Smart Home System Using Home Assistant

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Abstract: *This abstract describes a smart home system. I plan to implement an AI assistant into my smart home project by incorporating Amazon Alexa and Apple Siri. This will require setting up the necessary hardware and software to enable voice commands and this arises the need of home assistant. Typically, the Home Assistant application is designed to work with a Raspberry Pi, but due to the current shortage of Raspberry Pi devices, the application can also run on a laptop as a virtual machine or on an intel based old pc. The Home Assistant application plays a critical role in managing and integrating the different components of the smart home system. Although developing an application like Home Assistant is a complex and time - consuming process that usually involves a team of developers working together over a period of years, the open - source nature of the project allows for customization of the user interface to meet individual needs. The smart home system includes a variety of features that can be controlled through the Home Assistant application. These features include the ability to control lights, create LED ambient scenes, check the temperature, view the weather, monitor for intruders, detect short circuits, monitor water levels, security camera and track solar energy and battery levels. Additionally, the system can integrate with popular voice assistants, such as Siri, Alexa, and Google Assistant. One unique feature of the smart home system is the ability to control individually addressable LED strips that support multiple effects through the use of WLED (Open source platform). This feature allows users to customize the lighting in their home and create unique lighting effects. The smart home system is designed to be highly expandable and customizable, supporting a wide range of brands and self - developed models. The Home Assistant application supports many brands and models, making it highly compatible with a wide range of devices. Additionally, the system supports smart switches made using NodeMCU. In summary, the smart home system described offers a comprehensive and customizable solution for managing various features and devices within the home. Overall, the integration of AI skills this smart home project will add an extra layer of convenience and sophistication to the system, allowing me to control various functions through voice commands and enabling seamless automation of daily tasks.*

Keywords: Smart home system, AI assistant, Home Assistant application, Raspberry Pi, laptop, virtual machine, integrating, components, open - source, user interface, lights, LED ambient scenes, temperature, weather, intruders, water levels, security camera, battery levels, expandable, customizable, individually addressable LED strips, WLED, smart switches, convenience, sophistication, daily tasks

1. Introduction

In today's World many people think Home automation means controlling lights and fans via application like blynk, Alexa etc and are only limited to toggling these devices on or off. Installing a few smart plugs, switches, or light bulbs and controlling them through your smartphone does not make your home smart. A smart home should be smart enough to make decisions, automate your devices, and send notifications and alerts based on events, time, or information from various sensors. Majority of the smart devices come with their own applications and are priced differently. Most of the consumers buy products depending on various factors like design, quality, reliability, cost, value for money etc. So, in most of the cases for a consumer, the chances of having switches, lights, fans from the same brand are low. Most brands have their own applications for the control of their smart devices. The problem that arises here is the user has to use different applications for the control of various devices which is time consuming and does not justify smart devices. Although some smart home brands offer Alexa and Google Home Compatibility to integrate devices at one place and to enable voice assistants, majority of brands do not offer Apple HomeKit integration. According to a study most of the smart home users use Apple devices, but the lack of HomeKit support makes it difficult for these users to use these devices for their actual functionality. The devices that do offer these voice assistant services and integrations are

far more expensive than the regular devices. Another problem that arises is automation only turning on or off a switch doesn't make it smart. Creating schedules, taking user input, learning user's usage patterns should be a part of a smart home. Although some manufacturers provide a few basic options in their apps to automate their smart devices, they are connected to the cloud servers and fail to work if the network or internet is down, making them unreliable. Besides, they may also log or collect your activity data on their cloud servers, such as when, where, or how you use your smart devices.

2. Literature Review

"Smart Energy Efficient Home Automation System using IOT', by Satyendra K. Vishwakarma, Prashant Upadhyaya, Babita Kumari, Arun Kumar Mishra.

This paper presents a step - by - step procedure of a smart home automation controller. It uses IOT to convert home appliances to smart and intelligent devices, with the help of design control. An energy efficient system is designed that accesses the smart home remotely using IOT connectivity. The proposed system mainly requires, Node MCU as the microcontroller unit, IFTTT to interpret voice commands, Adafruit a library that supports MQTT acts as an MQTT broker and Arduino IDE to code the microcontroller. This multimodal system uses Google Assistant along with a web

based application to control the smart home. The smart home is implemented with main controller unit that is connected with the 24 - hour available Wi - Fi network. To ensure, that the Wi - Fi connection do not turn off, the main controller is programmed to establish automatic connection with the available network and connected to the auto power backup.

