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Home Automation Utilizing Artificial Intelligence & Internet of Things

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Abstract: ***This paper examines the most recent apps of Web of Things (IoT) innovation in residential settings, aiming to make homes more intelligent, automated, and digitally connected. The literature showcases a wide variety of systems, approaches, and practical implementations that demonstrate the effective use of IoT, artificial intelligence (AI), and geographic information systems (GIS) in domestic environments. With rapid technological progress and rising interest in smart homes and energy management, there is a clear need to identify existing gaps, understand the relationships between current methods, and establish a comprehensive framework for smart home design. This study presents a systematic review of journal articles published between 2010 and 2021, drawn primarily from the Scopus database. The selected papers were analyzed from both bibliographic and content perspectives to highlight key systems, best practices, and major contributors. Through systematic selection, coding, and critical evaluation, this review focuses on the smart home systems developed and the core technologies employed. The central question addressed is: What key lessons have we learned from a decade of advancements in smart home systems across various domains? The findings reveal significant gaps, particularly with in the integration of AI and IoT, as well as the constrained utilize of geospatial Informational data in smart home domestic advancement. There is together with a notable shortage of fully integrated solutions for energy efficiency and aged-care applications. This article aims to give scholars and experts a clear understanding of these shortcomings and practical guidance for addressing them. Ultimately, it supports the design of smart homes that enhance occupant achieving thermal comfort while minimizing energy consumption and lowering greenhouse gas emissions. Furthermore, the paper raises important new queries about how IoT and current systems can be further enhanced and integrated.***

Keywords: intelligent; clever; energy conservation; automation; IoT; AI; deep learning; machine learning; smart residence; dwelling; seniors; Actuator; consumers.

I. INTRODUCTION

Home automation powered by Artificial Intelligence (AI) focuses on creating living environments where connected devices communicate efficiently and function in harmony [1].

This is achieved through AI algorithms that learn, adapt, and refine their behavior based on data collected from sensors and user activity. By integrating.AI into everyday appliances such as lights, vacuum cleaners, security cameras, and kitchen gadgets. [9] homes become intelligent systems capable of recognizing and adjusting to residents' daily routines. These systems analyze behavioral patterns to detect whether occupants are present or away, enabling automatic adjustments to temperature, lighting, and security settings. Such capabilities not only support energy conservation but also enhance the efficient use of resources [1]. The entire process relies on AI algorithms that continuously gather sensor data and trigger automated responses accordingly. [1] The system learns daily habits and behavioral trends, allowing it AI-powered homes can proactively adjust settings, such as dimming lights and modifying heating in the evening based on user preferences. In the morning, an AI-equipped coffee maker can begin a wake-up routine and deactivate the alarm once the individual is awake [9].

By enabling seamless coordination between cameras, door locks, and alert systems [9], artificial intelligence greatly improved home security. New cameras and door locks can detect unusual activity and alert the homeowner immediately [4]. The homeowner receives an immediate notification on his or her smartphone, allowing him or her to monitor the situation in real time from anywhere [9]. Furthermore, personal well-being and safety are prioritized by integrating health-monitoring devices into the home network. These systems can promptly alert caregivers in the event of emergencies or abnormal health metrics, enabling timely intervention when required [8].

