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Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

HOME AUTOMATION SYSTEM

EXPERIENTIAL PROJECT REPORT

Submitted by,

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2022-2023

ACKNOWLEDGEMENT

We are indebted to our faculty**, Dr. Narendra Rao Pandray,** Assistant Professor**, Department of electrical and electronics engineering,** RVCE for his/her wholehearted support, suggestions and invaluable advice throughout our Experiential Learning Project work.

Our sincere thanks to **Dr. Ramakanth Kumar P.**, Professor and Head, Department of Computer Science and Engineering, RVCE for his support and encouragement.

We express sincere gratitude to our beloved Principal, **Dr. K. N. Subramanya** for his appreciation towards this Experiential Learning Project work.

Lastly, we take this opportunity to thank our **family** members and **friends** who provided all the backup support throughout the project work.

Abstract

The Intelligent Home Automation System is designed to usher in a new era of household convenience, safety, and energy efficiency. Its primary objective is to seamlessly integrate a range of electrical and electronic components. The overarching goal is to enhance user comfort and safety while optimizing energy consumption through intelligent automation, thereby offering a glimpse into the future of modern living.

It begins with the strategic placement of IR sensors to detect a person's presence, followed by the activation of a servo motor to indicate door status when someone approaches. Inside the home, a second IR sensor continuously monitors the person's presence, ensuring that automation functions remain active. An LDR sensor assesses ambient light conditions, triggering LED lights to enhance convenience and energy efficiency in dimly lit rooms. Additionally, a second servo motor controls the gas knob, enhancing safety by automatically shutting it off when the system detects that the person is leaving the house.

The results of the Intelligent Home Automation System project demonstrate a successful integration of electrical and electronic components to create a responsive and energy-efficient home environment. This innovative solution not only enhances user convenience and safety but also offers substantial energy savings by automating lighting and gas control.

The project serves as a promising example of the practical application of electrical engineering principles in modern home automation, paving the way for smarter and more sustainable living spaces.

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INTRODUCTION

In today's rapidly advancing technological landscape, the concept of home automation has emerged as a groundbreaking and transformative phenomenon. The Intelligent Home Automation System presented in this project embodies the essence of this technological evolution. This innovative system leverages a diverse array of electrical and electronic components to create an environment where the home responds intelligently to the presence and needs of its inhabitants. The primary objective of this project is to seamlessly integrate a range of hardware components, including Infrared (IR) sensors, Arduino Uno boards, servo motors, Light Dependent Resistor (LDR) sensors, and Light Emitting Diode (LED) lights, to develop an automated home environment that is not only responsive but also energy-efficient and safe.

The very foundation of this project lies in the meticulous placement of IR sensors, strategically positioned to detect a person's presence. Upon detecting someone approaching the entrance, the system activates a servo motor, providing a visual indication of the door's status. Once inside the home, a second IR sensor continuously monitors the person's presence, ensuring that the automation functions remain operational and responsive to their needs. The incorporation of an LDR sensor in this setup allows the system to assess ambient light conditions, automatically triggering LED lights to illuminate rooms when darkness falls, thereby enhancing both convenience and energy efficiency.

Safety, another paramount concern, is addressed through the implementation of a second servo motor dedicated to controlling the gas knob of a gas appliance, such as a stove or heater, within the house. This servo motor is programmed to rotate and turn off the gas knob when the system senses that the person is leaving the house, thus preventing potential gas leaks and enhancing overall safety.

The amalgamation of these technologies and components into a cohesive system exemplifies the intersection of electrical engineering and modern living. It showcases how electrical components can be harnessed to create a home environment that is not just automated but also responsive to the needs of its occupants. Furthermore, this project underscores the importance of energy conservation, as it actively contributes to energy savings by automating lighting and gas control based on the immediate requirements of the household.

In summary, the Intelligent Home Automation System represents a significant step forward in the evolution of smart living spaces, offering a glimpse into the future of modern homes, where responsiveness, convenience, safety, and energy efficiency coalesce seamlessly to redefine the concept of home living.

