INTERNET OF THINGS
PROJECT REPORT

END SEMESTER LAB EVALUATION

Automated Smart Desk

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INTRODUCTION

Modern students often encounter numerous distractions and environmental discomforts while studying, which can significantly reduce their concentration, efficiency, and overall productivity. Factors like inadequate lighting, improper temperature, and a lack of personalized study conditions contribute to mental fatigue and reduced learning outcomes. To address these challenges, we propose the development of an **IoT-based Smart Study Desk**—a cost-effective and user-friendly system designed to create a conducive and responsive study environment using basic sensors and automation technologies.

Our smart desk integrates sensors such as an LDR (Light Dependent Resistor) to monitor ambient lighting, a DHT11 sensor to measure temperature and humidity, and actuators such as LEDs and a DC fan to respond to these conditions. Using the ESP32 microcontroller, the system can intelligently decide when to turn on the fan if the room temperature exceeds a certain threshold or light up the desk area when the room becomes dim. These automatic responses aim to reduce manual intervention, allowing students to stay focused for longer durations.

In addition to automation, the project includes Blynk IoT platform integration, allowing users to control the system remotely via a smartphone and toggle automation on or off. This flexibility adds convenience while promoting efficient energy usage. The smart desk represents a practical implementation of IoT principles in daily life and contributes toward building smarter, more adaptive environments for students. It encourages healthier study habits by maintaining comfort and minimizing distractions, making it especially relevant for long study sessions in variable indoor environments.

RESEARCH GAP

- **Lack of Low-Cost Prototypes for Personal Use**
  Most research focuses on high-end or commercial smart desks for office or institutional settings, but few explore **affordable, low-power solutions** tailored to individual students or home-study use cases, especially in developing countries.

- **Limited Exploration of Basic Component Integration**
  Existing studies often integrate advanced IoT hardware and cloud systems. There is minimal research on **simple, sensor-based implementations (like LDR, DHT11, and DC fans)** that are more accessible to hobbyists, students, and entry-level developers.

- **Underutilization of Local Control Without Full Automation**
  Most models are either fully automatic or rely on cloud-based applications. There is a lack of systems that **allow users to manually override automation (e.g., via apps like Blynk)** for flexibility and learning control.

- **Neglect of Power Source and Energy Management Issues**
  Although some papers explore low-power designs, **power management and external power supply solutions** are not deeply addressed, which is essential when working with motors or fans in compact IoT setups.

COMMUNICATION PROTOCOL

The sensors and actuators in the Smart Study Desk communicate directly with the **ESP32 microcontroller** using the following methods:

- **Digital Read**:
    - **LDR Sensor** – Used to detect ambient light using the **digital output pin** (high or low based on light intensity threshold set by the onboard comparator).
      (Note: We are not using analog pins or ADC in this setup.)
- **Digital Write**:
    - **LED** – Controlled by ESP32 to turn on/off based on ambient lighting (via LDR).
    - **DC Fan** – Switched on or off depending on temperature conditions obtained from the DHT11 sensor.
- **Single-Wire Digital Communication**:
    - **DHT11 Sensor** – Communicates temperature and humidity data to the ESP32 using a **digital data pin** through a single-wire protocol.

METHODOLOGY

1. Ambient Light Detection

- LDR (Digital Output) → Connected directly to an ESP32 digital input pin.
- If it's dark, the ESP32 turns ON the LED automatically.

