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INTERNATIONAL TINKER INNOVATION & ENTREPRENEURSHIP CHALLENGE (i-TIEC 2025)

"Fostering a Culture of Innovation and Entrepreneurial Excellence"



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Kampus Pasir Gudang

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A-ST042: HOME AUTOMATION WITH ENERGY EFFICIENCY SYSTEM

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ABSTRACT

The Home Automation and Energy Efficiency System project is a prototype that aims to enhance household management by integrating renewable energy sources with Internet of Things (IoT) technology. The system automates and optimizes household utility control such as lighting, HVAC, and appliances using a microcontroller and a variety of sensors, including motion sensors, temperature and humidity sensors, and light sensors. The project shows considerable convenience and energy efficiency improvements, contributing to environmental sustainability. The IoT platform provides remote monitoring and control, allowing users to operate their home systems from anywhere via a smartphone application. This capability, together with real-time data processing and monitoring, ensures energy savings and user comfort by automatically controlling equipment based on occupancy and surroundings. The results of this project demonstrate its ability to reduce energy usage and promote sustainable living practices.

Keywords: Home Automation, IoT, Smart Home, sensors, microcontroller.

1. Product Description

The process of developing a Home Automation and Energy Efficiency System requires some steps, including system design, component implementation, and programming. The system runs on solar power which is renewable energy. The Arduino microcontroller is used as the primary control unit in this project, connected with inputs including the BH1750 light sensor, DHT22 temperature and humidity sensors, and VL53LOX motion sensors. The objective of the system is to increase efficiency by automating the control of appliances, ventilation, and lighting in the house and also by using sustainable energy that is solar energy. Input from the sensors is processed by the microcontroller and connected to the Blynk IoT platform to enable remote monitoring and control via a smartphone application.

2. Methodology

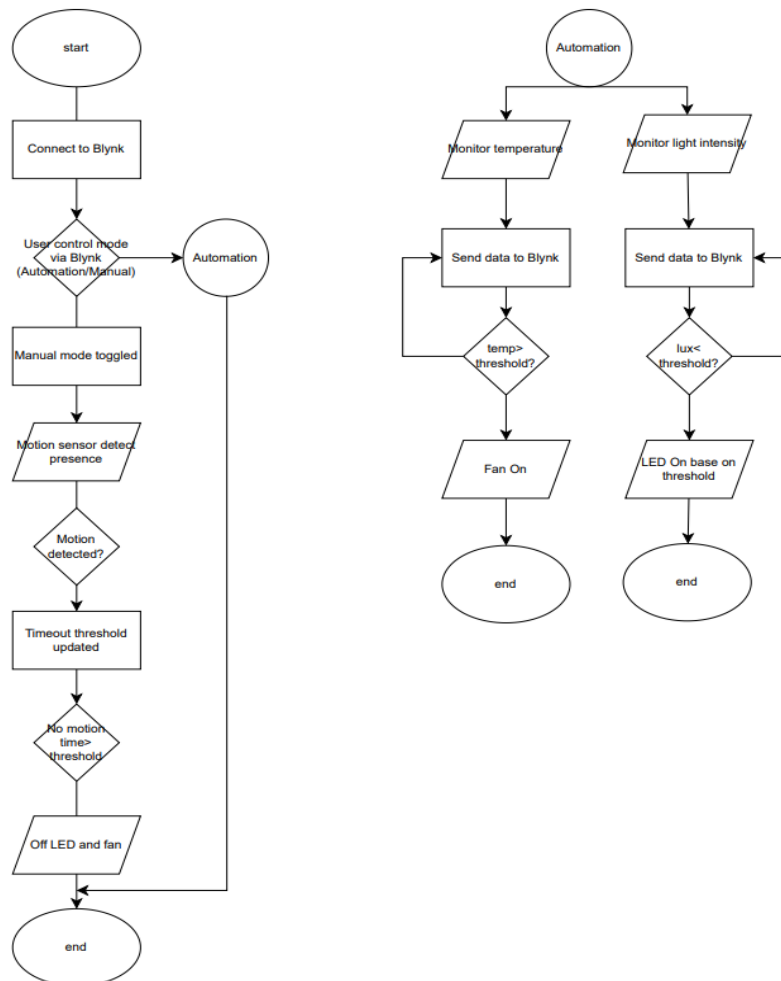


Figure 1. Flowchart of the system

Figure 1 shows the flow of the system. The system consists of 2 modes that can be toggled using Blynk. The flowchart illustrates a system that uses the Blynk IoT platform to control appliances like fans and lights through both automation and manual modes. Initially, the system connects to Blynk, where the user selects either Automation Mode or Manual Mode. In Manual Mode, the system relies on a motion sensor to detect presence. If motion is detected, the system remains active; otherwise, it monitors the elapsed time since the last motion. If no motion is detected beyond a specified threshold, the system turns off the LED and fan. On the other hand, in Automation Mode, the system operates autonomously by monitoring temperature and light intensity. It sends this sensor data to Blynk and performs actions based on predefined thresholds. If the temperature exceeds a set limit, the fan turns on, while low light intensity triggers the LED to turn on. This dual-mode operation ensures both convenience and energy efficiency, allowing users to rely on automation or manually control appliances as needed.

