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Finger Gesture Recognition based Home Automation using IOT

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Abstract: ***Home automation is a fast-expanding industry that attempts to give homeowners a more practical and effective method to manage their properties. The goal of this project is to create a home automation system using Arduino that recognises hand gestures and controls the linked home appliances using an APDS9960 gesture sensor. To recognise hand movements like up, down, left, and right and to carry out operations like turning on and off lights, fans, etc., the hand gesture algorithm is built using the Arduino IDE. The suggested technique eliminates the requirement for physical switches and offers a more practical and approachable method of operating household equipment.***
Keywords: Home Automation, APDS9960-Gesture Sensor, Arduino UNO, IoT, Contactless Communication

I. INTRODUCTION

Recognition of hand gestures using IoT with the use of hand gestures, consumers can operate home appliances through home automation technology. A computer or microcontroller processes the hand motions captured by sensors in the system in order to interpret them and carry out the intended actions, such as turning on or off lights or altering the temperature. Without the need for physical buttons or switches, this technology provides a simple and convenient method to operate household appliances. Additionally, a system that meets the requirements of the elderly and the disabled and enables remote monitoring of their health is required for the convenience of all parties. Such a system would provide much-needed assistance to them.

II. METHODOLOGY

A. Hardware Configuration

The system combines a gesture sensor with a microcontroller, such as an Arduino.

B. Gesture Detection

The user's hand motions are recognised by the gesture sensor module, which then provides the relevant data to the microcontroller.

C. Gesture Interpretation

To interpret gesture input and link it with predetermined motions that are connected to certain household appliances or tasks, the microcontroller executes an algorithm.

D. Contactless Communication

Following the microcontroller's interpretation of the gesture, the device or appliance (such as a smart bulb or a smart lock) will send a signal to carry out the required action.

III. COMPONENTS REQUIRED

The following components are necessary for the proposed system:

A. Arduino UNO

The ATmega328P microcontroller serves as the base for the open-source Arduino Uno microcontroller board. It was first released in 2010 by the Arduino Corporation in Italy.
Here is a brief description of each pin:
Reset: The microcontroller is reset via this pin.
3.3V: This pin offers regulated power at 3.3 volts
5V: This pin delivers regulated power at 5 volts

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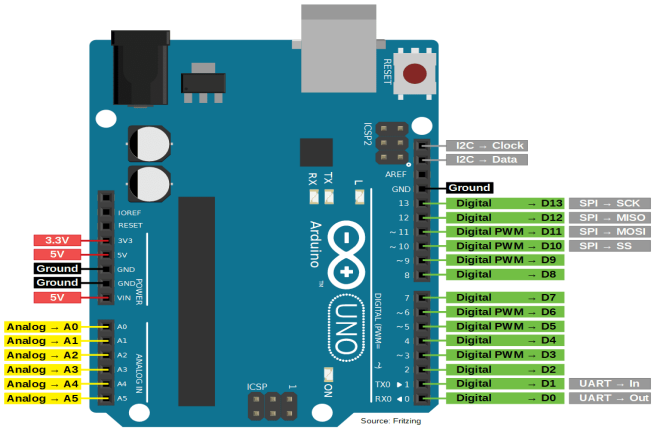


Fig. 1 Pin diagram of Arduino Uno

GND: These pins are connected to the ground.
AREF: For analogue inputs, this pin serves as the reference voltage.
6–11 Digital I/O Pins: These pins, known as digital I/O, can be used as inputs or outputs. They can deliver up to 40 mA of current and run at 5 volts.
12–13 Crystal Pins: For precise timing, these pins are used to link an external crystal oscillator.
14–19. Analogue Input Pins: These pins are capable of serving as analogue inputs. They are capable of measuring voltages between 0 and 5.
I2C pins: I2C communication is carried out using these pins.

B. APDS9966-Gesture Sensor

The APDS-9960 Gesture Sensor is a flexible sensor that may be utilised in several applications that call for gesture recognition, proximity sensing, and ambient light sensing. It is ideal for use in portable and wearable devices because of its low power consumption and tiny form factor.

