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ENHANCING ACCESSIBILITY AND INCLUSIVITY FOR PEOPLE WITH DISABILITIES

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ABSTRACT

This study introduces a new method of home automation tailored to the needs of those who have trouble moving about. Using only your hands, you can turn on and off lights, fans, and other electrical devices. Providing individuals with mobility impairments with the means to autonomously manage their living area is the declared goal of the initiative, which aims to encourage greater independence and better their quality of life. The suggested system uses computer vision and machine learning techniques to decipher recorded hand motions seen through a camera interface. The system may be able to interpret specific hand movements as commands to operate different home appliances if it has learned to recognize them. We create and deploy a reliable system for the detection and categorization of gestures in real-time. Modern computer vision techniques, including Convolutional Neural Networks (CNNs) and algorithms for hand tracking, enable the system to accurately understand motion. Assigning certain commands to the recognized motions allows for the operation of smart home electrical products, such as lighting and ceiling fans. Plus, if the disabled person needs assistance, this device may notify the caregiver. We aim to enable people with impairments to live more independently and comfortably in their homes by giving this home automation system that is controlled by gestures. Accessibility and inclusion in smart home settings are significantly advanced by our effort, which leverages state-of-the-art technology and prioritizes user-centric design concepts.

Keywords: Machine Learning, Home Appliances, Computer Vision, Gesture Recognition, Convolutional neural network, Alert messages.

I.INTRODUCTION

More and more consumer goods and mobile phones are allowing users to interact with them using hand gestures. A systematic and efficient plan is necessary to ensure that items may be easily accessed by the elderly and the disabled who are unable to walk. Technological procedures are combined with automation in this concept. Traditional home automation systems are not accessible to those with physical limitations or advanced age. Our intended users are those who

struggle to complete common tasks with ease and speed. Wearable sensors that were physically fastened to the hand using gloves were the exclusive means of hand motion recognition in the past. When the user bent their fingers or moved their hands, the sensors picked up on a physical response. A computer was linked to the glove so it could process the data. Help is on the way for those who are physically unable to do things well because to online and gesture automation. Commonplace home appliances that incorporate IoT extensively. This project report explores the creation and execution of a gesture-controlled home automation system that is tailored to the needs of individuals with impairments. This system utilizes gesture recognition technology with the aim of creating an easy-to-understand interface for managing electrical appliances such as lights and fans in the home. Thanks to advancements in communication protocols, microcontrollers, and sensors, people will be able to easily engage with their environments, granting them greater agency in their daily lives.One area of study in human-computer interaction is hand gesture recognition, which enables computers to comprehend and react to the typical hand movements. Home automation systems conserve energy and cut down on the need for human involvement. Plus, if the disabled person needs assistance, this device may notify the caregiver. A giant leap toward a more accessible and inclusive world for people with impairments has been made possible by home automation systems that employ hand gesture detection technologies.

II.LITERATURE REVIEW

The literature evaluation of a few studies that provides further details on their use of deep learning in home automation appliances is provided below. Several scholars are analyzing hand gestures for their studies.

Jayashree Katti et al. (2021) focused on improving and streamlining human life. Electronic devices can be controlled with hand gestures. Additionally, this will be beneficial given the current state of the COVID-19 pandemic, its important to keep a social distance and use contact-free gadgets which are advantageous in public areas. The most common and significant form of communication in contemporary life is through hand gestures. They can help with the creation of safe and welcoming user interfaces for various applications. Several computer vision algorithms have employed color and depth cameras to identify hand gestures, but it is still difficult to classify movements from diverse persons accurately.

According to Akanksha Kulkarni et al. (2021), the CNN model for defining gesture and controlling devices with specific movements. In this COVID-19 pandemic condition, gesture recognition technology will be simple to use, effective, and secure.

Abdullah Mujahid, et al.'s study from 2021 was to observe how gestures can aid those with particular difficulties in conversing with others. This research provides a lightweight model for gesture identification that does not require additional preprocessing, image filteration, or image enhancement. It is based on convolutional neural networks, specifically DarkNet-53 and YOLO (You Only Look Once) v3. The proposed model was able to correctly identify motions in low-resolution picture mode and in a difficult environment. The proposed model was evaluated using a labeled dataset of hand gestures in the Pascal VOC and YOLO formats. Through feature extraction from the hand and hand movement recognition using our proposed YOLOv3 based model, we were able to provide improved results with accuracy, precision, recall, and an F-1 score of 97.68, 94.88, 98.66, and 96.70%, respectively. Additionally, we contrasted our model with Single Shot Detector (SSD) and Visual Geometry Group (VGG16), both of which had accuracy rates of 82–85%. Static hand images and dynamic motions captured on video may both be detected in real time using the trained model. 97.68, 94.88, 98.66, and 96.70% for accuracy, precision, recall, and an F-1 score, respectively. Furthermore, we compared our model with the 82–85% accuracy rates of the Single Shot Detector (SSD) and the Visual Geometry Group (VGG16). The trained model may be used to recognize both dynamic motions collected on video and static hand photographs in real time.