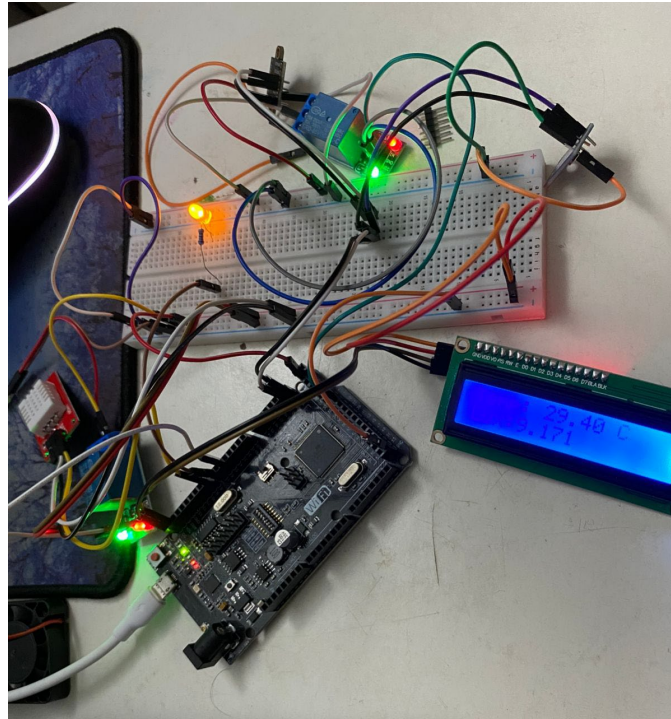


Figure 2. Project development

Figure 2 shows the project development. The system has been through several troubleshooting, a few improvements, and changes throughout the process. The setup includes an Arduino microcontroller as the central component, connected to various peripherals on a breadboard for prototyping. There are multiple components wired to the system, such as LEDs, sensors, and a relay module, which indicate active monitoring and control of devices. A 16x2 LCD screen displays real-time data, including temperature readings. The wiring includes jumpers connecting components like a temperature sensor, motion detector, or other IoT-related modules, and a USB cable powers the Arduino and facilitates data communication. This setup demonstrates a functional prototype for a smart monitoring and automation system, integrating sensors, actuators, and a display for interactive feedback.

Figure 3 showcases the interface of a Blynk-based IoT application, designed for monitoring and controlling smart devices. The dashboard features a simple and intuitive layout, including a toggle switch to manually turn the system or connected appliances on and off. A temperature gauge prominently displays the current reading as 29 °C, providing real-time environmental monitoring within a scale of 0 to 100. Additionally, there are separate toggle switches labelled sensors and motion, allowing the user to activate or deactivate functionalities like general sensors and motion detection. This interface combines real-time data visualization with control options, making it easy to manage and monitor the system efficiently.

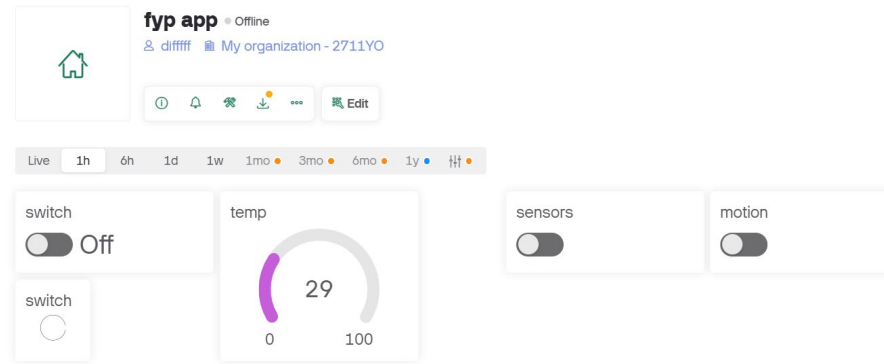


Figure 3. Blynk dashboard

3. Novelty and uniqueness

This project stands out because it combines IoT technology with sensor-based automation, giving users a customizable smart home solution. Unlike conventional systems, this system allows users to switch between automated control (using temperature and light sensors) and manual motion detection via the Blynk IoT platform. The system provides real-time data such as light intensity and temperature for monitoring from the sensors. These readings are simultaneously transmitted to the Blynk app on users' smartphones. The ability to remotely control these systems using the Blynk app offers flexibility. Users can switch between automation and manual operation, making this system practical and adaptable.

4. Benefit to mankind

By encouraging sustainability, energy efficiency, ease, and intelligent control for common appliances, this initiative has enormous positive effects on humanity. Installing a solar-powered system lowers electricity prices and lessens dependency on non-renewable energy sources, helping to create a cleaner world. Automating lights and fans according to environmental circumstances lowers wasteful energy use, which lowers electricity costs and creates a more sustainable atmosphere. Convenience and safety are increased by the option to remotely control automation using Blynk, which guarantees users have control even when they are not at home. For instance, users can stop motion-based systems when traveling or activate automated lighting control at work.

5. Innovation and Entrepreneurial Impact

By integrating IoT, sensors, and automation into a scalable smart home system, this initiative fosters creativity. It promotes the adoption of energy management systems that are based on technology and can be customized to meet specific needs. From an entrepreneurial perspective, this solution has great potential in the growing smart home market. Its adaptability enables it to be expanded to include new features and devices such as appliance monitoring, energy tracking, and security systems, allowing for further innovation and

product development that can suit users' preferences. Furthermore, this project promotes an innovative culture by demonstrating the benefits of combining hardware components with software platforms. It demonstrates how simple, low-cost components can be used to create impactful solutions for energy efficiency and home automation, inspiring future developers, students, and entrepreneurs to pursue similar technology-driven approaches.

6. Potential commercialization

In the rapidly expanding global smart home and IoT industries, the project has immense commercialization potential. Its capacity to combine manual IoT control with sensor-based automation appeals to both household and business users seeking adaptable, energy-efficient solutions. By providing remote access via IoT, the system appeals to tech-savvy customers who value convenience and energy efficiency. With minor changes, this project could be expanded to include voice control, for example, Google Assistant and Alexa, power consumption tracking, and integration with larger home automation ecosystems.

7. Acknowledgment

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