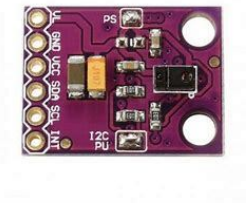


Fig. 2 APDS-9960 Gesture Sensor

Operational Voltage: 2.4V to 3.6V
Operating Range: 4–8 inches (10–20 cm)
I2C Interface (0x39 for I2C Address).
Proximity, RGB colour sensing, and ambient light Gesture detection and sensing in an optical module
I2C-bus Fast Mode Compatible interface with 400 kHz data rates.

C. LCD Display

An LCD display is one of the most popular accessories for microcontrollers. 16x2 and 20x2 LCD screens are some of the most popular LCDs attached to the numerous microcontrollers.
According to this, there are 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively. It is simple to connect to the Arduino.

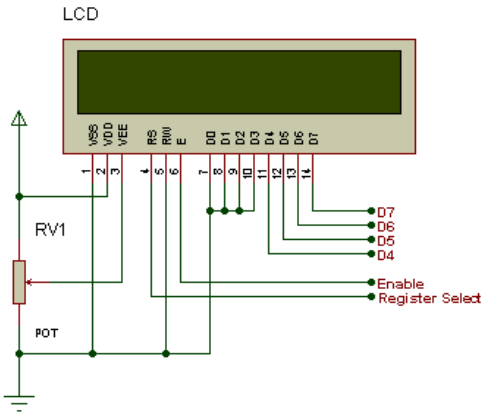


Fig. 3 LCD Display

D. Relays

An electromagnet drives an electrical switch known as a relay. By opening and shutting contacts in another circuit, it is used to regulate one electrical circuit. Electronic circuits, automation systems, and power distribution systems all often employ relays. The AC appliances in the project are turned on or off using the 12V, 2A relays.

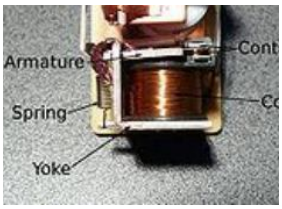


Fig. 4 Relay

IV. WORKING

The system combines an APDS9960 sensor and an Arduino UNO board to recognise six different hand gestures: left, right, up, down, near, and distant. According to the direction of the hand movement, the board receives a signal from this sensor and uses it to operate the gadgets. The system features two fans and two light bulbs as its four output devices. The system makes use of two relays and two transistor boards to control these devices. Transistors are used to operate the fans, while relays are used to regulate the lights. The system's two loads are linked to the relays through AC input cables; the first bulb is attached to one relay, while the second bulb is connected to the other relay.

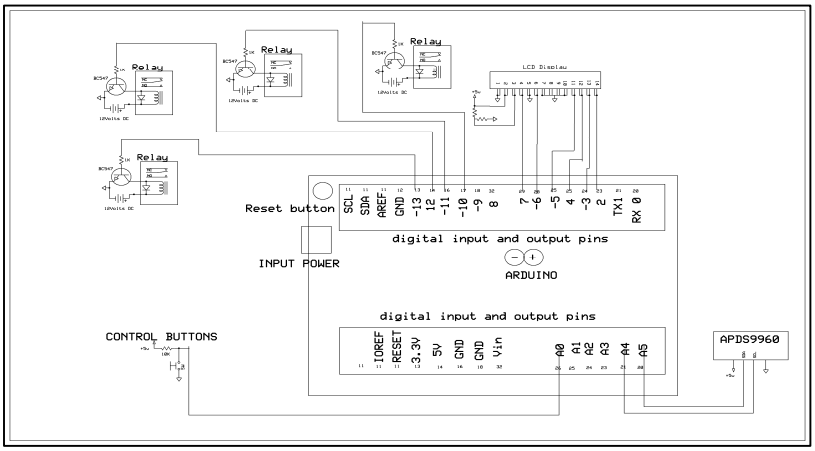


Fig. 5 Schematic Diagram

The system switches on the associated relay when it detects a hand movement in a certain direction, which subsequently illuminates the accompanying bulb. The transistor boards, which are managed by the board, are also connected to the two fans. The system turns on the associated fan after activating the corresponding transistor board when it detects a hand movement in that direction. We may switch on every gadget at once by utilising the NEAR gesture. Finally, a FAR motion to turn off all the devices An LCD display is attached to the board to show the output and status of the system. On the board, pins 3 through 8 are used as the interface pins for the display. Finally, a regulator power supply board is used by the system to deliver 5 volts of DC power. The regulator power supply board receives the AC input before distributing it to the various components of the system.

