Visvesvaraya Technological University, Belagavi – 590010

PROJECT PROPOSAL
ON

KinderNeutron:An Efficient Energy Saving Using IOT and Deep-Learning

Submitted in partial fulfillment of the requirements for the degree

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE & ENGINEERING

Submitted by

Suhas S Bhandary	4SO20CS161
Varsha V Shetty	4SO20CS177
Vijayalaxmi Bhat G M	4SO20CS180
Viyola Henna Dsouza	4SO20CS183

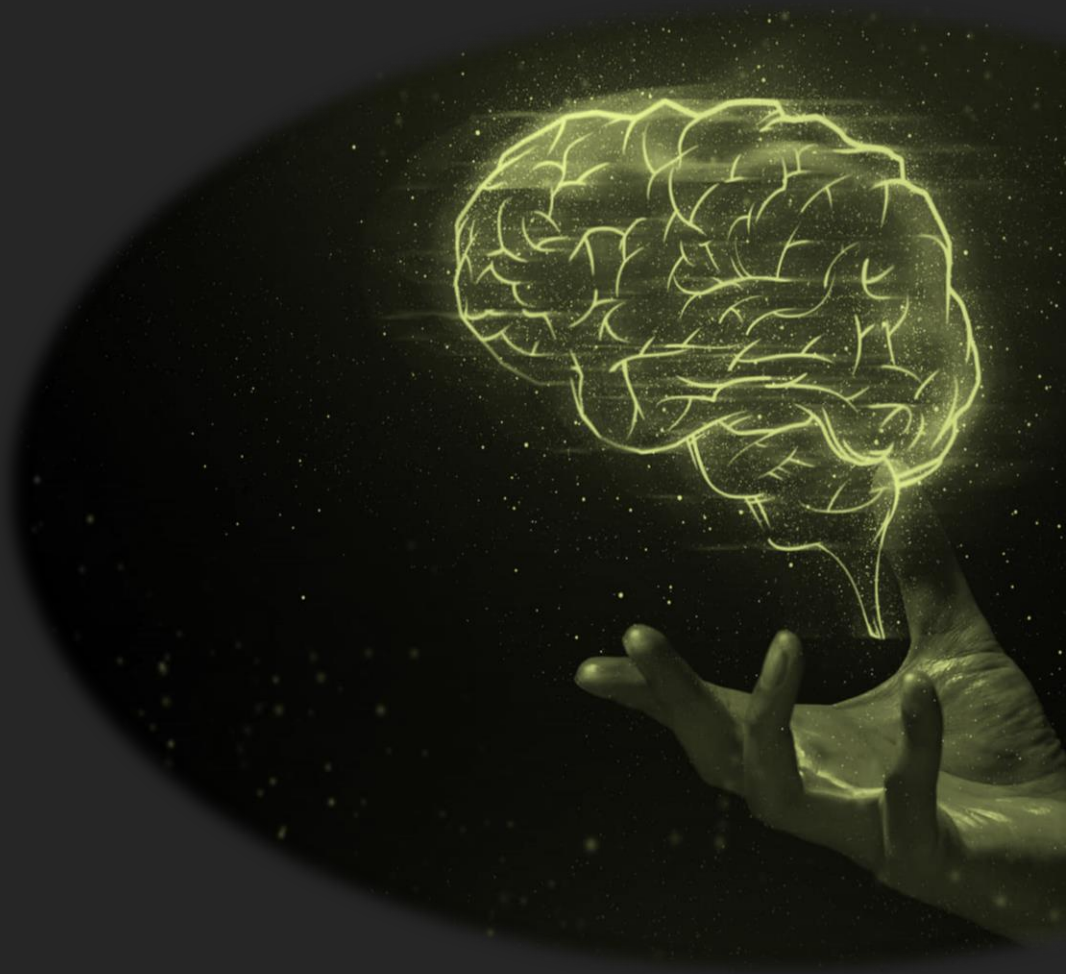
Under the guidance of
Dr. Sofia Rego
(Assistant Professor, CSE Department)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
ST JOSEPH ENGINEERING COLLEGE
An Autonomous Institution
(Affiliated to VTU-Belagavi, Recognized by AICTE, NBA Accredited)
Vamanjoor, Mangaluru-575028, Karnataka

2023-2024

KINDER

NEUTRON



AN EFFICIENT ENERGY SAVING SYSTEM USING IOT AND DEEP-LEARNING, A ROUGH PROPOSAL

AUTHORS:

SUHAS S BHANDARY | VARSHA V SHETTY |VIJAYALAXMI BHAT G M | VIYOLA HENNA DSOUZA

Introduction

Electricity is an essential element of a building's operating system. With the increasing population in India, the education sector is also growing rapidly.Students constitute major sector of Indian Population.They use a large amount of energy in the classroom for in-class activities and fun activities provided in the classroom. But what is troubling in today's globalization is that misuse of electricity can negatively affect the humans and environment. Most of the electricity comes from non-renewable fossil fuels and therefore decreases over time.Many of these today's technologies help us all to save electricity. Too much electricity is wasted in the classroom,by injudicious use. In order to overcome this problem,Smart classroom for saving electricity can be a solution.This project will automatically shut off the lights,fans and other electrical appliances when the last person exits the classroom.At school, or in colleges, sometimes the fan and the lights are on even when no one is in the room or the area. The most common power wasting in an organization is likely due to negligence.In order to avoid wasting electricity, automatic changes to electrical equipment will be considered.This can be acheievd by integrating system with Internet of Things(IoT).The IoT refers to a system of interrelated, internet-connected objects that are able to collect and transfer data over a wireless network without human intervention. We can set up cameras in classrooms, like the ones used for security (CCTV), and link them to a smart system called the Internet of Things (IoT). This smart system connects all the devices and makes them work together. The cameras take pictures, and the smart system looks at these pictures to check if there are people in the classroom. If it doesn't see anyone, it's clever enough to turn off the lights, fans,and other electrical appliances. This is a great way to stop wasting electricity and, at the same time, do something good for our planet by using smart technology. Wireless technology is popular nowadays because it is convenient, easier to construct, and saves cost. Users can get the signal in the long-range without wiring. In this modern age, electricity usage is increasing with sophisticated and versatile electrical appliances. In fact, energy savings are also an important requirement when there is too much electricity usage in the building. In educational institutions, there are too many electrical appliances that students and lecturers need to use while studying, but a huge amount of electricity is wasted due to negligence. Therefore, this project suggests a smart classroom for electricity-saving with integrated IoT system which can also be used at any building, office, dorm or labs.

Problem Statement

Excessive electricity use in classrooms in India's growing education sector is a problem because it costs schools/colleges a lot of money and harms the environment. Often, lights, fans, and air conditioners are left on when nobody is using the room because people forget to turn them off. We can solve this problem by using smart technology. We can install cameras (CCTV) in classrooms and use the Internet of Things (IoT) to connect them to a computer system. This computer system can "see" if there are people in the classroom by looking at the images from the cameras. If it sees that there are no people in the room, it can automatically turn off the lights, fans, and air conditioner. This way, we can save electricity and help the environment using a smart system that learns from the images it captures.

Scope

The current application of the project is to automatically control lights and fans in a room based on live camera recognition of people. It ensures energy efficiency and user convenience by turning off lights and fans when no one is present in the room.

The future scope of this project can be listed as follows:

1. Home Automation: Extend the system to automate various aspects of home management, controlling window blinds, and managing entertainment systems based on room occupancy and user preferences.
2. Smart Buildings: Apply the system to larger buildings or offices for intelligent energy management,optimizing lighting, and other utilities for energy savings.
3. Energy-Efficient Street Lighting: Apply the concept to street lighting, where lights are dimmed or turned off when there are no pedestrians or vehicles nearby, resulting in energy savings for municipalities.

Some of the future updates that can be applied to this project are:

1. AI Enhancements: Continuously improve the deep learning model with more data and advanced techniques for even better person detection accuracy.
2. Voice and Gesture Control: Incorporate voice or gesture control for users to interact with the system without physical switches.
3. Energy Prediction: Use historical data to predict energy consumption patterns and further optimize energy usage based on occupancy forecasts.
4. Multi-Room Integration: Extend the system's capability to control multiple rooms or zones within a building, enabling even more granular control.

Methodology:

1. Define Project Scope and Requirements:

Clearly outline the project's objectives, including the hardware and software components which were planned to use.Specify the room size, camera placement, and the types of lights and fans which we intend to control.

2. Gather Hardware and Software:

Collect the necessary hardware components, including cameras, Arduino or Raspberry Pi, servos for camera control, lights, fans, and IoT modules.Set up the development environment, including installing Python, deep learning frameworks (e.g., TensorFlow, PyTorch), and any required libraries.

3. Develop the Deep Learning Model:

Collect a dataset of images with and without people in the room.Preprocess the images, augment the data if needed, and split it into training and testing sets.Choose a deep learning architecture (e.g., Convolutional Neural Network, CNN) and train the model to recognize

people in the room.Evaluate the model's performance using metrics like accuracy, precision, and recall.