LITERATURE SURVEY

SR NO.	TITLE OF THE PAPER	AUTHORS	YEAR OF PUBLICATION	INFERENCE
1.	Home Automation using Arduino	Neha Malik, Yogita Bodwade	March,2017	One of the topics which is gaining popularity is Home Automation System because of its innumerous advantages. Home automation refers to the monitoring and controlling of home appliances remotely. with the never ending growth of the Internet and its applications, there is much potential and scope for remote access and control and monitoring of such network enabled appliances. This paper deals with discussion of different intelligent home automation systems and technologies from a various features standpoint. The effort targeted on the home automation concept of where the controlling and monitoring operations are expediting through smart devices.
2.	A Low Cost implementation of Smart Home Automation Using Arduino	R.Akila , Dr.K.Dharmarajan	July,2021	Home Automation System (HAS) gives basic and Reliable innovation with Android Application. Home apparatuses like fan, bulb, AC, Automatic entryway are constrained by Home mechanization framework utilizing ARDUINO UNO with WIFI module as correspondence. The automated technique of controlling the devices could be a substitution of traditional switches. In this paper, discussed about how the appliances are linked with each other smartly with software application and also with hardware board. It completely gives the clear architecture of how it is working internally with the hardware board with the implementation of low-cost

HARDWARE USED

1 ARDUINO UNO BOARD

Arduino is a microcontroller board based on the ATmega328P .It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHZ quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Arduino Uno Specifications

- Microcontroller: ATmega328P
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Inout Voltage (limit): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- PWM Digital I/O Pins: 6
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB (ATmega328P) of which 0.5 KB used by bootloader
- SRAM: 2 KB (ATmega328P)
- EEPROM: 1 KB (ATmega328P)
- Clock Speed: 16 MHz
- LED_BUILTIN: 13
- Length: 68.6 mm
- Width: 58.4 mm
- Weight: 25 g

2) SERVO MOTOR

A servo motor is an electric motor that allows for precise control of angular or linear position, speed, and torque.

Specifications:-

Model:	SG90 Servo Motor
Control System:	PPM
Working Frequence:	1520µs / 50hz
(RX) Required Pulse:	3.3 ~ 5 Volt Peak to Peak Square Wave
Operating Voltage:	4.8 ~ 6 V DC Volts
Operating Speed (4.8v):	0.15 Sec/60 Degrees
Operating Speed (6v)	0.12 Sec/60 Degrees
Stall Torque (4.8v):	1.3kg/cm
Stall Torque (6v):	1.5kg/cm
Motor Type:	Brushed DC Motor
Gear Type:	Plastic Gears
Case Material:	Plastic
Programmable:	NO
Connector Wire Length:	24.0cm (9.4 inch)
Dimensions:	23 x 11.5 x 24mm
Weight:	9 grams

3) LDR Sensor

Light-dependent resistors (LDRs) are electronic components that detect light and change the operation of a circuit based on the light levels. LDRs are also known as photoresistors, photocells, or photoconductors.

The specifications for a Light Dependent Resistor (LDR) sensor include:

Operating voltage: 3.3V to 5V DC

Operating current: 15ma

Dimensions: 5 x 4 x 3cms

Weight: 50 grams

Light resistance: 5-10k Ohm

Dark resistance: Up to 500k Ohm

Maximum operating temperature: +800 degree Celsius

Output type: Digital outputs (D0)

Sensitivity: Adjustable

Indicator LED: Output and power LED indicator

PCB size: 3cm

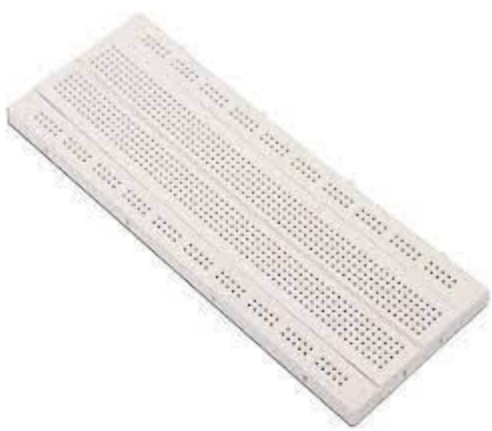
4) IR Sensor

An infrared (IR) sensor is an electronic device that detects infrared radiation in its surroundings.

