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A VOICE RECOGNITION BASED IOT HOME AUTOMATION SYSTEM

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Abstract

The concept of home automation is an on growing topic in this century and it plays a vital role in our daily lives as individuals, as innovators and also as a collective society. Home automation significantly reduces the need for human labor, saves time, and minimizes the effort required for daily tasks. This research aims to explore the challenges and potential of home automation. With the increasing demand for enhanced home security systems, there is a need for intuitive and efficient control mechanisms. Modern smart homes integrate automation to ensure not only security but also energy efficiency, especially in the absence of occupants. The scope of home automation varies from controlling a single device to managing an entire household seamlessly. While implementing such a system poses various challenges, overcoming them unlocks numerous possibilities, making it one of the most valuable innovations in our technology-driven era. This paper proposes a voice recognition-based model to enhance the user experience in managing smart homes. The topic was selected for its promising future prospects and continuous technological advancements.

Keywords: Home automation, voice recognition, smart homes

Introduction

A clever domestic is a domestic that offers its citizens the comfort, comfort and simplicity of operation of gadgets in any respect times, no matter wherein the resident certainly is inside the house. It usually consists of electrical appliances such as lighting, fans, air-conditioners, room-heaters, air-coolers and microwave oven etc.; and electronic gadgets such as television, computers, audio systems, laptops, music-systems and mobile devices etc. All these appliances and gadgets can be connected and controlled remotely, over a secure channel using WiFi or internet through software application, from within or outside the house [1].A smart home typically comprises three key components: (i) an internal home network, (ii) intelligent control systems, and (iii) home automation facilitated through wired or wireless access gateways. These appliances and gadgets are generally connected to specific sensors, so as to make these automatically adapted to certain situations and in-turn make the occupants

feel comfortable. An adaptive smart home refers to a system that employs machine-learning methods to identify patterns in residents' daily routines. Subsequently, it formulates automation rules and actions that replicate these patterns [2]. Once these systems become aware of the requirements of residents, the residents can then be provided with a better living experience, by predicting their future needs and perform routine tasks. The aim would be to reduce physical movements and labour by the humans, by sensing and proactively responding to their needs. This important application domain is predicted to steadily increase in the future[3]. Moving away from the traditional methods such as keyboard or switches to control the devices, voice control is one of the easiest methods to give input commands. Also, voice recognition is a more personalized form of control, since it can be adapted and customized to a particular speaker's voice. Voice recognition differs distinctly from speech recognition. In speech recognition the subject of analysis is the spoken text, while in voice recognition the subject of analysis is the voice of the speaker and the spoken text remains secondary here, though both are taken into account. Thus, voice recognition is better for controlling and accessing the appliances.Considering the rapid economic expansion, living standards keep rising day by day and people eventually have a higher requirement For ease of get entry to to the diverse day by day tasks. The highbrow society for this reason has to result in some of modifications and innovations and give you sufficient improvements to delight the contemporary-day own circle of relatives in each manner possible and the market has to come up with affordable tech assistants for these individuals in such a way that they are more advanced than the other companies but still affordable sufficient to be sold with the aid of using any member of the society and now no longer simply of the wealthy society. There are several methods to incorporate smart home automation systems in our homes, a few of them are as follows:

• **DTMF:** A widely used type of system operates through dual-tone multi-frequency (DTMF) technology for automation. This system enables wireless control of appliances.[4].

• **Speech recognition:** It is thought to be one of the maximum complex regions of laptop science. Speech recognition, being inherently dynamic, employs various techniques for its implementation. These include artificial neural networks (ANN), pattern-based recognition, statistical analysis, and language modeling. Such recognition methods find frequent application in home automation systems.[5]. It is an growing idea and has emerge as a huge unfold fashion across the world, and the most important of corporations are trying to excel on this subject such as Google, Amazon, etc. All we must do is simply speak to our home equipment and supply the specified set of instructions and the relaxation is sorted with the aid of using the voice assistant.

• **Wi-Fi (Wireless Fidelity):** In today's era, Wi-Fi has gained extensive availability and serves as an ideal foundation for home automation setups. Its numerous benefits include wireless setup options, cost-effectiveness, absence of wall damage or drilling requirements, and straightforward network connectivity accessible to any user.[6].

• **Web Applications:** Any tool along with fan, AC, TV, and vehicles primarily based totally on the idea of electronics may be related to the Internet surroundings the use of a software program as an interface and accessing it remotely through an Android or Web-based application. Hence every other shape of automation may be executed the usage of the Android and Web applications.

• **Short message service (SMS):** Check and control the safety of the house or appliances in the office using mobile phones assigned to send commands in the form of SMS Texts and obtain the reputation of the device .