TABLE I
DESCRIPTION WITH RESPECT TO GESTURES

Gesture	Description
Up	To turn ON the chosen gadget, swipe from the board's bottom to its top.
Down	To turn OFF the chosen gadget, swipe downward from the boards top to its bottom.
Left	To move an object on a screen from right to left.
Right	To move a devices cursor from left to right on a screen.
Near	All the gadgets turn ON when a near hand is placed close to the sensor module.
Far	When a far hand is removed from the sensor module, every gadget turns OFF.
None	The gesture that was being made could not be accurately predicted by the sensor.

V. RESULTS

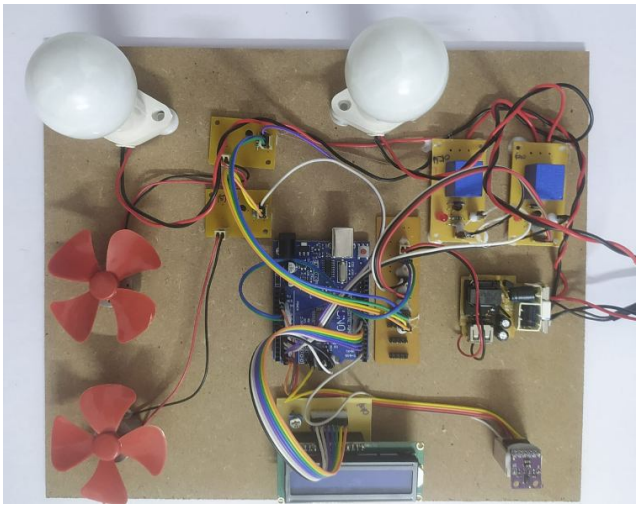


Fig. 6 Hardware Arrangement

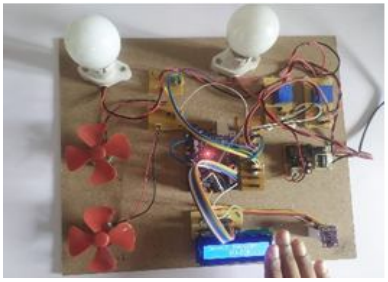


Fig. 7 Bulb1 on LCD

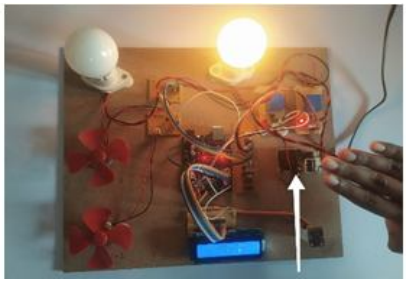


Fig. 8 Bulb1 ON

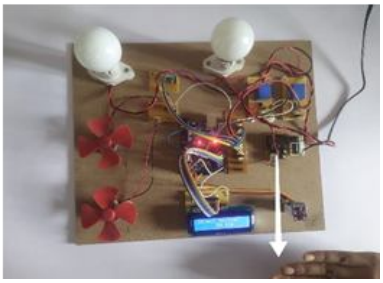
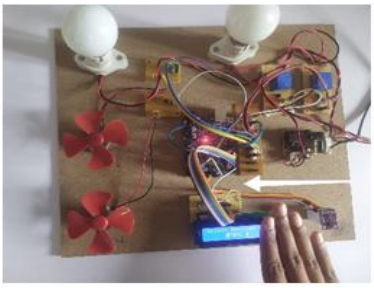
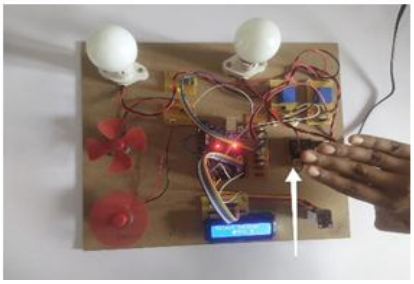
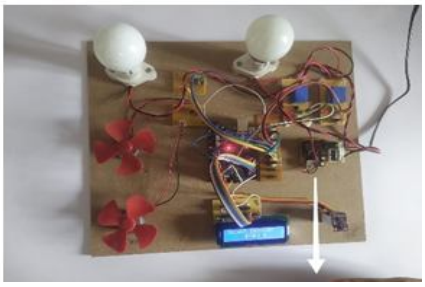