The specifications of IR sensor are given below:-

Operating voltage	5V or 3.3V DC
Comparator chip	LM393
Output type	Digital and Analog output
Obstacle detection range	2cm to 20cm
Detection angle	35 degree
PCB size	3.1cm x 1.5cm

5) Breadboard:



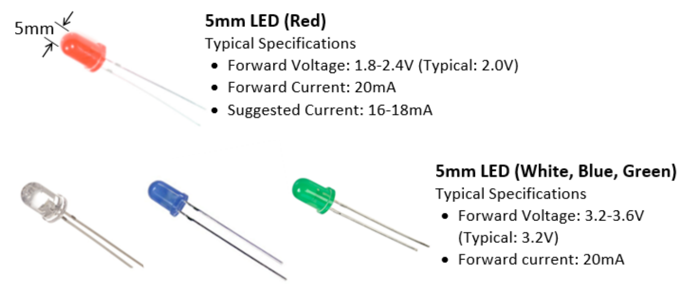
A breadboard is a crucial prototyping tool in electronics. It provides a platform for building and testing electronic circuits without the need for soldering. Breadboards consist of a grid of holes connected by conductive strips. In your project, a breadboard is likely used for creating temporary connections and prototyping circuitry.

6) Jumper Wires:

Jumper wires are short wires with connectors at each end, typically used for making temporary connections on breadboards or between components on a circuit. They provide flexibility in creating electrical connections in electronic projects.

7) LED Lights:

LED (Light Emitting Diode) lights are semiconductor devices that emit light when current flows through them. LEDs are known for their energy efficiency and long lifespan. In your project, LED lights are controlled automatically based on the readings from the LDR sensor. They provide illumination when needed, contributing to energy savings and convenience.



8) MCB

A Miniature Circuit Breaker (MCB) is an electrical switch designed to protect an electrical circuit from overcurrent and short circuits. MCBs are essential for electrical safety. While it is not explicitly mentioned how the MCB is used in your project, it could be involved in ensuring the safety of the electrical connections.

These hardware components form the foundation of your home automation system, allowing it to detect, process data, and control various aspects of the home environment. Their proper integration and utilization are critical for the success of your project.

FLOWCHART

```
Start
|
|--- Person Detected by IR Sensor (Near Entrance)?
|       |
|       No ---|--- No Action
|       |
|       Yes ---|--- Activate Servo Motor (Door Open)
|               |
|               |--- Person Detected by IR Sensor (Inside Home)?
|               |       |
|               |       No ---|--- No Action
|               |       |
|               |       Yes ---|--- System Active
|               |               |
|               |               |--- Is Room Dark (LDR Sensor)?
|               |               |       |
|               |               |       No ---|--- No Action
|               |               |       |
|               |               |       Yes ---|--- Turn On LED Lights
|               |               |
|               |               |--- Person Leaving (IR Sensor)?
|               |               |       |
|               |               |       No ---|--- No Action
|               |               |       |
|               |               |       Yes ---|--- Activate Second Servo
|
|--- End
```

Implementation/Methodology

The implementation of the Intelligent Home Automation System begins with a comprehensive understanding of the project's requirements. The primary aim is to create a system that enhances home comfort, safety, and energy efficiency through the integration of various electrical components. The hardware selection phase involves carefully choosing the necessary components, including IR sensors for door indication and presence detection, an LDR sensor for light sensing, servo motors for door and gas knob control, an Arduino Uno Board, a breadboard, jumper wires, LED lights for automatic lighting, and miniature circuit breakers (MCB) or other power management components.

With the hardware in place, the next step is to design the circuit and establish electrical connections. Creating a detailed circuit diagram ensures that all components are interconnected correctly, and attention is given to power management and voltage regulation to maintain a stable power supply throughout the system. Specialized circuits or voltage regulators may be employed to address voltage fluctuations effectively.

The integration of IR sensors involves configuring them for door indication and presence detection. Placing these sensors strategically ensures their optimal performance. Additionally, an LDR sensor is installed and configured to assess ambient light conditions within the room. Precise control of the two servo motors for door and gas knob control requires careful implementation of electrical engineering principles, which may include motor driver circuits or direct connections to the Arduino board.