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II. CONTEXTUAL WORK

At home, IoT Technology & devices can be utilized to create intelligent and secure environments tailored for elderly and disabled individuals. By leveraging AI through wireless connectivity and voice commands, controlling household devices becomes more accessible and convenient. [3]. Smart mirrors are used in home automation to build what's commonly known as a magic mirror. These mirrors offer a natural interface, allowing users to control household devices or interact with AI-based features similar to Google Assistant or WhatsApp chatbots. However, sensors and microcontrollers involved in the system cannot be directly linked and must function independently. In addition to convenience and control, smart mirrors can also support security systems and fire alarms, enhancing home safety.. [4If people were able to use electricity more efficiently at home and contribute to climate change mitigation, the overall demand for electricity in everyday life might still rise. Artificial intelligence algorithms can help by tracking when household appliances are turned on or off and monitoring the energy usage of individual devices within a home. [1]. Voice assistants enable control over household devices by integrating IoT and natural language processing (NLP), offering an efficient way to manage home automation. Combining these technologies allows for a higher level of automation beyond the many semi-smart appliances currently available. With IoT and NLP, you can fully automate tasks and operate various devices—like lights, fans, coffee makers, and door alarms—through simple voice commands. [9] A home automation technology built on the Internet of Things (IoT) intended to track and manage household appliances and electronic devices. It uses an ESP8266 Wi-Fi module to establish an internet connection, enabling remote control of various systems such as lighting, temperature, humidity, and fans through the integration of different sensors. [16]. This automation system uses a smartphone to manage various devices by means of An expansive picture of the house or location being controlled. The panoramic view provides a 360-degree representation of the space. [17]. At the same time, we aim to guarantee both comfort and full safety for homeowners. The system relies on PIR and vibration sensors to identify unexplained activities inside the residence. In addition, this network of sensors offers comprehensive protection against burglary. [18Create a chatbot that leverages AI and IoT to manage household appliances. At its core, a Raspberry Pi serves as the central processing unit, equipped with various sensors and interfaces—including a PIR sensor, gas detector, and Pi Camera. The Pi Camera links to the Telegram cloud platform, enabling communication between the user and connected home devices. Appliances are then controlled through AI-generated commands transmitted via this system. [19].

III. METHODOLOGY

The diagram below outlines typical home automation processes. At the core, a primary microcontroller—specifically an Arduino UNO—manages connected sensors by processing input data collected from them, with overall operations guided by artificial intelligence. The first step involves connecting the temperature sensor connected to the Arduino-UNO.

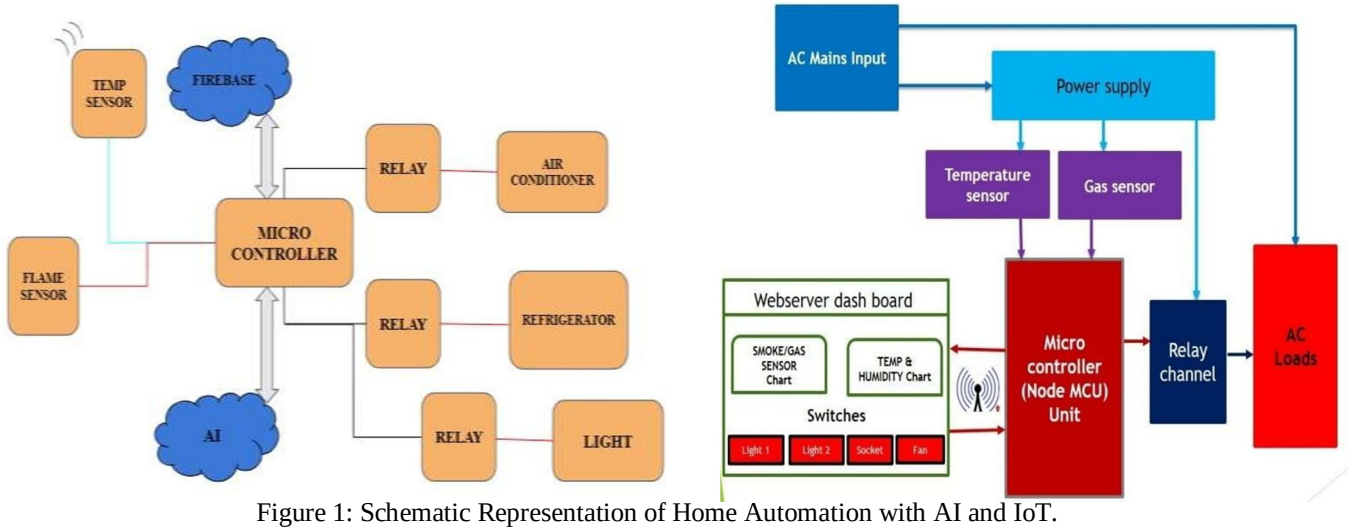


Figure 1: Schematic Representation of Home Automation with AI and IoT.

Temperature sensors gather information regarding the heat within your house. Arduino UNO begins operating with AI instructions. For instance, when the temperature rises, the AI will initiate a conversation with the owner. Upon receiving a response from the homeowner, the controller activates the air conditioner or fan in the home, and the device shifts to On mode. If not, the owner won't react with AI and will automatically activate or deactivate according to the most recent data saved in memory.

