Design of Intelligent Wardrobe System Based on IoT Technology

Mr. SK. Jagadeesh Babu [1], T. Mahicharan [2], V. Devaki Sai Lakshmi[3], P. Vyshnavi[4], G. Manjusha[5], SK. Sajid[6]

[1]*Assistant Professor, Dept. Of ECE, PBR VITS, Kavali, Nellore District, Andhra Pradesh, India*
[2-6]*UG Students, Dept. Of ECE, PBR VITS, Kavali, Nellore District, Andhra Pradesh, India*

---***---

Abstract - The Intelligent Wardrobe System based on IoT Technology presents the design of an automated smart storage solution aimed at providing environmental control and safety monitoring for clothing preservation. An Arduino Mega microcontroller serves as the central controller, interfacing with a DHT11 sensor to monitor temperature and humidity inside the wardrobe. Filament bulbs act as heaters to maintain optimal conditions, while a fire sensor detects potential fire hazards. Upon fire detection, a relay activates a water pump to suppress flames. Smart LED lighting is managed through relay modules, automatically adjusting based on system conditions. All sensor data and system status are uploaded to an IoT platform via an ESP8266 WiFi module, enabling remote monitoring and real-time alerts. This system enhances clothing preservation, energy efficiency, and safety, providing a smart and connected solution for modern wardrobes.

Key Words: IoT, Intelligent Wardrobe System, DHT11 Sensor, Temperature and Humidity Monitoring, Fire Detection.

1. INTRODUCTION

The rapid advancement of the Internet of Things (IoT) has transformed everyday objects into smart, connected devices that enhance convenience and efficiency in daily life. Traditional wardrobes are passive storage units that lack intelligence, making it difficult for users to manage clothing effectively in terms of organization, environmental maintenance, and safety monitoring.

The Intelligent Wardrobe System based on IoT Technology is a smart storage solution designed to preserve clothing by automatically monitoring and controlling the internal environment of a wardrobe. Unlike traditional wardrobes that merely provide storage space, this system integrates sensors, automation, and IoT connectivity to maintain optimal temperature and humidity conditions while ensuring safety through fire detection and automatic suppression.

An Arduino Mega microcontroller acts as the core controller, interfacing with a DHT11 sensor to track environmental parameters, filament bulbs to regulate warmth, and smart LED lighting for visibility. In the event of a fire hazard, a fire sensor triggers a relay to activate a water pump, protecting the contents from damage. All system data is transmitted to an IoT platform for real-time monitoring and alerts, enabling users to supervise wardrobe conditions remotely The motivation behind this project is to develop a smart, user-friendly, and cost-effective intelligent wardrobe system that simplifies clothing management while ensuring proper storage conditions using IoT-based solutions. This system is suitable for smart home applications, retail showrooms, hotels, and textile storage units.

2. LITERATURE SURVEY

2.1 IoT-Based Smart and Healthy Wardrobe System (2019): This study proposed a wardrobe system model using the IoT concept combining six Arduino sensors to trigger a dehumidifier, humidifier, and air purifier, maintaining air quality and preventing mold growth in stored clothing. A color sensor was also used to help users identify clothing colors, improving usability and garment care.

2.2 IoT Smart Wardrobe System: Design & Implementation (2019): This research used Raspberry Pi, Arduino UNO, RFID system, and Microsoft Azure Cloud to track wardrobe usage, categorize garments, and generate statistical reports. The system suggested outfits based on calendar events and frequency of clothing use, with potential for future weather-based recommendations using machine learning.

2.3 IoT-Based Smart Wardrobe with RGB and Sound Sensor (2025): This recent research designed a smart wardrobe equipped with a color sensor for garment combination suggestions and a voice/sound sensor for hands-free control. A microcontroller-based hardware connected to a mobile application was used to manage wardrobe status automatically and respond to user inputs, promoting a more interactive smart home experience.

3. EXISTING SYSTEM

Traditional wardrobes are passive storage units that provide only space for clothing without monitoring or environmental control. Users must manually check for moisture, temperature, or lighting conditions, which can lead to issues like mold growth, fabric damage, or fading of colors. Any ventilation or lighting solutions are usually independent, non-automated devices, and there is no system to alert users when conditions become unfavorable.

Key Disadvantages of the Existing System:

- No environmental monitoring (temperature/humidity)
- Risk of moisture accumulation, mold formation, and fabric damage
- No automation for lighting, ventilation, or climate control
- Absence of fire safety mechanisms and alert systems
- No IoT integration or remote monitoring capability
- Inefficient manual lighting causing energy wastage
- No data collection or smart organization features.

