# An Improved AI Based Light And Fan Control System Using YOLO Deep Learning To Reduce Electricity Consumption

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*Abstract-* *An innovative indoor automation system enhances energy efficiency by combining real-time object detection with environmental sensing. Using the YOLO algorithm in Python and light/temperature sensors, it monitors human presence and room conditions to control lights and fans. The system includes three modules: computer vision for occupant detection, sensors for environmental monitoring, and an automated control unit for appliances. It ensures devices operate only when needed, promoting energy efficiency and supporting sustainable living.*

*Keywords*- YOLO Algorithm, Automation System, Environmental Sensing.

## I. INTRODUCTION

In recent years, smart automation systems have gained momentum for improving convenience and energy efficiency. A key application is automating indoor lighting and climate control, where traditional systems often lead to energy wastage due to manual or scheduled control. This project proposes an intelligent system using Python and YOLO object detection to automate light and fan control based on human presence and ambient conditions. The system integrates computer vision with light and temperature sensors to respond dynamically to room activity. When occupancy is detected, lights are turned on; if the temperature exceeds a set threshold, the fan activates automatically. If no occupancy is detected, both lights and fan are turned off, ensuring devices operate only when needed.

The rest of this paper is organized as follows. The next section composes a review of similar researches that have been implemented and tested for Home Automation for Energy Efficiency. In Section III, the proposed algorithm is described. The stages of the proposed AI-based fan and light control system. In Section IV, experimental results are reported. Finally, some conclusions are given and future work is proposed.

## II. LITERATURE SURVEY

Literature Survey is most important step in the software development process. Before developing the tool, it is necessary to determine the time factor, economy and company strength. Once these things are satisfied, the next step is to determine which operating system and language can be used in developing the tool.

[1] **Energy-Efficient Smart Home Automation System Using Deep Learning** Techniques by A. Singh and R. Gupta, discusses the challenges in smart home automation, such as optimizing energy consumption, ensuring real-time responsiveness, and maintaining user comfort. The authors propose a system that integrates deep learning—specifically Convolutional Neural Networks (CNNs)—with environmental sensing to manage energy usage intelligently. YOLO (You Only Look Once) is used for accurate human detection under varying lighting conditions, while sensors monitor light intensity and temperature. This combination significantly reduces false activations compared to traditional motion sensors, making the system more efficient and responsive.

[2] **IoT-Based Smart Lighting and Climate Control** by A. Kumar and S. Verma presents an IoT-enabled system designed to optimize energy consumption and improve user convenience. The system uses LDR and DHT11 sensors to monitor light intensity and temperature, with a machine learning algorithm that adapts to user behavior for predictive control of lights and fans. A mobile app interface enables real-time remote control and monitoring, along with insights into energy usage to promote energy-saving habits. Experimental results showed up to 35% energy savings while maintaining comfort. The authors also suggest future enhancements with motion and air quality sensors to improve automation in residential and commercial settings. The paper highlights IoT and AI's role in sustainable energy management for homes and businesses.

**[3] AI-Driven Smart Home Automation for Energy Efficiency** by R. Sharma and P. Mehta introduces an AI-based home automation system aimed at enhancing energy efficiency through intelligent control of lighting and climate systems. The system integrates environmental sensors, such as DHT11 for temperature and LDR for light intensity, with a neural network to optimize appliance operation. It adapts to user habits, adjusting lighting and fan settings based on room conditions and occupancy, resulting in a 40% reduction in energy usage compared to manual systems. A mobile app enables real-time monitoring and manual control. The study also suggests future improvements like integrating renewable energy sources and additional sensors for better air quality

**[4] Overhead View Person DetectionUsing YOLO** by M. Ahmad, I. Ahmed, and A. Adnan explores using YOLO for real-time person detection in overhead view scenarios. The study addresses challenges such as perspective distortions and occlusions, utilizing YOLO's deep learning-based object detection for accurate detection. YOLO's performance was compared to traditional methods like Haar cascades and HOG+SVM, with results showing superior speed and accuracy.

The system demonstrates potential applications in crowd monitoring, industrial safety, and smart surveillance. The study emphasizes the effectiveness of YOLO in enhancing real-time detection efficiency for modern surveillance systems.