This task is managed by Arduino UNO using commands from artificial intelligence. A fire risk exists in the kitchen. In this situation, damage to property could happen. Enables you to store the flame sensor that identifies the flame value. Upon detecting a flame, the AI will begin its initialization process. The AI subsequently issues an alert and sends a notification to the property owner. The most important aspect of the house is to activate the lights, which is the primary responsibility of each owner. This will cease upon the project's implementation. The LDR sensor measures the light intensity in your house linked to the Arduino UNO. For LDRs If the sensor does not detect any lights in the house, the AI will start requesting commands and when the owner responds to these commands, the lights in the house will turn on. When the sensor detects light in the house, the artificial intelligence will start requesting commands again, and when humans are no longer able to respond to these commands, it will automatically turn off based on past data stored in its memory. Security has become an important issue these days. If a stranger enters your home without permission, you can use a notification to identify him or her, and you can also hear a voice saying, ``Hello, welcome.'' This will occur after implementation of this project. The camera module will be installed at the entrance of the house. First, we train AI and ML on family data such as different facial expressions and fingerprints. This allows the controller to recognize known and unknown people trying to enter your home. If a stranger tries to enter the house, the system will directly say, "Sorry, you are not a family member, we do not allow you inside the house," and the door will not open.

IV. WORK & METHOD PROCESS

The entire process of an AI-powered home automation system is shown in the diagram below. A chosen power supply is the first step in the process, following which the system goes through initialization—during this phase, the artificial intelligence component begins to boot up and prepare for operation.

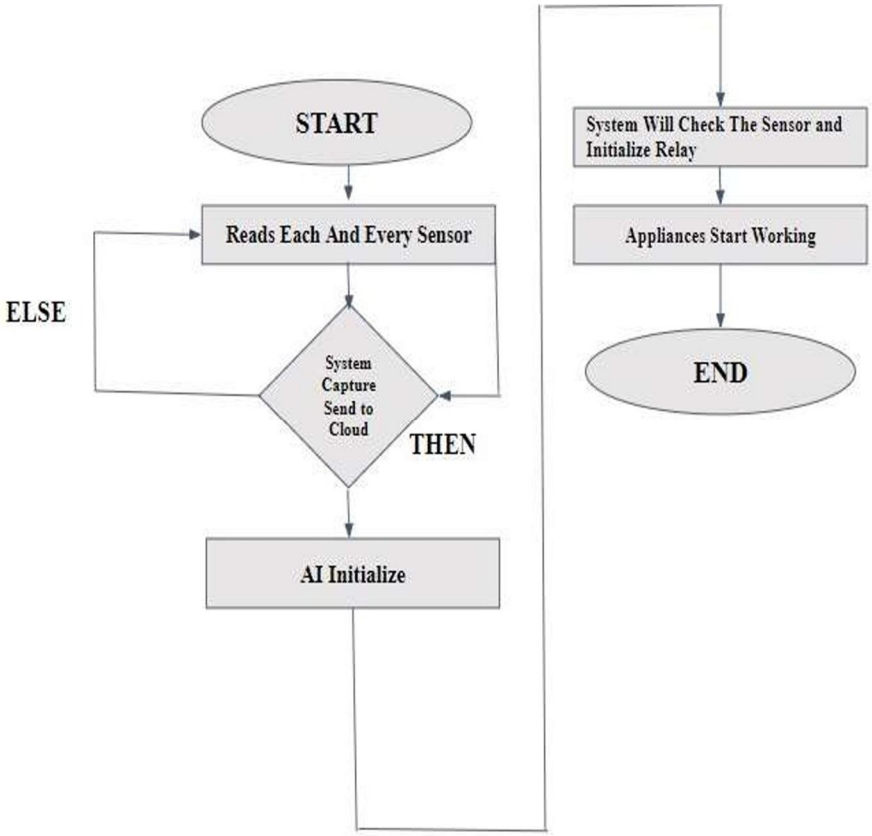


Figure 2: Home Automation System Process Flow Diagrams.