"IOT Based Smart Security and Home Automation", by ShardhaSomani, Parikshit Solunke, ShaunakOke, ParthMedhi, Prof. P. P. Laturkar.
This paper focuses on a system that provides features of Home Automation relying on 10T to operate easily, in addition to that it includes a camera module and provides home security. The android application basically converts Smartphone into a remote for all home appliances. Security is achieved with motion sensors if movement is sensed at the entrance of the house; a notification is sent that contains a photo of house entrance in real time. This notification will be received by the owner of the house via internet such that app can trigger a notification. So, owner can raise an alarm in case of any intrusion or he/she can toggle the appliances like opening the door if the person is a guest. The system uses Raspberry Pi, a small sized computer which acts as server for the system. The smart home consists of two modules. Home automation that consists of; fan light and door controller, and security module that consists of; smoke sensor motion sensor and camera module.

"A Dynamic Distributed Energy Management Algorithm of Home Sensor Network for Home Automation System", by Tui - Yi Yang, Chu - Sing Yang, Tien - Wen Sung.
This paper proposes an optimization of home power consumption based on PLC (Power Line Communication) for an easy to access home energy consumption. This also proposes a Zigbee and PLC based renewable energy gateway to monitor the energy generation of renewable energies. ACS and DDEM algorithm are proposed for the design of an intelligent distribution of power management system to make sure ongoing power supply of home networks. To provide efficient power management the power supply models of home sensor network are classified groups viz. main supply only, main supply and backup battery, rechargeable battery power and non - rechargeable battery power. Devices with features are assigned to these groups. It targets to establish real time processing scheme to address variable sensor network topologies.

"Enhance Smart Home Automation System based on Internet of Things", by Tushar Churasia and Prashant Kumar Jain.
This paper proposes a system that develops a model to reduce the computation overhead in existing smart home solutions that uses various encryption technologies like AES, ECHD, hybrid, etc. these solutions use intermediate gateway for connecting various sensor devices. The proposed model provides a method for automation with sensor - based learning. The system uses temperature sensor for development, but other sensors can also be used as per requirement. These smart home devices with sensors can configure themselves autonomously and can operate without human intervention.

This work minimizes encryption decryption and focuses on authentication and automation of smart home devices with learning. The system bypasses local gateway mentioned in existing system to provide better security for smart home devices and sensor data and save computation overhead. The real time broker cloud is directly connected with smart home and manages all incoming and outgoing request between users and devices. The main purpose to use real time broker cloud is save time of cryptographic operations.

"Visual Machine Intelligence for Home Automation", by Suraj, Ish Kool, Dharmendra Kumar, Shovan Barman.
The paper presents a vision - based machine intelligence system to sense on/off state of common home appliance. The proposed method of sensing the state of appliances results on a novel home automation system. The accessibility of the suite of devices in the home over a remote network is facilitated by the IP Addressing methods in the IOT. This project uses two boards viz. Raspberry Pi and Intel Galileo Gen 2. The communication between the User devices, Raspberry Pi and the Intel Galileo boards happens over a wireless network. The UDP protocol is deployed to facilitate the wireless communication of the nodes present in the home automation network. A Pi Cam and a USB Logitech camera attached to the rotating shaft of two different servo motor capture snapshots that are passed as inputs to the Machine Learning based models trained using dlib - C++ to detect the state of the operation of the appliances. The proposed method uses visual modality to automate the appliances, as privacy concerns may emerge while using the images from some specific places, as a counter to this issue, an SPDT switch is added to the Raspberry Pi which when turned off ensures that even if the images are taken from the webcams, they are just passed as inputs to the machine learning models and are not displayed on the website when the users access the website on the server address obtained from Raspberry Pi.