The literature survey explores the progression of smart home automation systems, starting from traditional manual control methods to more advanced, AI-driven solutions. Traditional systems often lead to inefficiencies and energy wastage, while modern solutions leveraging IoT and deep learning technologies offer greater accuracy and responsiveness. Systems using environmental sensors and machine learning algorithms, like those integrating YOLO for object detection, enhance energy efficiency by adapting to user behaviour and room conditions. However, challenges remain, including integrating renewable energy sources and ensuring seamless user experiences. This survey emphasizes the potential of combining AI, IoT, and machine learning to create intelligent, energy-efficient systems, laying the foundation for the proposed smart home automation project with real-time control of lighting and climate.

### III. METHODOLOGY

This project integrates hardware configuration, software development, and system testing to create an intelligent, energy-efficient lighting and fan control system.

The hardware setup includes a microcontroller with serial communication, an LDR for light sensing, a temperature sensor, and relays to control the fan and lighting, all powered by a stable external supply.

The microcontroller was programmed to read sensor data and communicate with a Python-based host system using serial communication. It makes real-time decisions to control appliances based on predefined thresholds.

On the software side, a Python program using the pySerial library was developed to interface with the microcontroller and a YOLO-based deep learning model for human detection.

The system processes camera frames, detects human presence, and evaluates light and temperature levels to trigger device control. Integration involved uploading firmware and running the Python script. Testing validated YOLO detection accuracy, sensor responsiveness, and communication reliability. Stress tests ensured system performance under challenging conditions like poor lighting and partial human visibility.

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The diagram illustrates the operational workflow ofAn Improved AI Based Light and Fan Control System Using YOLO Deep Learning to Reduce Electricity Consumption

**Frame Acquisition**
- Continuously read frames from a camera using OpenCV or similar tools.

**Human Detection via YOLO Model**
- Feed the acquired frames into a pre-trained YOLO deep learning model.
- Detect the presence of humans in the frame with real-time inference.

**Detection Output Processing**
- If a human is detected, send the detection result to the microcontroller via Serial Communication (COM port).
- If no human is detected, continue scanning frames.

**Sensor Data Collection**
- **LDR (Light Dependent Resistor):** Measures ambient light intensity.
- **Temperature Sensor:** Measures room temperature.

**Microcontroller Decision Logic**
- Based on inputs from:

- o   Human Detection (via YOLO),
- o   LDR sensor,
- o   Temperature sensor,
- Decide whether to:
    - o   Turn on/off the LED (light),
    - o   Turn on/off the fan.

**Device Control**

- The microcontroller sends output signals to:
    - o   **LED** – turns on if a human is present and it's dark.
    - o   **Fan** – turns on if a human is present and the temperature is high.

**Loop Execution**
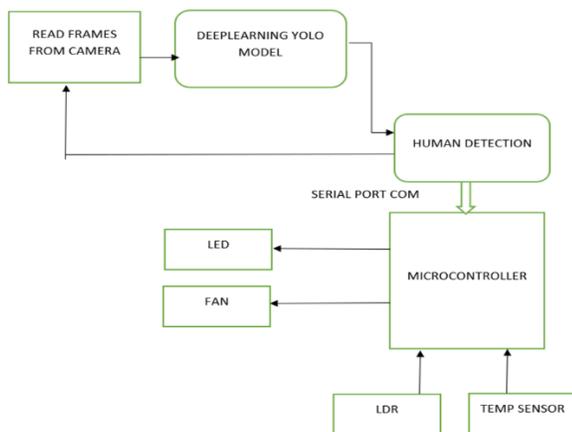
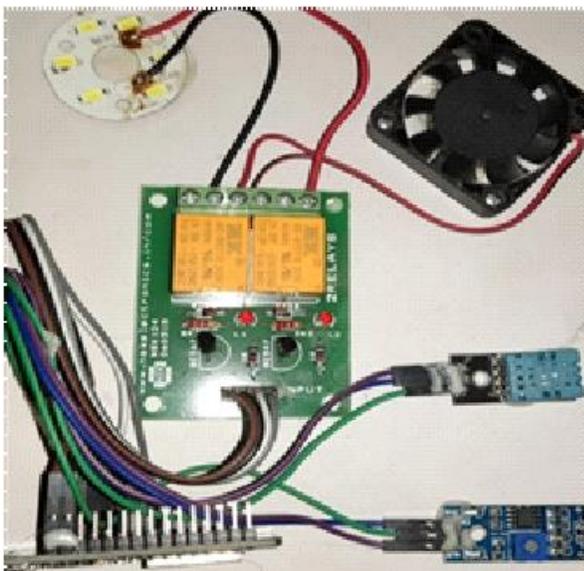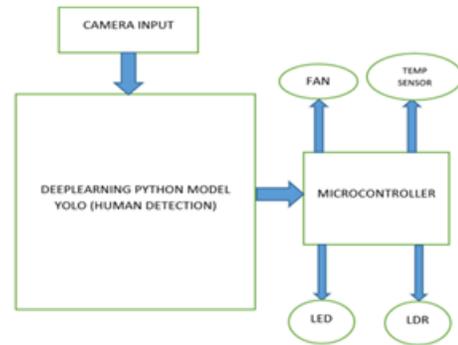- Continue the process in a loop for real-time automation.