After the system is initialized, the sensors will start reading the data with respect to sensor specifications. If the system receives the data with the sensors, then it will be sent to the cloud. Otherwise, again the sensors will start reading the data with these processes will come under the IoT part.

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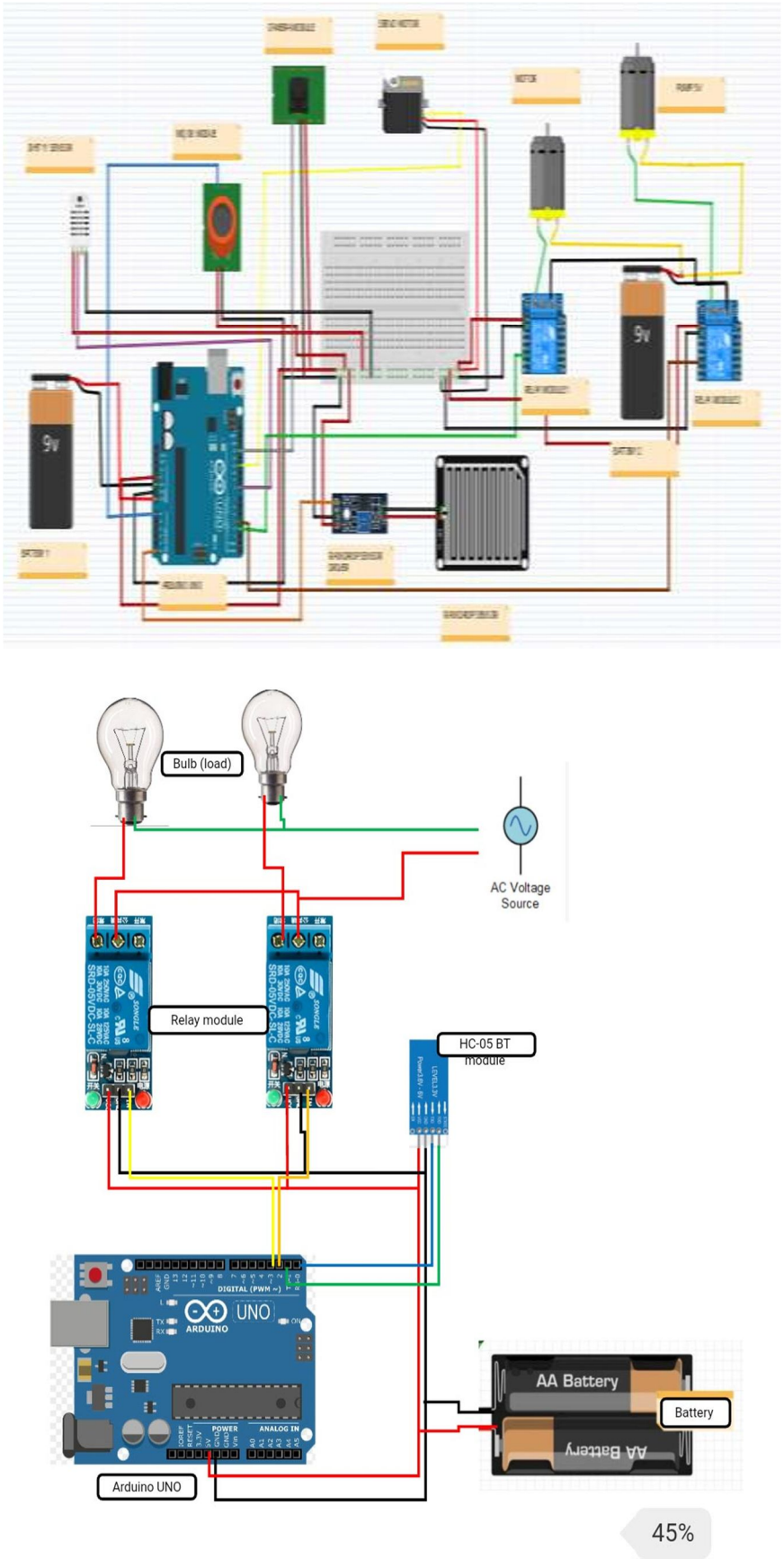


Figure 3: The Home Automation System Schematic Diagram Utilizing a sensor-integrated ARDUINO controller

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V. OBSERVATIONS OUTCOMES

Home automation combined with artificial intelligence introduces cutting-edge technology into daily routines. By connecting household devices through sensors, the system achieves greater efficiency and precision. It can detect and learn daily routines and behaviors, integrating artificial intelligence with home automation enables advanced control over lighting, climate, and security systems. The combined potential of AI and home automation points toward a future in which living spaces adapt seamlessly to individual needs, improving quality of life with unprecedented comfort and personalization.