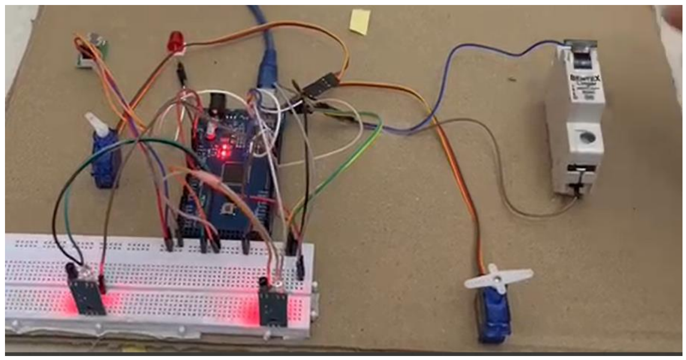
The heart of the system lies in the Arduino programming, where code is developed to orchestrate the entire operation. The code is responsible for reading data from the IR sensors and LDR sensor, interpreting sensor inputs to control the servo motors for door and gas knob, and managing the activation of LED lights for automatic room lighting. Code optimization, organization, and thorough documentation are essential aspects of this phase to ensure efficient system performance.

Signal conditioning techniques, such as filtering and amplification, are applied to process sensor data accurately. Safety measures, including proper grounding, short-circuit protection, and isolation techniques, are implemented to guarantee the safety and reliability of the entire system.

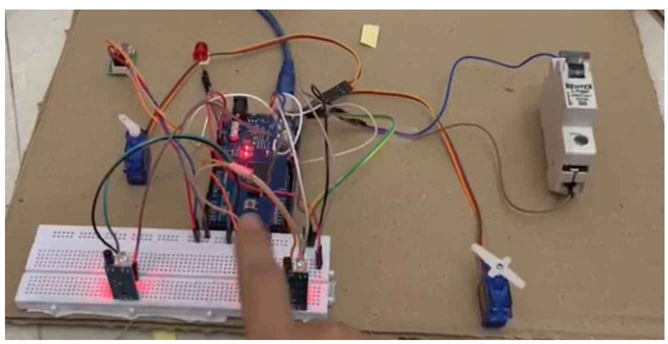
Energy efficiency concepts are employed to optimize the operation of various home appliances, enhancing convenience while conserving energy. Testing and calibration are essential steps to ensure the system functions as intended. Calibrating sensors and motor movements ensures precise control.

Comprehensive documentation, encompassing circuit diagrams, code explanations, calibration procedures, and project specifications, serves as a valuable resource for future reference. Validation and user testing validate the system's functionality, and a project presentation highlights the electrical engineering aspects, sensor integration, servo motor control, and safety measures during project demonstration. Upon successful validation, finalization and documentation mark the conclusion of the project, preparing it for presentation, documentation, and future utilization.