"A Low Cost Home Automation System Using Wi - Fi based Wireless Sensor Network Incorporating internet of Things", by Vikram. N, Harish. K. s, Nihaal. M. S, Raksha Umesh, Shetty Aashik Ashok Kumar.
This paper illustrates a methodology to provide a low cost Home Automation System (HAS) using Wireless Fidelity (Wi - Fi). This crystallizes the concept of internetworking of smart devices. A Wi - Fi based Wireless Sensor Network (WS) is designed for the purpose of monitoring and controlling environmental, safety and electrical parameters of a smart interconnected home. The different sections of the HAS are temperature and humidity sensor, gas leakage warning system, fire alarm system, burglar alarm system, rain sensing, switching and regulation of load & voltage and current sensing. The primary requirement of HAS to monitor and control of devices is accomplished using a Smartphone application. The application is developed using Android Studio based on JAVA platform and User Interface of those are exemplified. The primary focus of the paper is to develop a solution cost effective flexible in control of devices and implementing a wide range of sensors to to capture various parameters.

"Voice Controlled Home Automation System using Natural Language Processing and Internet of Things", by Mrs. Paul Jasmin Rani, Jason Bakthakumar, Praveen Kumaar. B, Praveen Kumaar. U, Santhosh Kumar.

The paper focuses on the construction of a fully functional voice based home automation system that uses Internet of Things, Artificial Intelligence and Natural Language Processing (NLP) to provide a cost - effective, efficient way to work together with home appliances using various technologies such as GSM, NFC, etc. it implements a seamless integration of all the appliances to a central console, i. e. the mobile device. The prototype uses Arduino MK1000, known as GenuinoMK1000. The NLP in this project gives the user the freedom to interact with the home appliances with his/her own voice and normal language rather than complicated computer commands. The appliances are connected to the mobile device through an Arduino Board that establishes the concept of Internet of Things. The Arduino Boards are interfaced with the appliances and programmed in such a way that they respond to mobile inputs.

3. Methodology

The Proposed project aims to show the possibilities of a high end smart home setup, taking home automation to unimaginable levels. From fully customized dashboards to integrating existing devices, this project aims to set a benchmark In the world of home automation. The project is the first to solve the issue of the user having to use multiple applications for different devices and has all the devices under one application. It also showcases how digital panels/tablets can replace traditional switches taking it to the next level. It also shows how lighting can be controlled and can sync with various environments like gaming, party and other themes taking a step towards the future. It also monitors the energy usage and gives the user detailed reports which help in minimizing waste. It also has integrated security system that alerts for anyone trespassing, camera that detects intruders. This model supports all the voice assistants including Siri. In conclusion since everything is shown as a model a real life implementation is shown by means of a camera.

In order to develop an application that addresses all these issues it would take years and thousands of peoples effort. From custom integrations to custom dashboards to existing dashboards an existing application like blynk is not capable of performing these tasks. So in order to implement this project have used Home Assistant, which is an open source platform like GitHub where people create their own automations and implementations and share with other users that are experienced in this field. It has over 20 million+ contributions that can be used or modified depending upon the use case. The Home Assistant is the heart of the project. I have also used Wled an open source addressable led software for controlling rgb lighting, open rgb for syncing screen. I have created custom switches and added the esp devices via esp home. Integrations in the project.

- Home Assistant on Mac on Debian as a VM on Mac OS
- RGB Lighting
- Cooling fan & Water Pump
- Smart Garage

- Smart Switches
- Water Level monitoring System
- Solar Power Monitoring System
- Adding devices using their API
- Temperature & Humidity monitoring
- Intruder Alarm System
- ESP32 Camserver
- Alexa, Google Assistant, Siri Integration

4. Implementation

Implementation

I have efficiently applied a smart home gadget that carries Amazon Alexa and Apple Siri as AI assistants. To acquire this, I installation the essential hardware and software program components to allow voice instructions, and I included the Home Assistant application into the device. Due to the present day shortage of Raspberry Pi devices, I opted to run the Home Assistant utility on a laptop as a virtual machine or on an Intel - based old PC, both of which proved to be appropriate options.

The Home Assistant application plays a critical role in managing and integrating the various components of the clever home gadget. Although developing an utility like Home Assistant is a complicated and time - consuming procedure that typically includes a team of developers running collectively over a duration of years, the open - source nature of the mission allowed me to customize the user interface in step with my individual needs.