This paper focuses on three key household components:

1) Temperature ranges
2) Smoke detection thresholds
3) Level of water in storage containers

A. Temperature of Degree Standards

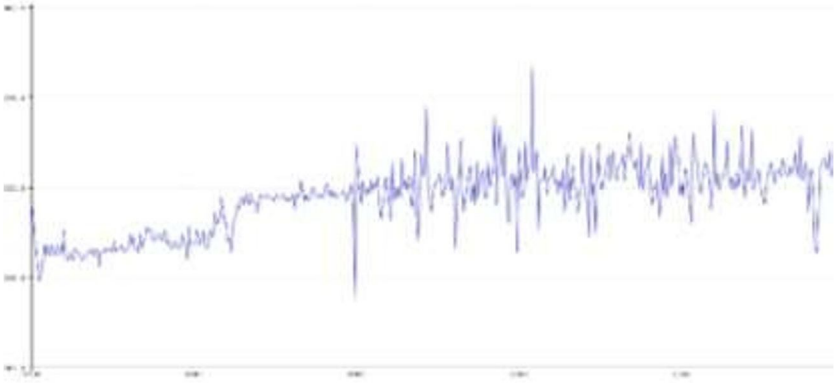


Figure 4: Temperature readings from a home automation system's DHT11 sensor are shown graphically.

The current temperature reading is at a moderate level. As the temperature rises, these changes will be displayed on the graph. The data for this graph will come from a DHT11 sensor linked to an Arduino UNO microcontroller. Once the temperature reaches a preset threshold, the device automatically turns on the home fan, powered by a dedicated power source.



Figure 5 shows the temperature sensor's serial monitor output.

When the temperature reaches 270°C or higher, the controller automatically activates the fan. If the temperature is below 270°C, the fan is turned off.

B. Smoke layers

The smoke detection system operates within two levels:

A. Minimal amount of smoke
B. A lot of smoke
C. Minimal smoke.

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This shows that the amount of smoke in the house is within acceptable bounds. The graph below reflects a typical, safe level of gas in the household environment.

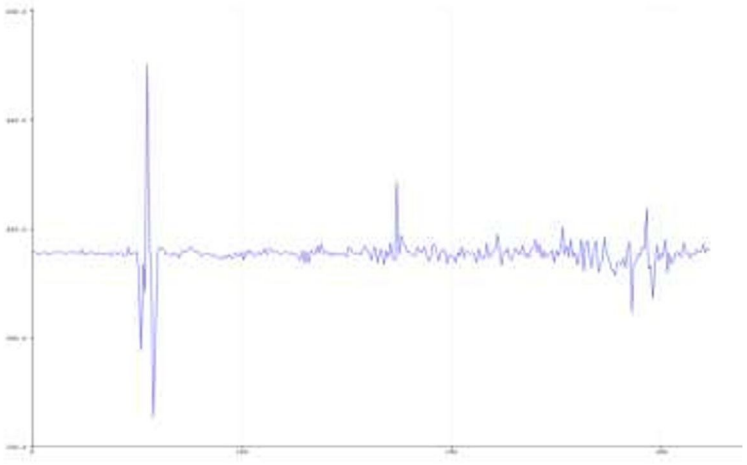


Figure 6: shows the typical smoke level in a house while the device is operating.

C. A lot of smoke tires

If smoke levels rise, The exhaust fan is turned on automatically and a notification is sent via the Arduino UNO (controller). to the user's mobile device. This notifies the homeowner of smoke's presence, guaranteeing prompt awareness and action.