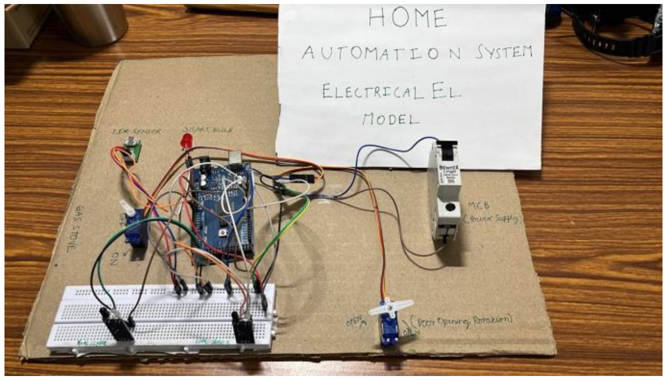
PROJECT IMAGES



Initial project setup with all connections

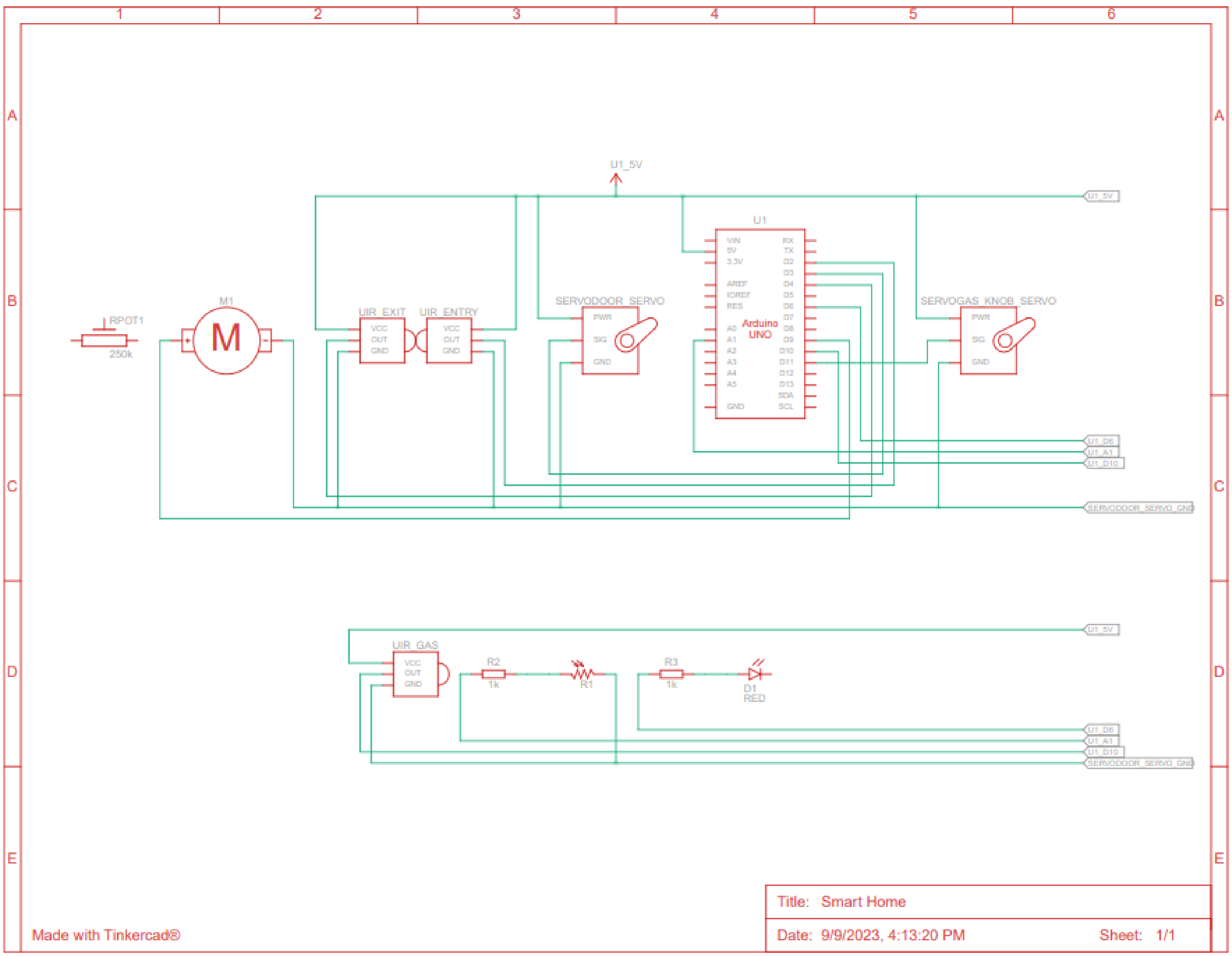


Finger being sensed by IR sensor and thus the servo motor blade rotates showing the stimulation of a moving door



Final Image of our completed Project

CIRCUIT DIAGRAM



ARDUINO CODE

```
#include <Servo.h>

Servo servoDoor;
Servo servoGas;

int pinIRDoor = 5;
int pinIRGas = 6;
int valDoor = 0;
int valGas = 0;
int doorOpen = 0;
int gasKnobClosed = 0;

int pinLightSensor = A0;
int pinLED = 7;
int lightValue = 0;
int threshold = 60;

void setup() {
  servoDoor.attach(3);
  servoGas.attach(9);

  Serial.begin(9600);
  Serial.println("--- Welcome to Smart Home System ---");
  pinMode(pinLightSensor, INPUT);
  pinMode(pinLED, OUTPUT);
}

void loop() {
  valDoor = digitalRead(pinIRDoor);
  valGas = digitalRead(pinIRGas);
  lightValue = analogRead(pinLightSensor);

  if (valDoor == 0 && doorOpen == 0) {
    servoDoor.write(150);
    delay(100);
    Serial.println("Door is open");
    doorOpen = 1;
  } else if (valDoor != 0 && doorOpen == 1) {
    servoDoor.write(10);
    delay(100);
    doorOpen = 0;
  }

  if (valGas == 0 && gasKnobClosed == 0) {
    servoGas.write(150);
    delay(100);
    Serial.println("Gas knob is closed");
    gasKnobClosed = 1;
  } else if (valGas != 0 && gasKnobClosed == 1) {
    servoGas.write(10);
    delay(100);
    gasKnobClosed = 0;
  }

  if (lightValue < threshold) {
    digitalWrite(pinLED, HIGH);  // Turn on the LED
  } else {
    digitalWrite(pinLED, LOW);  // Turn off the LED
  }
}
```