The smart domestic system I carried out boasts a huge range of features that can be managed thru the Home Assistant software. One of its primary capabilities is the potential to manipulate lights, inclusive of the capability to create LED ambient scenes. This characteristic lets in me to customise the lights in my home and create precise lights effects the use of in my opinion addressable LED strips, which might be supported through the WLED open - source platform.

Another critical thing of the system is its capability to offer actual - time data. I can take a look at the temperature and look at the weather at once from the Home Assistant application. Additionally, the gadget includes security features by monitoring for intruders and detecting short circuits. It additionally includes the ability to monitor water ranges, integrate safety cameras for surveillance functions, and track sun electricity and battery degrees.

One of the extremely good strengths of the smart domestic system is its compatibility with famous voice assistants inclusive of Siri, Alexa, and Google Assistant. By integrating these voice assistants into the gadget, I can manipulate diverse capabilities and gadgets inside my home the use of voice commands, including a further layer of convenience and sophistication to the machine. Whether I want to show on the lighting, alter the temperature, or test the safety digicam feed, I can truly speak my instructions to the AI assistants, taking into consideration seamless automation of every day duties.

In terms of expandability and compatibility, the smart home device is designed to help a extensive variety of manufacturers and models. The Home Assistant utility, being quite versatile, supports many brands and models of smart devices, ensuring compatibility with a vast array of devices in the marketplace. Furthermore, the machine comprises clever switches made using NodeMCU, providing extra flexibility for integrating self - developed fashions or custom designed devices into the device.

Overall, the implementation of this smart domestic system has supplied me with a complete and customizable solution for dealing with various capabilities and devices within my domestic. The incorporation of AI abilties through the combination of Amazon Alexa and Apple Siri as voice assistants has significantly improved the ease and class of the system. With voice commands and seamless automation, I can effects control the lighting, temperature, security features, and other functions within my domestic, making every day responsibilities extra efficient and exciting.
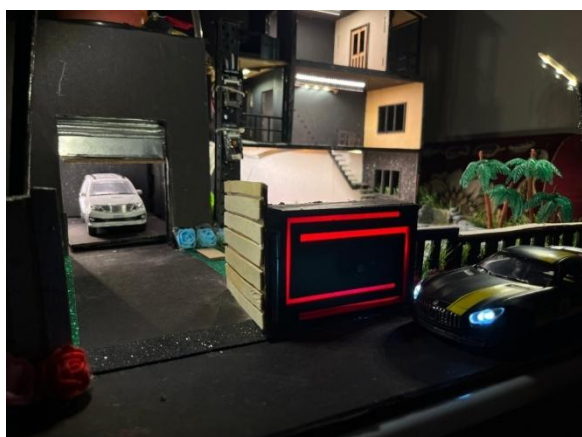
5. Results and Discussion