4. Integrate IoT Components:

Connect the Arduino or Raspberry Pi to the lights, fans which were planned to use.Write code to control the lights and fans based on input from the deep learning model.

5. Implement Camera Control:

Set up a camera system with pan and tilt capabilities (using servos or a motorized camera mount).Use similar library like OpenCV to capture live video feed from the camera.Implement object detection using the deep learning model to identify people in the room.If no people are detected for a certain duration, trigger the lights and fans to turn off.

6. Implement IoT Communication:

Establish communication between the deep learning model and IoT components. Create a protocol for the model to send instructions to the Arduino/Raspberry Pi.

7. Testing and Calibration:

Test the entire system in a controlled environment, ensuring that it accurately detects people and controls lights and fans as intended. Calibrate the system for various lighting conditions and room layouts.

8. Deployment and Integration:

Install the system in the target room and integrate it with the existing electrical and IoT infrastructure.

9. User Interface (Optional):

Develop a user interface, such as a mobile app or a web application, for manual control and monitoring.

10. Maintenance and Optimization:

Regularly maintain and optimize the system to ensure it functions efficiently and accurately.Consider adding features like voice control or scheduling.

11. Documentation:

Document the entire project, including hardware connections, software code, and user instructions.

12. Consider Privacy and Security:

Ensure that the camera system respects privacy and follows legal regulations.Implement security measures to protect the IoT components and data.

13. Troubleshooting:

Plan for troubleshooting and provide support for potential issues that may arise during operation.

14. User Training:

If applicable, provide user training on how to use and interact with the system.

Feasibility Study:

The feasibility study of this project is to create an automated system that reduces energy consumption by controlling lights and fans in a room based on real-time occupancy detection through a deep learning model and provides user-friendly automation and control options.

1. Technical Feasibility:
    - Assess the availability and compatibility of the necessary hardware components (camera, Arduino, servo motors, IoT modules, lights, fans, etc.) for the project and ensure they can work together seamlessly.
    - Evaluate the feasibility of implementing the deep learning model and the required software components for real-time video processing and IoT integration.

2. Economic Feasibility:
    - Estimating the total project cost, including hardware, software development, testing, and deployment costs.
    - Determining the potential energy savings from automating lights and fans. Calculate how long it will take for the project to pay for itself in terms of energy cost savings.

3. Operational Feasibility:
    - Assessing whether the system can be operated by end-users without significant technical knowledge.
    - Evaluating the reliability of the system and the need for maintenance and updates.

4. Legal and Regulatory Feasibility:
    - Investigating legal and regulatory requirements for installing and operating such a system, including privacy regulations related to video surveillance.
    - Ensure compliance with local building codes and safety regulations.

5. Risk Analysis:
    - Identify potential risks and challenges that could affect the project's success, such as technical issues, budget overruns, or regulatory hurdles.
    - Develop contingency plans for addressing these risks.

6. Environmental Impact:
    - Considering the environmental impact of this project, especially in terms of energy savings and determine if the project aligns with sustainability goals.

Hardware/Software requirements:

1. Camera Module: A camera module, such as a Raspberry Pi Camera, to capture live video feed for person detection.
2. Microcontroller: A microcontroller like Arduino Uno to control hardware components and interface with the camera and other devices.
3. Servo Motors: Servo motors for camera pan and tilt, allowing it to cover the entire room.
4. Operating System:An appropriate OS for the microcontroller and any involved servers or computers.
5. Switches: Switches to control lights and fans, ensuring compatibility with the electrical load.
6. Power Supply: Power sources with proper voltage and current ratings for camera, microcontroller, servo motors, and other components.
7. Deep Learning Framework: A deep learning framework like TensorFlow or PyTorch for developing the person detection model.
8. OpenCV: The OpenCV library for image processing tasks and camera interface.
9. Programming Languages: Proficiency in Python for deep learning development, C/C++ for Arduino programming.
10. Installed Memory(RAM):8.00 GB
11. Processor:Intel i7 10th generation, RTX 3060 GPU with 6GB of VRAM
12. Hard disk space:256GB SSD

Cost Estimation

The detailed cost estimation for the project is pending and will be finalized after a thorough assessment of component prices and quantities.

References

[1] Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT Press.

[2] Smith, J. (2020). The application of deep learning in image recognition. Journal of Artificial Intelligence Research, 45(2), 123-135.

[3] Banzi, M., & Shiloh, M. (2014). Getting Started with Arduino: The Open Source Electronics Prototyping Platform. Maker Media, Inc.

[4] Monk, S. (2016). Programming Arduino: Getting Started with Sketches. McGraw-Hill Education