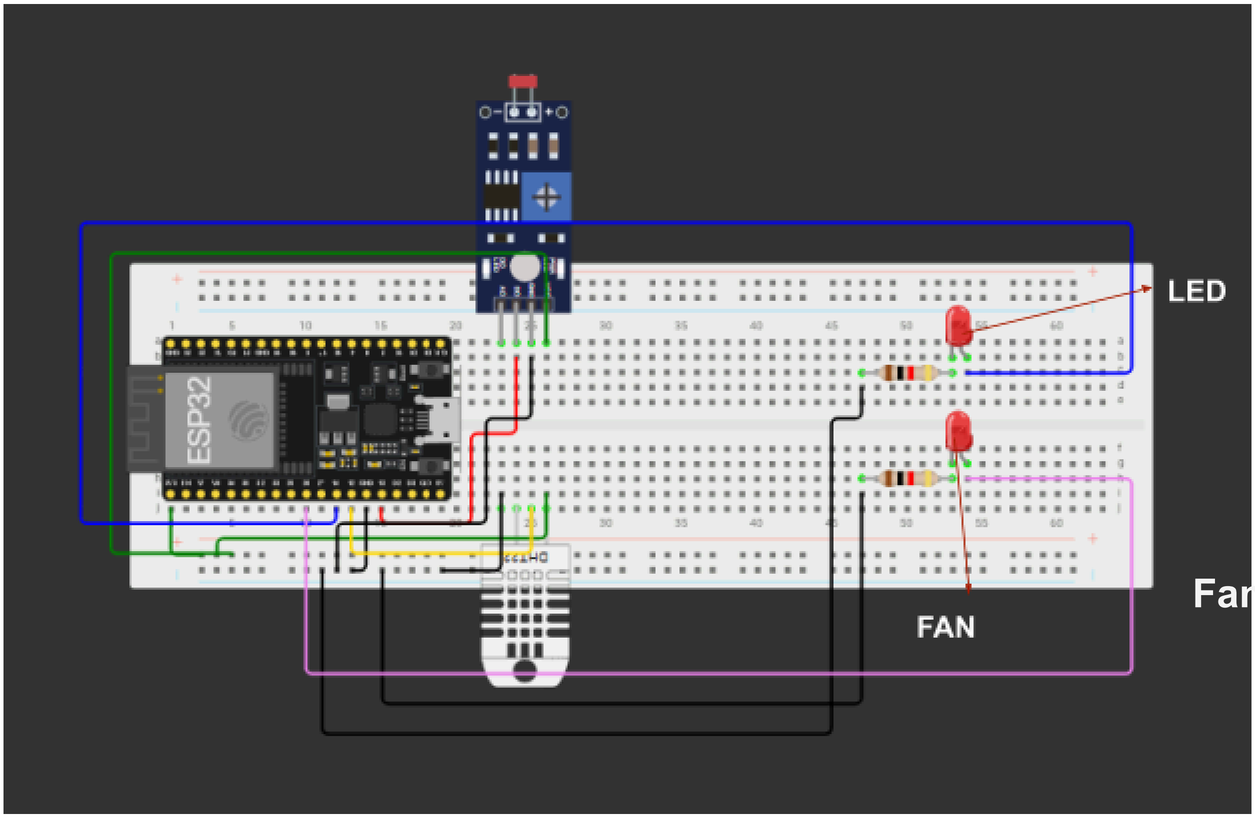
2. Temperature Monitoring

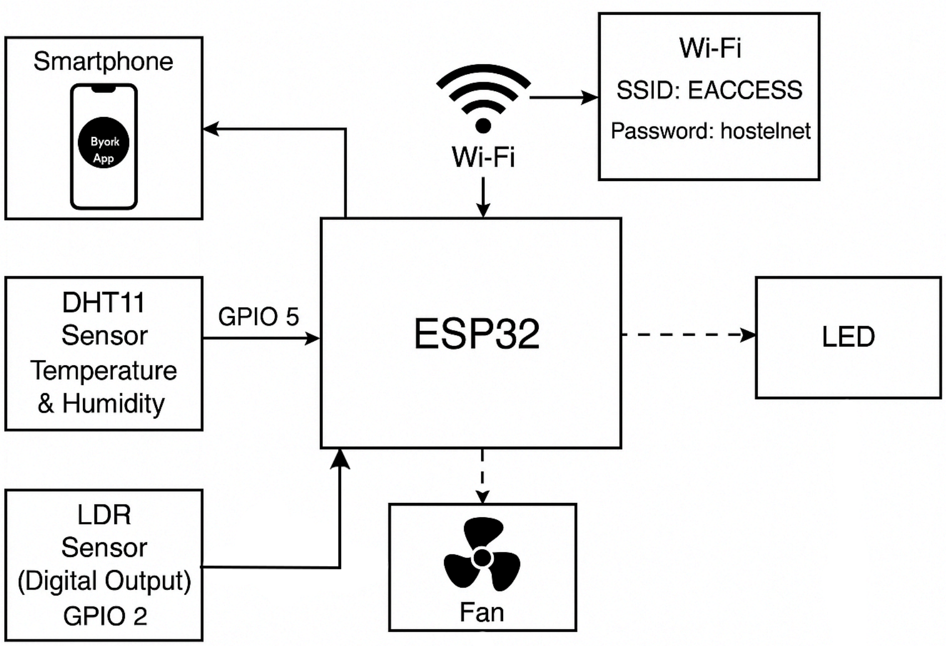
- DHT11 Sensor sends temperature and humidity data to the ESP32 using a single digital pin.
- If the temperature exceeds 28°C, the ESP32 triggers a digital HIGH signal to turn ON the DC fan.
- The fan turns OFF once the temperature drops below the threshold.

3. Automation Output

- The ESP32 processes the input from the LDR and DHT11 sensors.
- Based on logic conditions, it uses `digitalWrite()` to control:
  - LED (based on light level)
  - Fan (based on temperature)

CIRCUIT DIAGRAM





CONCLUSION

The IoT-Based Smart Study Desk project successfully demonstrates how simple and cost-effective components can be integrated using an ESP32 microcontroller to create an intelligent and responsive study environment. By using a digital-output LDR sensor, the system efficiently detects ambient light and controls an LED for optimal lighting. Additionally, the DHT11 sensor monitors temperature, enabling automatic control of a DC fan to maintain a comfortable atmosphere.

This prototype not only promotes energy efficiency and user comfort but also highlights the practical application of embedded systems and IoT principles in everyday life. Its modular nature ensures easy upgradability, such as integrating Bluetooth or cloud-based control in the future. Overall, this project serves as a foundation for further innovation in smart workspace automation and encourages hands-on learning in sensor-based IoT development.