4. PROPOSED SYSTEM

The proposed Intelligent Wardrobe System uses an Arduino Mega microcontroller as the main controller to manage environmental conditions and safety features. The system integrates multiple sensors and actuators to ensure efficient monitoring and control. Arduino Mega 2560: Central processing unit with 54 digital I/O pins, 16 analog inputs, 4 UARTs, and 16 MHz crystal oscillator

- DHT11 Sensor: Measures temperature (0-50°C) and humidity (20-90% RH) with ±2°C and ±5% RH accuracy
- ESP8266 WiFi Module: Enables IoT connectivity for transmitting data to cloud platforms like ThingSpeak
- Fire/Flame Sensor: Detects flame wavelengths in the 760nm-1100nm range from up to 100cm distance
- Relay Modules: Control high-power devices (heater, water pump) using low-power Arduino signals
- Filament Bulb (Heater): Maintains optimal temperature to prevent moisture buildup
- DC Water Pump: Activated during fire detection for automatic fire suppression
- I2C LCD Display (16x2): Displays real-time sensor data and system status
- Buzzer: Provides audible alerts during fire detection or abnormal conditions
- LED Lights: Smart lighting controlled via relay modules for automated visibility

Hardware Requirements

The hardware platform is built around the Arduino Mega 2560, based on the ATmega2560 microcontroller. The DHT11 sensor uses a capacitive humidity sensor and thermistor to measure surrounding air conditions, outputting a digital signal (data updates every 2 seconds). The ESP8266 WiFi module (NodeMCU-based) provides IoT connectivity using the Lua-based firmware running on the ESP-12 module, with USB-to-UART conversion for programming. The flame sensor uses infrared flame flash detection to distinguish fire from other light sources, providing both analog and digital output signals. Relay modules serve as electromagnetic switches enabling the Arduino to control high-power devices including the heater and water pump safely.

Software Requirements

The system is programmed using the Arduino IDE (open-source) with code written in Embedded C/C++. The software initializes all sensors and modules, reads DHT11 and flame sensor data, displays values on the I2C LCD, sends data to the IoT platform using the ESP8266, and controls relay modules based on conditional logic. The ESP8266 transmits sensor data to the ThingSpeak IoT cloud platform for remote monitoring and real-time alert generation.

Solution to Existing System Limitations

The proposed system addresses all identified limitations of traditional wardrobes. Environmental monitoring is achieved through the DHT11 sensor providing continuous temperature and humidity measurement. Automated climate control via relay-controlled heaters eliminates manual intervention. Fire safety is addressed through the integrated flame sensor and automatic water pump activation. IoT integration through the ESP8266 module enables real-time remote monitoring and alerts. Smart LED lighting controlled by relays eliminates manual operation and reduces energy waste.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 10 Issue: 04 | April - 2026 SJIF Rating: 8.659 ISSN: 2582-3930

4.1 System Architecture

The proposed architecture includes the following key components working in an integrated manner:

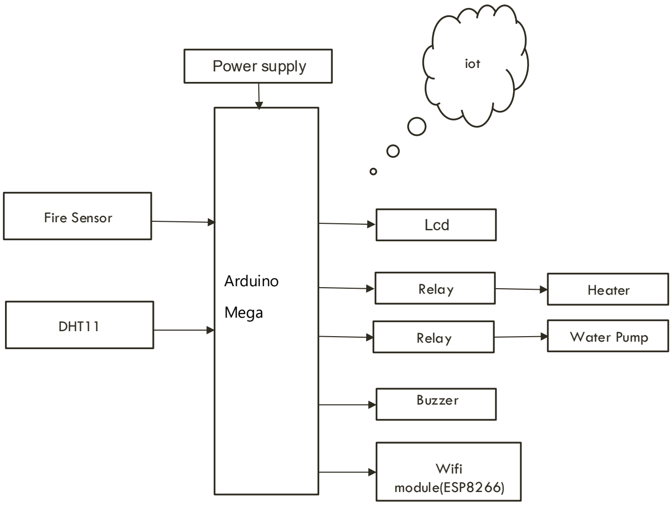

Fig 4.1:Block Diagram of Proposed System

The Intelligent Wardrobe System based on IoT technology is designed as an integrated system that combines sensors, a microcontroller, actuators, and IoT connectivity to provide automated environmental control and safety monitoring.