Fig. 9 Bulb1 OFF

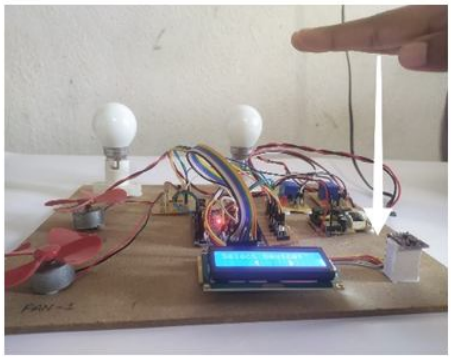
Consider the above Fig. 7, Fig. 8, Fig 9 for selecting the bulb using ‘left or right gestures’, switching ON using ‘up gesture’ , and switching OFF by ‘down gesture’ respectively. Similarly, Bulb 2 operation is done in the same way.

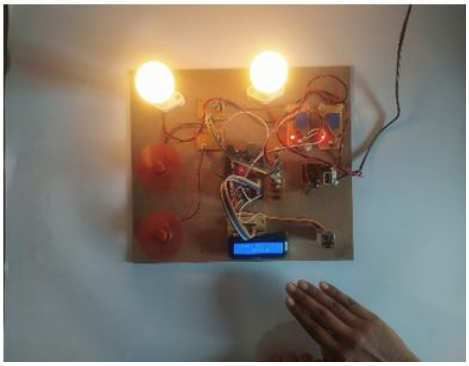

Fig.10 Fan1 on LCD

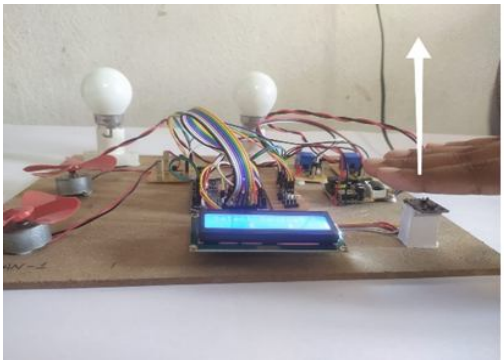

Fig. 11 Fan1 ON

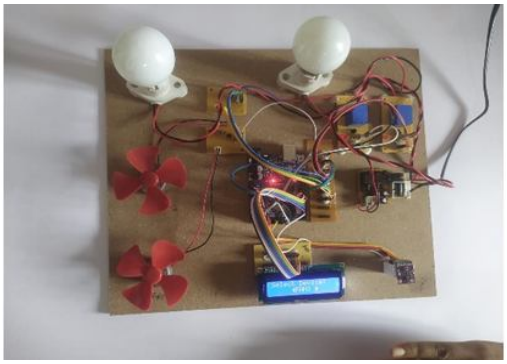

Fig. 12 Fan1 OFF

Consider the below Fig. 10, Fig. 11, Fig. 12 for selecting the fan1, switching ON, and switching OFF respectively. Similarly, Fan 2 operation is done in the same way.


Fig 6.4(a): NEAR Gesture


Fig 6.4(b): All devices "ON"


Fig 6.5(a): FAR Gesture


Fig 6.5(b): All devices "OFF"

By using NEAR gesture, we can turn ON all the devices at a time. And a FAR gesture to OFF all the devices.

VI. CONCLUSION

It is clear from this project's work that a home automation system for individual control can be made inexpensively from low-cost, locally available components and used to control a variety of home appliances, including security lamps, televisions, air conditioners, and even the entire home lighting system. Better yet, the small number of components needed allows them to be packaged into a discrete, small container. Different home appliances used in the lighting system, air conditioning system, home entertainment system, and many more are controlled by the designed home automation system. Due to its scalability and adaptability, this system It has been created with features that integrate with all of the hardware used. Each module's presence and placement have been carefully considered and have a positive impact on how well the unit functions. In addition, the project has been implemented effectively, employing cutting-edge ICs and advancing technology. Consequently, the project has been successfully developed and tested