Relevance to Electrical engineering

Using **servo motors** which are electrical devices that convert electrical energy into mechanical motion.

Dealing with **power systems** such as wires, MCB, and circuits that supply and control the electricity for your sensors and devices.

Applying **signal processing** techniques such as filtering, amplification, and modulation to process the signals from your sensors and devices.

In real life applications, it will be used on many **electrical appliances** such as Bulbs, Tube lights, etc.

Using the **energy-saving concept** that makes the operations of various home appliances more convenient and saves energy. It involves automatic controlling of all electrical or electronic devices in homes.

Using **electrical sensors**, such as IR and LDR sensors , that play a significant role in home automation.

CONCLUSION

In conclusion, our Intelligent Home Automation System represents a successful fusion of electrical engineering, sensor technology, and automation principles. This project aimed to enhance the comfort, safety, and energy efficiency of homes by leveraging a range of electrical components.

We began by carefully selecting the hardware components, including IR sensors for door and presence detection, an LDR sensor for light sensing, servo motors for door and gas knob control, and an Arduino Uno Board for central control. The system's circuit design prioritized power management, voltage regulation, and safety measures, ensuring a stable and secure electrical supply.

The implementation phase involved configuring IR sensors, integrating the LDR sensor, and meticulously controlling the servo motors. Signal processing techniques were applied to ensure accurate sensor data interpretation, and safety protocols such as grounding and short-circuit protection were implemented to guarantee reliable operation.

Energy efficiency was a core consideration, with automatic LED lighting and gas knob control contributing to reduced energy consumption. The system's user interface was further enhanced by the optional inclusion of a mobile app or Bluetooth terminal, enabling remote control and monitoring.

Throughout the project, we adhered to electrical standards and regulations, emphasizing safety and code compliance. Thorough documentation, including circuit diagrams, code explanations, and calibration procedures, ensures the project's reproducibility and serves as a valuable resource for future endeavors.

In conclusion, our Intelligent Home Automation System not only showcases the integration of electrical engineering principles but also embodies the potential for smart, energy-efficient, and convenient living. This project reflects our commitment to innovation and our vision of a smarter and more sustainable future for residential environments.

FUTURE WORK

There are several avenues for future work and enhancements to our Intelligent Home Automation System:

1. **Expand Device Compatibility**: Currently, our system controls lighting and gas appliances. Future work could involve expanding compatibility to include a broader range of household devices, such as heating and cooling systems, entertainment systems, and security systems.

2. **Voice Recognition Integration**: Incorporating voice recognition technology can make the system even more user-friendly. Users can control devices and monitor their home by issuing voice commands, enhancing accessibility and convenience.

3. **Machine Learning for Predictive Automation**: Implementing machine learning algorithms can enable the system to learn user preferences and predict their actions. For instance, the system could anticipate when to turn on heating or cooling based on historical data and weather forecasts.

4. **Enhanced Security Features**: Integrating advanced security features, such as facial recognition for access control or intrusion detection, can further enhance home safety and security.

5. **User-Friendly Mobile App:** Continuously improving the user interface and mobile app for remote control and monitoring can make the system more accessible to a broader range of users.

6. **Integration with Renewable Energy Sources**: Incorporating renewable energy sources like solar panels and wind turbines can make homes more sustainable and reduce reliance on the grid.

By pursuing these avenues of future work, our Intelligent Home Automation System can continue to evolve, providing users with an even more advanced, energy-efficient, and user-friendly solution for smart living.

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