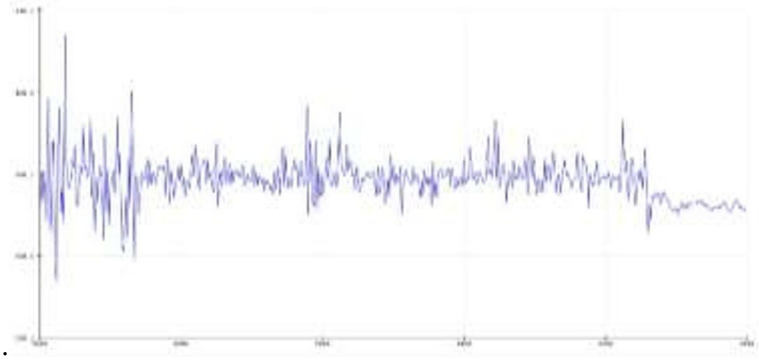


Figure 7: A visual depiction of A lot of smoke Grades



Figure 8: Excessive Smoke Range at Home

When the smoke level hits 200, a warning is triggered in the home, typically through an audible beep.
If the smoke concentration rises further and reaches the threshold of 300, the system activates the exhaust fan while also sending a notification to the homeowner.

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D. Measures of Water level Standards

This Figure 9. shows a graph illustrating the usual water level in the tank. As the level decreases to the "Too LOW" point, the system triggers the water pump automatically.

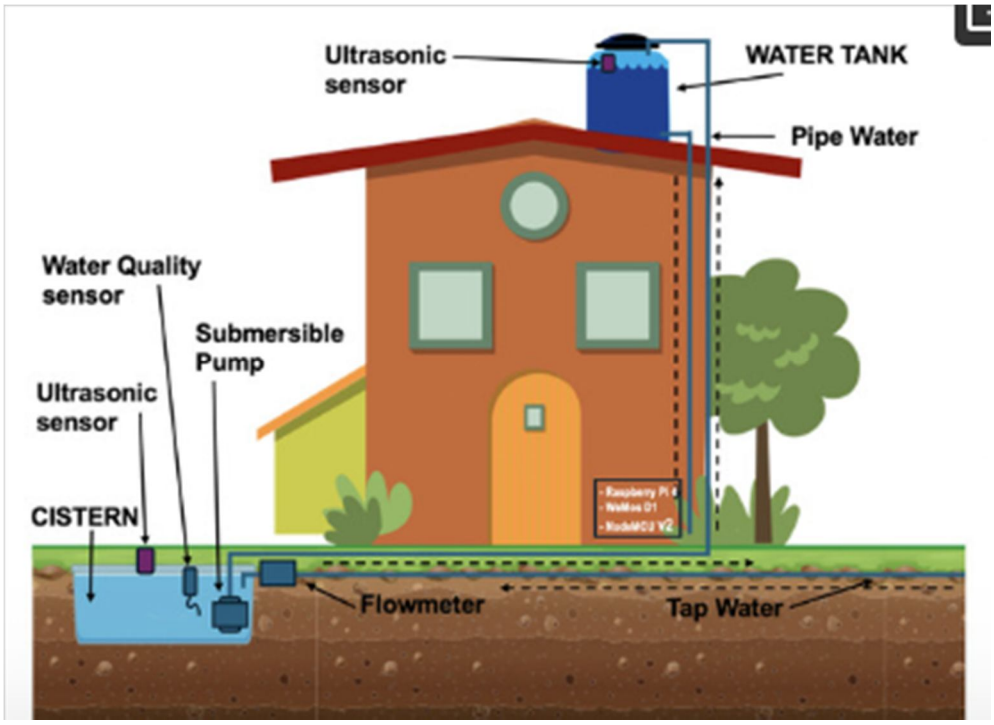


Figure 9: Graphically Represented of Measure of Water Intensity Standards in Tanks.

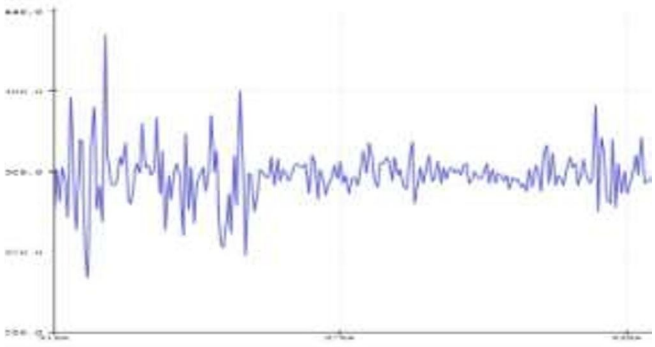


Figure 10: Visual depiction on the tank's Superior water Intensity Standards.