The architecture of the system is centered around the Arduino Mega microcontroller, which acts as the main processing unit. All input devices, output devices, and communication modules are connected to this controller to ensure coordinated operation.

The input layer consists of sensors such as the DHT11 sensor and flame sensor. The DHT11 sensor continuously monitors temperature and humidity inside the wardrobe, while the flame sensor detects the presence of fire or abnormal heat conditions. These sensors send real-time data to the Arduino Mega for processing.

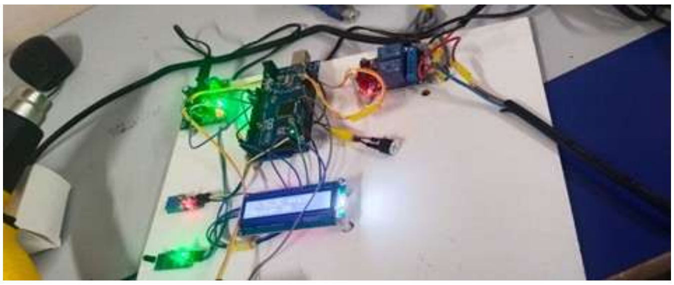

Fig 4.2:Working Model of the Proposed System

The proposed Intelligent Wardrobe System operates as an automated and IoT-enabled solution designed to monitor and control environmental conditions inside a wardrobe. The system is built around the Arduino Mega microcontroller, which acts as the central controller and coordinates all operations.

When the system is powered ON, the Arduino initializes all connected components, including sensors, display units, relays, and the WiFi module. The DHT11 sensor continuously measures the temperature and humidity levels inside the wardrobe, while the flame sensor monitors for any fire hazards.

The collected sensor data is sent to the Arduino Mega for processing. The system compares the sensor values with predefined threshold levels to determine whether the conditions are normal or require action. The real-time values of temperature and humidity are displayed on the LCD screen, providing direct feedback to the user.

If the temperature or humidity exceeds the safe limits, the Arduino activates the relay module, which turns ON the heater (filament bulb) to maintain optimal environmental conditions. Once the conditions return to normal, the system automatically turns OFF the heater.

In case the flame sensor detects fire, the system immediately triggers emergency actions. The buzzer is activated to alert the user, and the relay switches ON the water pump to suppress the fire. This ensures quick response and enhances safety.

The ESP8266 WiFi module enables IoT functionality by sending sensor data and system status to an online platform. This allows users to monitor the wardrobe conditions remotely and receive alerts in real time.

ADVANTAGES

- Automated Environmental Control
- IoT Connectivity
- Alerts and Notifications
- Enhanced Clothing Protection
- Smart
- Low-cost

APPLICATIONS

- Homes
- Boutiques
- Retail Stores
- Hotels

5. RESULTS AND DISCUSSIONS

The implementation integrates hardware components, sensors, and software to create an automated smart wardrobe. The Intelligent Wardrobe System based on IoT technology successfully transforms a conventional storage unit into a smart, automated, and safety-aware environment for clothing preservation. By integrating sensors, relays, smart lighting, fire detection, and IoT connectivity through an Arduino Mega-based architecture, the system continuously maintains optimal temperature and humidity while providing real-time monitoring and alerts.

The automatic fire suppression mechanism further enhances safety, ensuring protection of valuable garments. This combination of environmental control, automation, and remote accessibility results in improved energy efficiency, reduced manual effort, and enhanced reliability, making the system a practical and modern solution for homes, retail spaces, and smart living environments.

Future enhancements include integration with a dedicated mobile application, incorporation of Artificial Intelligence for smart outfit recommendations and usage tracking, additional sensors (motion, air quality, RFID), voice assistant integration (Alexa/Google Assistant), and cloud-based predictive maintenance analytics.

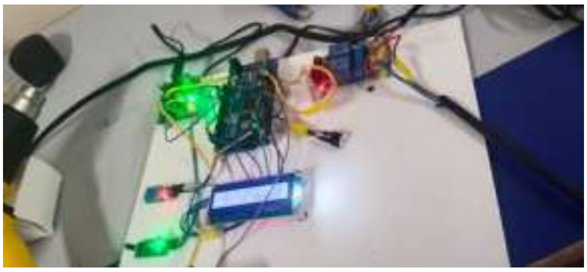

Fig. 5.1: Fire sensor detected pump on.

