temperature regulation
*Absence of dual heating and cooling functionality
*Limited battery efficiency
*No intelligent decision-making capability
*Minimal integration with mobile application

Because of these limitations, existing systems cannot provide continuous adaptive thermal comfort in rapidly changing environmental conditions. Therefore, there is a need for an intelligent climate-adaptive wearable solution such as the proposed *Thermo Pilot smart jacket*, which automatically regulates temperature using sensor-based feedback and embedded control algorithms.



Figure IV.a

V. PROPOSED SYSTEM

The proposed system, Thermo Pilot: A Climate Smart Jacket, is designed to provide automatic temperature regulation by integrating environmental sensors, embedded controllers, thermoelectric modules, and wireless communication technologies. Unlike existing systems that rely on manual operation, the proposed jacket continuously monitors surrounding conditions and adjusts internal temperature accordingly to maintain user comfort.

The Thermo Pilot jacket uses a temperature and humidity sensor (DHT22) to measure environmental conditions in real time. The collected sensor data is processed by a microcontroller (ESP32/Arduino), which compares the readings with predefined comfort threshold values. Based on the analysis, the controller automatically activates either the heating module or the cooling module.

IV.CHALLENGES FACED

Centralizing and analyzing global agricultural export data isn't as easy as it first sounds.

One major hurdle is the tangled, non-standardized format and unusual collection points that current trade data presents. Export records often span multiple documents, use varying units of measurement, and involve non-uniform terminology across different regions or customs offices. This raw data often packs disparate metrics together (e.g., volume, value, and logistics details), changes meaning based on the source (e.g., farm gate price vs. FOB price), and includes rare trade codes you just don't see in domestic sales data anymore. Many existing digitized versions—whether manually entered spreadsheets or fragmented customs reports—have

Ifthe surrounding temperature falls below the comfort range, the system activates the heating pads to increase warmth. Similarly, when the temperature rises above the threshold level, the cooling fans or thermoelectric (Peltier) modules are activated to reduce internal temperature. This ensures continuous thermal comfort without requiring manual intervention.

Additionally, the system supports wireless communication using Bluetooth or Wi-Fi, allowing users to monitor temperature values and control system operation through a mobile application . This enhances usability and
provides flexibility for manual adjustments when required.

VI. ADVANTAGES

The proposed Thermo Pilot: Climate Smart Jacket offers several advantages over conventional wearable thermal-regulation garments. The integration of sensors, microcontrollers, and thermoelectric modules enables automatic and intelligent temperature control, improving user comfort and safety in varying environmental conditions.

A. Automatic Temperature Regulation

The system continuously monitors environmental temperature and automatically activates heating or cooling modules based on predefined threshold values. This eliminates the need for manual adjustments and ensures consistent thermal comfort.

B. Dual Heating and Cooling Functionality

Unlike traditional smart jackets that provide only heating or only cooling, the Thermo Pilot jacket supports both functions in a single wearable system. This makes it suitable for use in both cold and hot environmental conditions.

C. Real-Time Monitoring Capability

The integration of temperature and humidity sensors environmental conditions. The system processes this data in real time to maintain optimal comfort levels.

D. Wireless Connectivity Support

Using built-in Bluetooth or Wi-Fi communication (via ESP32), the jacket allows users to monitor temperature data and control system operation through a mobile application, improving usability and flexibility.

E. Energy-Efficient Operation

Thesystem is designed to operate using a rechargeable batterywith controlled power usage. Intelligent activation of heating and cooling modules helps reduce unnecessary energy consumption.

F. Lightweight and Wearable Design

All components are compact and embedded carefully with in the jacket structure, ensuring portability, flexibility, and user comfort without affecting normal movement.

G. Suitable for Multiple Environmental Conditions

This adaptability makes the system highly versatile for real-world applications.

H. Improved Safety and Comfort

By maintaining stable body temperature, the jacket helps reduce risks associated with extreme weather exposure, especially for outdoor workers, travelers, and defense personnel.

VII. COMPONENT

The Thermo Pilot system is composed of several essential hardware components that work together to achieve automatic temperature regulation. The Arduino microcontroller serves as the central processing unit, responsible for reading sensor data and controlling the output based on programmed logic.

A temperature sensor, such as the DHT11, is used to measure the ambient temperature and provide real-time input to the controller. The processing unit evaluates this data and determines whether heating is required.

AMOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor) is employed as a switching device to control the heating element. It enables safe handling of high current while being driven by low-power signals from the Arduino.

The heating element is implemented using nichrome wire,which generates heat when electric current flows through it. This heat is utilized to provide warmth within the jacket.

A rechargeable battery, such as a Li-ion battery or power bank,is used to power the entire system, ensuring portability and usability in wearable applications.

Additionally, a breadboard and connecting wires are used during the prototyping phase to establish and test circuit connections effectively.

VIII. FLOW CHART

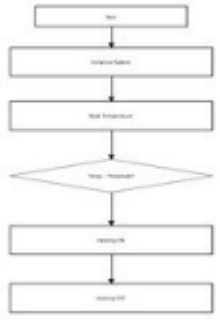


Figure VI II.a

C. Mobile Application Monitoring Output Using ESP32 wireless connectivity, users can: View live temperature readings Monitor system operation status Manually control heating or cooling if required This improves usability and remote accessibility.

D. Comfort-Level Stabilization Result Aftersystemactivation:

Internal jacket temperature becomes stable

User discomfort due to extreme weather reduces

Continuous adaptive regulation is maintained automatically

Thus,the Thermo Pilot jacket successfully provides a smart wearable climate-control output system that enhances safety,comfort, and adaptability in varying environmental conditions.

IX. OUTPUT X. REFERENCES

The output of the Thermo Pilot: Climate Smart Jacket is the automatic regulation of the user's body temperature based on environmental conditions detected by the sensor system. The jacket continuously monitors surrounding temperature and humidity and activates appropriate heating or cooling mechanisms to maintain thermal comfort.

A. Automatic Temperature Adjustment

The primary output of the system is the activation of heating pads when the temperature drops below the predefined threshold and activation of cooling modules (Peltier device/fan) when the temperature rises above the comfort level.

Example:
If temperature < 18°C → Heating module activates If

temperature between 18°C–28°C → System

remains idle (comfort zone)
If temperature > 28°C → Cooling module activates This

ensures continuous comfort without manual

intervention.

X. REFERENCES

[1] A. Monk, *Programming Arduino: Getting Started with Sketches*, 2nd ed., McGraw-Hill, 2016.

[2] M. Banzi and M. Shiloh, *Getting Started with Arduino*, 3rd ed., Maker Media, 2014.

[3] DHT11 Temperature Sensor Datasheet, Aosong Electronics Co., Ltd., 2018.

[4] IRLZ44N MOSFET Datasheet, International Rectifier, 2015.

[5] J. G. Webster, *Electrical Measurement, Signal Processing, and Displays*, CRC Press, 2003.

[6] S. Franco, *Design with Operational Amplifiers and Analog Integrated Circuits*, McGraw-Hill, 2014.

[7] Arduino Official Documentation, "Arduino B. Real-Time Sensor Display Output Uno Rev3," [Online].Available: as:The system provides real-time environmental data such Temperature readings Humidity levels System status (Heating ON / Cooling ON / Idle)
https://www.arduino.cc

[8] R. S. Khandpur, *Handbook of Biomedical Instrumentation*, McGraw-Hill, 2003. These values can be displayed on: .Serial monitor (during testing)
Mobile application (via Bluetooth/Wi-Fi) Optional LCD display module