Figure 1: Gate with Reed sensor for Intruder System

Figure 2: Smart Garage

Figure 3: Model with Alexa Echo

Figure 4: Model
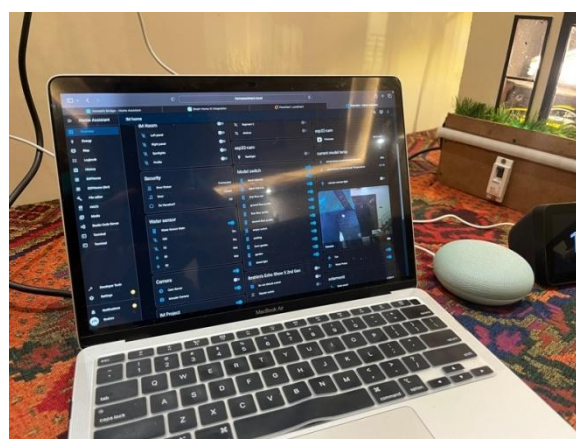

Figure 5: Model with Solar Panel

Figure 6: Model Control Dashboard

Figure 7: Real Life Smart Home Dashboard

6. Conclusion

In conclusion, the implementation of an AI assistant into a smart home project, utilizing Amazon Alexa and Apple Siri, offers a significant enhancement to the overall functionality and convenience of the system. By setting up the necessary hardware and software to enable voice commands, the Home Assistant application becomes an essential component in managing and integrating various features within the smart home system. The smart home system described in this project provides a wide range of capabilities that can be controlled through the Home Assistant application. From controlling lights and creating LED ambient scenes to monitoring temperature, weather, intruders, short circuits, water levels, security cameras, solar energy, and battery levels, the system offers comprehensive control and monitoring of the home environment. Additionally, the integration with popular voice assistants like Siri, Alexa, and Google Assistant allows for seamless voice control and automation of daily tasks. The ability to control individually addressable LED strips, supported by the WLED open - source platform, adds a unique feature to the smart home system. This feature enables users to customize and create unique lighting effects in their home, adding a personal touch to the ambiance. The smart home system is designed to be highly expandable and customizable, supporting a wide range of brands and self - developed models. The compatibility of the Home Assistant application with various brands and models ensures flexibility and interoperability with different devices. Moreover, the support for smart switches made using NodeMCU further enhances the system's compatibility and adaptability. Overall, the integration of AI skills through the implementation of Amazon Alexa and Apple Siri adds an extra layer of convenience and sophistication to the smart home system. The voice command functionality and automation capabilities provided by the AI assistant greatly enhance the user experience and streamline daily tasks. As technology continues to advance, there are several potential future enhancements and areas of exploration for this smart home project. These include integration with additional voice assistants, incorporating advanced machine learning algorithms for personalized user experiences, implementing facial recognition and biometric security measures, optimizing energy usage and sustainability, integrating with a broader range of IoT devices, enhancing security features, enabling voice - controlled automation, improving the user interface, integrating with third - party services, and fostering community and developer support. By embracing these future scope and enhancements, the smart home system can continuously evolve, providing users with a more sophisticated and comprehensive home automation solution. The combination of AI assistance, seamless control through voice commands, and extensive customization options make this smart home project a valuable addition to modern living environments.

7. Future Scope

1) Advanced Machine Learning Algorithms: Enhance the AI assistant's capabilities by integrating advanced machine learning algorithms. This could involve developing personalized user profiles, improving voice recognition accuracy, and providing more intelligent and context - aware responses to user queries and commands.
2) Facial Recognition and Biometric Security: Implement facial recognition technology to enhance home security by allowing authorized individuals access to the smart home system. This could be integrated with security cameras or smart locks, providing an added layer of convenience and protection.
3) Energy Optimization and Sustainability: Expand the system's capability to monitor and optimize energy consumption further. This could involve integrating with smart thermostats, energy - efficient appliances, and renewable energy sources like solar panels. Advanced algorithms could analyse energy usage patterns and provide recommendations for optimizing energy consumption.
4) Integration with IoT Devices: As the Internet of Things (IoT) continues to expand, integrating the smart home system with a broader range of IoT devices would enable control and monitoring of a wider range of appliances and sensors. This could include home appliances, wearable devices, health monitoring systems, and more.
5) Enhanced Security Features: Strengthen the security features of the smart home system by integrating with advanced security protocols, implementing intrusion detection systems, and enhancing data encryption. This would help protect user privacy and prevent unauthorized access to the system.
6) Voice - Controlled Automation: Expand the system's automation capabilities to allow users to create complex routines and scenarios using voice commands. This could involve setting up sequences of actions triggered by specific voice commands or conditions, such as "Good night" to turn off lights, lock doors, and adjust the thermostat.
7) Improved User Interface: Continuously improve the user interface of the Home Assistant application to enhance usability and accessibility. This could involve developing mobile apps for easier control on smartphones, introducing intuitive visual interfaces, and

Paper ID: SR23611035733   DOI: 10.21275/SR23611035733   1349

implementing personalized dashboards for individual users.

8) Integration with Third - Party Services: Enable integration with popular third - party services and platforms, such as home security systems, streaming services, online shopping platforms, and more. This would allow users to access a wider range of services and functionalities through their smart home system.

9) Community and Developer Support: Foster a strong community and developer support around the project to encourage collaboration, innovation, and continuous improvement. This could involve organizing hackathons, providing documentation and resources for developers, and encouraging contributions to the open - source Home Assistant project.

These future scope and enhancements would further enhance the functionality, flexibility, and usability of the smart home system, providing users with a more sophisticated and comprehensive home automation experience.

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