A new method that identifies hand gestures based on Indian Sign Language and produces text and voice output from it based on Indian Sign Language and produces text and voice output from it. has been proposed by Uma N. M. et al. (2021). This system employs a vision-based technique in which web cameras and other technologies are used to record hand motions and face expressions. Using image processing and a neural network to classify the collected images, Open CV is a software that translates hand movements and facial expressions into text and speech. It is based on hardware that uses a Raspberry Pi computer.

III.PROPOSED METHODOLOGY

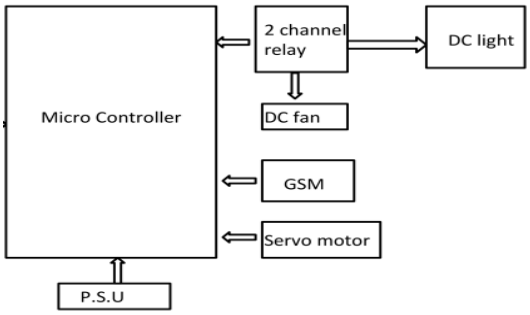

Figure 3.1 Model of the block diagram of the proposed system

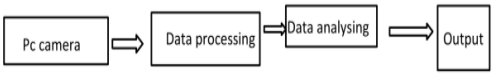

Figure 3.2 Model of the block diagram in the receiver side

The proposed home automation system integrates deep learning with microcontroller technology, 2-channel relays, GSM connectivity, servo motors, direct current (DC) lighting and fans, and UART communication to create an intelligent and energy-efficient home. Through the application of deep learning algorithms, the system will adjust to user preferences and behavior in order to optimize energy consumption.

An Arduino or Raspberry Pi, or any number of similar microcontrollers, can be used to manage and coordinate a wide variety of household devices. The 2-channel relays may automate DC lights and fans when used as switches, allowing users the ability to remotely supervise and plan their operation. This aids in energy efficiency and adds to the convenience.

With the use of GSM technology, remote control and monitoring are now possible using mobile devices. By receiving real-time updates, configuring preferences, and remotely operating devices, users may remain engaged with their home automation system even when they're not physically present. The system utilizes servo motors to control smart blinds and drapes, which enhance privacy and save energy use.

A more responsive and integrated home automation system is possible with UART connectivity, which allows data to be quickly exchanged between the microcontroller and other associated devices. With a focus on energy savings, convenience, and security, the proposed system integrates multiple technologies to create an intelligent and intuitive home automation solution. The ability to learn and adjust to customer preferences makes this home automation system both cutting-edge and future-proof.

1. SENSOR INTERFACING

Interfacing with sensors involves a number of signal conditioning techniques, including amplification, filtering, and conversion from analog to digital. Even if your microcontroller has an analog-to-digital converter (ADC), you'll still have to modify the sensor so it can communicate with it.

2. PREPARING POWER SUPPLY UNIT

To ensure that the internal components of a controller have access to low-voltage regulated DC power, a power supply unit (PSU) transforms mains AC power. A power supply is utilized to transform the 240 volts AC mains electricity into a more usable 12 volts DC voltage. Linear and switch mode power supplies are the two main varieties. The voltage is reduced in a linear power supply by means of a transformer. In order to generate a high DC voltage, the AC signal is rectified and controlled.
Often housed in a design resembling an AC connector, an AC adapter (also known as an AC/DC adaptor) transforms one form of external power source into another. You might hear the term "charger" or "recharger" used to describe adapters for devices that run on batteries. When an electrical equipment needs power but doesn't have the internal components to generate the voltage and current from the mains, an AC adapter can be utilized. An external power supply's internal circuitry is extremely similar to that of an integrated or internal power supply.

3. PROGRAMMING MICROCONTROLLER

Depending on its programming, a microcontroller—a programmable integrated circuit—can perform a wide variety of tasks. Microcontrollers come in a variety of types and may perform a wide range of tasks. One of the most potent instruments in contemporary design is the microcontroller, which is characterized by its adaptability. The fundamentals of microcontrollers and their programming are covered in this guide.