When the water level sensor identifies a high level, it indicates that the tank has reached its maximum capacity (725). Consequently, the system automatically shuts down the water pump.



Figure 11: Using a serial monitor to indicate the water tank level

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E. AI Identifying Voice Instructions

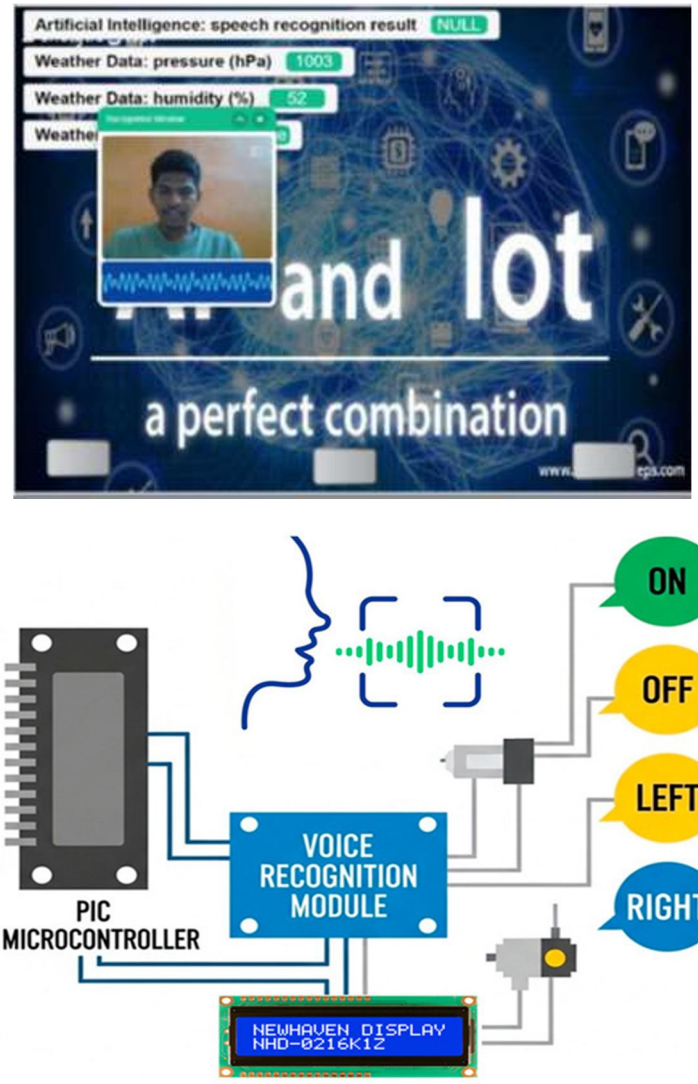


Figure 12: Examination of the recognition of vocal directives via artificial intelligence.

By integrating IoT with AI technologies, it becomes possible to monitor temperature, smoke, and water levels in homes in real time, as well as control lighting and fans. This system relies on a microcontroller along with various sensors and actuators. The sensors gather environmental data, which is then processed using user-friendly AI algorithms.

VI. CONCLUSION

Home automation powered by artificial intelligence Integrating AI technology into home systems and appliances enables smooth communication with platforms like Google Assistant, Amazon Alexa, and Apple Siri. By leveraging AI, homeowners can enjoy a more efficient, convenient, and adaptive living environment. These intelligent systems rely on interconnected devices and sensors to monitor, analyze, and respond to occupants' behaviors and preferences. This enables the automatic adjustment and optimization of various functions, including lighting, heating and cooling, security systems, appliances, and entertainment setups. A key component of AI-driven automation is data collection and analysis. Sensors placed throughout the home gather information on factors such as temperature, humidity, occupancy, and energy consumption. This data is processed by AI algorithms that detect usage patterns and make informed decisions accordingly. Voice assistants, a common application of AI in smart homes, allow users to interact with their devices using natural language, eliminating the need for manual controls and simplifying operation. Simple voice commands may be used to do things like playing music, changing lights, or setting reminders thanks to integration with Platform services such as Google Assistant, Amazon Alexa, and Apple Siri.