When the enter/save button on the remote interface is pressed, the ploughing mechanism is activated as shown in Fig.5.2. The ploughing tool attached to the robot begins loosening the soil while the robot moves across the agricultural field. When the back button is pressed, the ploughing operation stops.

Fig. 5.2: ThingSpeak graph showing real-time temperature and humidity and fire sensor data

In addition to environmental monitoring and safety features, the system is designed to ensure efficient coordination between all hardware components. The Arduino Mega continuously communicates with sensors and output devices, ensuring that real-time decisions are executed without delay.

The relay module plays a crucial role in isolating low-power control signals from high-power devices. This not only protects the microcontroller but also ensures safe operation of devices like the heater and water pump. The system is designed in such a way that all actions are automatic, reducing the need for human intervention.

The LCD display provides a user-friendly interface by showing real-time values of temperature, humidity, and system status such as heater ON/OFF or fire alert. This helps users easily understand the current condition of the wardrobe without needing external devices.

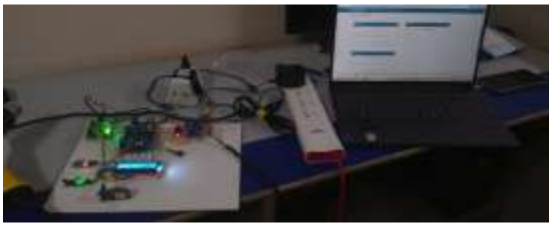

Fig. 5.3: Intelligent wardrobe system based on iot technology

6. CONCLUSION AND FUTURESCOPE

The Intelligent Wardrobe System based on IoT technology successfully transforms a conventional storage unit into a smart, automated, and safety-aware environment for clothing preservation. By integrating sensors, relays, smart lighting, fire detection, and IoT connectivity through an Arduino Mega-based architecture, the system continuously maintains optimal temperature and humidity while providing real-time monitoring and alerts.

The automatic fire suppression mechanism further enhances safety, ensuring protection of valuable garments. This combination of environmental control, automation, and remote accessibility results in improved energy efficiency, reduced manual effort, and enhanced reliability, making the system a practical and modern solution for homes, retail spaces, and smart living environments.

Future enhancements include integration with a dedicated mobile application, incorporation of Artificial Intelligence for smart outfit recommendations and usage tracking, additional sensors (motion, air quality, RFID), voice assistant integration (Alexa/Google Assistant), and cloud-based predictive maintenance analytics.

ACKNOWLEDGEMENT

The authors express sincere gratitude to Mr. SK. Jagadeesh Babu, Assistant Professor, Department of ECE, PBR VITS, Kavali, for his timely guidance and support. Heartfelt thanks to Dr. R. Sravanthi, Professor and Head of Department of ECE, and Principal Dr. V. Anil Kumar for providing the necessary infrastructure and facilities for completion of this project work.

REFERENCES

[1] Author(s). (2019). IoT-Based Smart and Healthy Wardrobe System. International Journal / Conference on Internet of Things and Smart Systems.

[2] Author(s). (2019). IoT Smart Wardrobe System: Design & Implementation Research. Journal of Smart Home and IoT Technologies.

[3] Author(s). (2025). Design and Construction of IoT-Based Smart Wardrobe with RGB Sensor and Sound Sensor. International Conference on IoT and Embedded Systems.

[4] Smith, K., & Jones, A. (2021). Smart Clothing: A New Approach to Fashion and Wearable Technology. Fashion Technology & Innovation Journal, 12(3), 45-59.

[5] Wang, Y., & Zhang, X. (2020). An Overview of Wearable Technologies in IoT: Opportunities and Challenges. IEEE Internet of Things Journal, 7(5), 4352-4365.

[6] Fashion Institute of Technology. (2021). Smart Wardrobe Technologies: A Market Analysis.

[7] Consumer Electronics Association. (2022). The Future of Smart Clothing: Innovations and Market Opportunities.

[8] Baker, T., & Wong, M. (2023). Designing Smart Wardrobe Systems for Enhanced User Experience. International Conference on Fashion and Technology.

[9] Thompson, S. (2023). User Engagement in Smart Wardrobe Systems: Challenges and Solutions. Global Conference on Smart Textiles.

[10] Williams, R., & Thompson, J. (2023). Integrating Smart Textiles into Everyday Fashion. Proceedings of the International Textile Conference, pp. 45-52.

[11] Brown, T., & Lewis, M. (2021). Smart Wardrobe Management: A User-Centric Approach. Proceedings of the International Conference on Smart Fashion, pp. 98-104.