4. READING ANALOG DATA

An analog-to-digital converter (ADC) circuit inside the board's microcontroller takes readings of this fluctuating voltage and converts them to a value between zero and ten thousand. The input value is zero and the voltage traveling to the pin is zero when the shaft is fully rotated in one direction. When the shaft is fully rotated counterclockwise, the input value is 1023 and 5 volts are traveling to the pin. Between these two extremes, the analog Read function takes a voltage input from the pin and outputs a value between 0 and 1023.

IV.RESULT AND OUTPUT

Figure 4.1 Hand gesture recognition

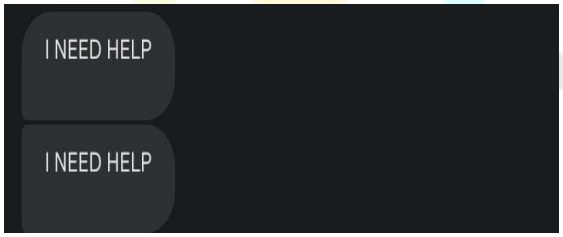

Figure 4.2 Emergency message received to the care taker

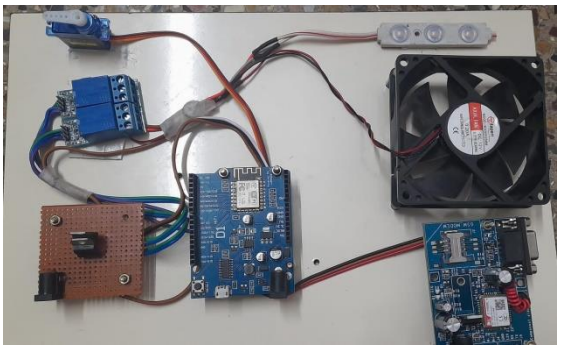

Figure 4.3 Hardware model

Home automation systems that use sign language recognition technologies greatly benefit individuals with disabilities by allowing them to control household appliances through hand gestures. Caring for the elderly or the crippled, who may not always have someone to aid them, can be approached in a unique way using this approach. Traditional home automation systems may not be affordable or specifically designed to meet the needs of individuals with disabilities or advanced age. A clever and futuristic approach, the system can adapt and understand user routines over time with the help of artificial intelligence and deep learning algorithms. The usage of a GSM modem for remote control further enhances the system's accessibility and convenience, allowing clients to securely and effectively manage their properties.

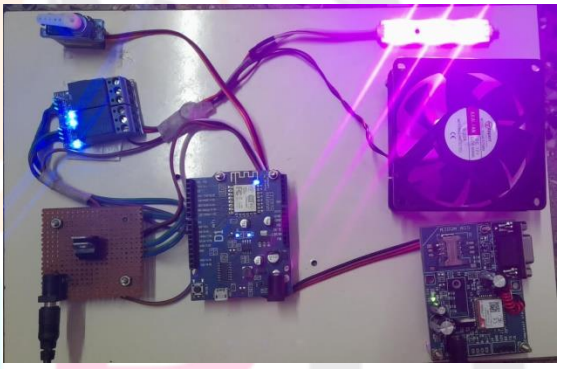

Figure 4.4 Output

V.CONCLUSION

Finally, the suggested home automation system offers an all-inclusive and high-tech answer by combining the capabilities of deep learning, microcontrollers, relays, GSM, servo motors, and UART communication to build an intelligent and user-friendly house. The system learns the user's preferences through the use of deep learning algorithms, which optimizes energy consumption and overall efficiency. Users are able to remotely manage and program the functioning of DC lights and fans with the help of 2-channel relays, and the utilization of a microcontroller as the main processing unit allows for smooth device coordination.

With the use of GSM technology, users can

remotely monitor and control their home automation system, get real-time updates, and do it all from any location. Servo motors automate a previously manual process, such as opening and closing blinds or curtains, which improves privacy and reduces energy use. In addition, a responsive and well-integrated home automation network is fostered by UART communication, which guarantees quick data interchange. By providing adaptability, energy efficiency, and enhanced personalization, this proposed solution not only overcomes the shortcomings of current home automation setups but also looks forward to future demands. All things considered, a comprehensive home automation system that meets the needs of modern life in terms of comfort, convenience, and sustainability is the result of integrating these technologies.

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