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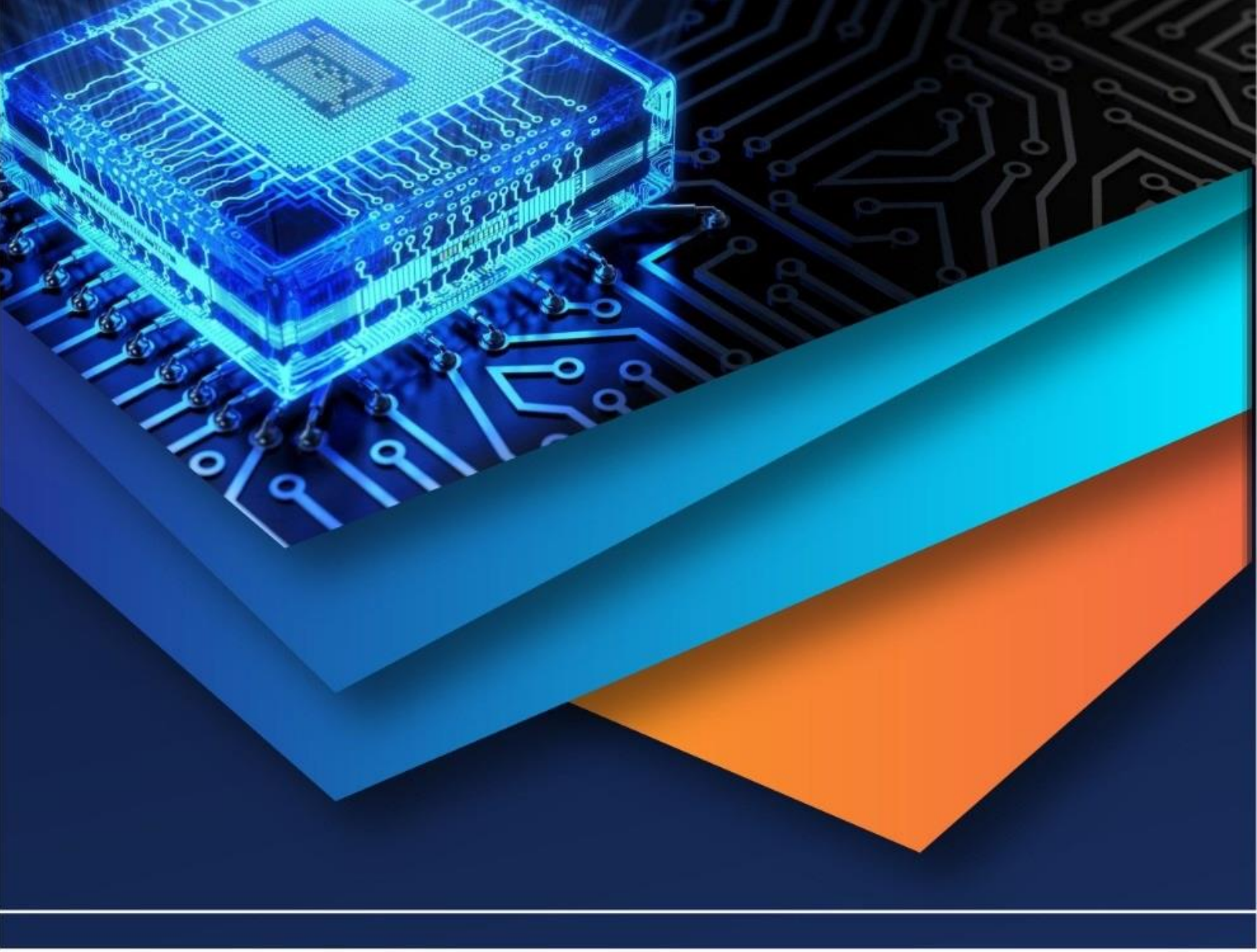
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