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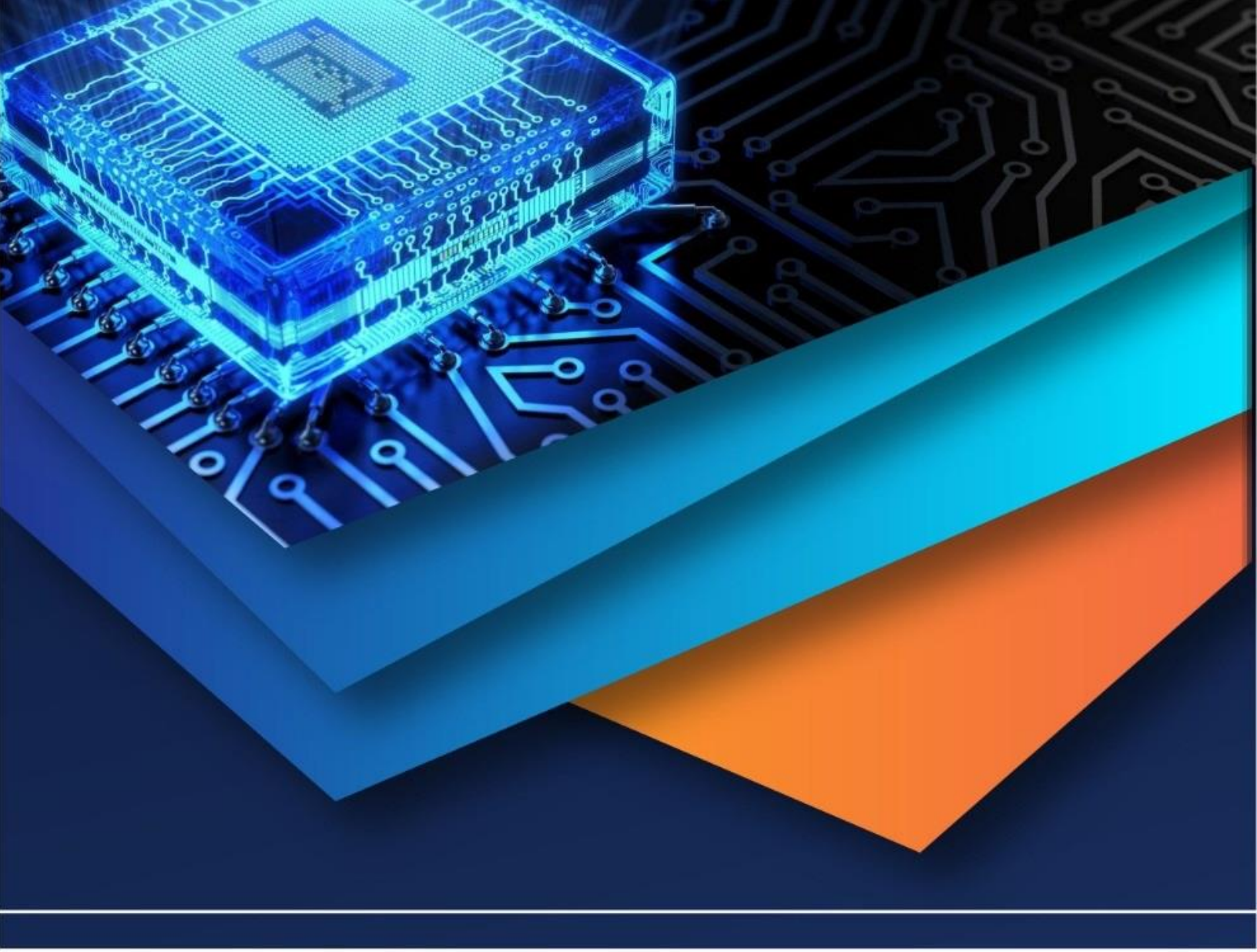
VII. FUTURE SCOPE

Based on the present scenario, we may create a cross-platform system that can be used on several platforms, such as iOS and Windows. By automating all other household appliances as well, the restriction of only being able to operate a few gadgets may be lifted. The prototype may incorporate sensors to implement autonomous control of household appliances, such as an LDR that can detect daylight and adjust bulb timing and a PIR that can detect motion and be used for security reasons by sounding an alert. By including small workplaces in the project's scope as well as households, the project's reach may be extended to a wide range of settings. This project allows for voice control of the devices utilising Bluetooth by attaching a voice module.

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