**Figure 1 :Overall Methodology Flowchart for Automated Light and Fan Control System Using YOLO and Environmental Sensors**

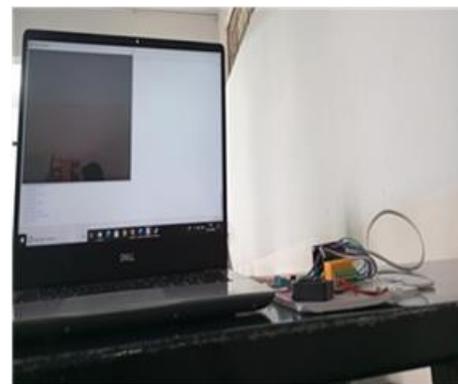## IV. SNAPSHOTS



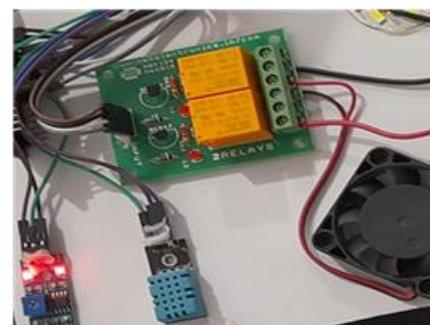**Snapshot 1:Smart Control Device**



**Snapshot 2: Bluetooth Connection Test**



**Snapshot 3**: **Camera for Human Detection**



**Snapshot 4: LDR Sensor Activation**



**Snapshot 5: Human Triggered lighting**

## V. CONCLUSION

In conclusion, the development of an intelligent system for automatic lighting and fan control based on human presence, ambient light intensity, and room temperature represents a significant step towards enhancing convenience and energy efficiency in indoor environments. Through the integration of Python programming, YOLO object detection, and microcontroller-based hardware, we have successfully created a robust and responsive system capable of making real-time decisions to optimize lighting and climate control. By leveraging computer vision techniques, the system accurately detects human presence in the room, enabling it to initiate lighting and fan control actions accordingly.

The use of YOLO object detection ensures high accuracy and reliability even in varying lighting conditions, enhancing the system's usability in real-world scenarios. Additionally, by incorporating sensors such as the Light Dependent Resistor (LDR) and temperature sensor, the system intelligently adjusts its operations based on environmental factors. This proactive approach to lighting and climate control not only improves user comfort but also contributes to energy conservation by minimizing unnecessary energy consumption. Furthermore, the system's modular design ensures scalability and adaptability for diverse use cases, making it suitable for both residential and commercial applications.

The integration of real-time data processing and automated decision-making demonstrates the potential of smart systems in revolutionizing energy management practices. Beyond its primary functions, this system can serve as a foundation for future enhancements, such as voice control, integration with IoT ecosystems, or the inclusion of machine learning algorithms for predictive behavior analysis.

In essence, this intelligent lighting and fan control system exemplifies the growing role of technology in addressing sustainability challenges while improving user experience. By automating routine tasks and optimizing energy usage, it contributes to the broader goal of creating smarter, greener living spaces that align with modern energy conservation goals.

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