Fig. 1 Diagram illustrating the fundamental structure of a home automation system[9]

Smart homes:

Smart homes represent the concept of a home where the home appliances are connected to each other via some central home network, and if required they can be controlled and operated from some remote location too. Smart home appliances can communicate to each other and are also capable of communicating to other smart objects of the home [7]. According to the Smart Home Association, the precise definition of clever domestic innovation is: "the combination of generation and offerings via domestic networking for a higher best of living" [8]. The term smart home is used to define a house which uses a system-based algorithm to carry out basic human needs and reduces labor hours on carrying out these tasks. The maximum well-known domestic controllers are those which are related to a Windows device in the course of programming after which left to carry out the responsibilities on its own. Integrating those clever domestic structures lets in them to speak records with the interconnected devices with inside the precise domestic and for this reason permitting command interpretation the usage of voice popularity and more. This discipline is growing substantially as technology are getting an increasing number of abundant. These domestic networks cowl communication, entertainment, safety, adaptability, and records records systems[10]. As stated in the Global Health and Aging report by the World Health Organization (WHO), around 524 million people, representing around 8% of the population of the world, were of the age of 65 or above in the year 2010. By the year 2050, this huge number is estimated to reach 1.5 billion (around 16% of the population of the world). In addition to this, the WHO estimates that 650 million people live with a number of disabilities around the world. Hence, it's crucial for innovators to devise user-friendly smart environments aimed at promoting greater independence in daily life for elderly and differently abled individuals.[11]. When a research was conducted for elderly and disabled people, the results were that besides the fact they want to be at home for as long as possible, they additionally need help of their day by day lifestyles and emergency responses as to once they fall or have a clinical condition, this will be included in a clever domestic and is one of the main objectives of upcoming innovations in this field.In a smart home, variety of appliances can be controlled by technology, examples can be lights being switched ON using movement detectors so they're used handiest while needed. Another instance will be the blinds of the home windows remaining on their personal while lighting internal are switched ON, or the thermostat detecting the temperature of the room and automatically changing it according to the environment needed. Although smart homes are anticipated to play a significant role in the future, they are currently in their nascent stage and remain beyond the financial reach of many. Demand remains restricted as it's miles simplest including complexity in preference to user-friendliness.

BLOCK DIAGRAM

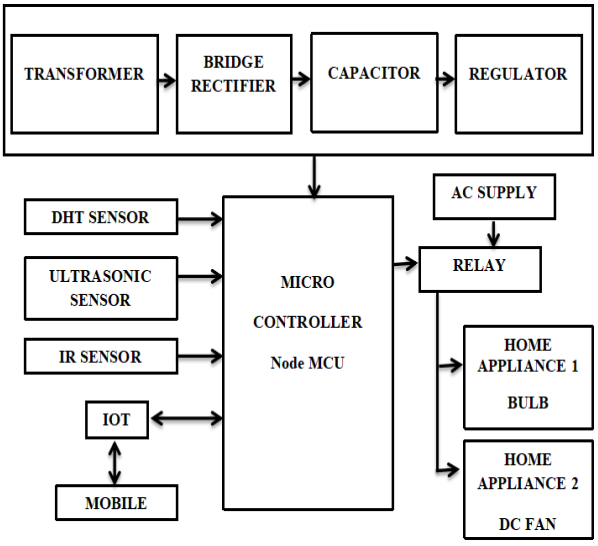

Fig. 2 BLOCK DIAGRAM

Home Automation Challenges

In spite of the progress made in home automation systems, numerous challenges persist in this domain, given its emerging nature and status as a relatively new frontier across various disciplines. This discipline holds some of regions for improvement, a number of them are as follows:

• **Eco-friendly:** The gadgets used and structures applied ought to be green and ought to now no longer upload to the massive quantity of e-waste that's already found in this polluted world. The gadgets have to be of such way that they may be used and reused and have to now no longer be generated as waste or purpose pollutants while out of use.

• **Cost-effective:** The gadgets and machine used with inside the automation machine ought to be price range pleasant sufficient for a not unusual place middle-elegance guy if you want to buy and ought to now no longer only Be reachable to wealthy residents of a kingdom due to the fact that could result in a want for clever houses best for wealthy humans and some thing past creativeness for middle-magnificence residents of a country.

• **Safe to use:** The gadgets used ought to be secure as they'll be used on a day by day foundation and it ought to be made positive that there are right safety precautions taken in case these devices cause harm. There should be proper safety protocol at all times.

• **Ease of adaptation:** The system designed to fulfill essential functions in a smart home should be user-friendly and flexible enough for newcomers to grasp and utilize effortlessly in their daily routines, without requiring constant assistance to navigate a system intended to enhance their independence. It need to be adaptable to every age and those of unique wishes and people who require extra assist of their each day chores.

• **Secure:** Since those gadgets are used thru the Internet, it's far very clean to hack such structures and therefore cyber protection ought to be one of the important issues when generating and implementing these systems because once the system gets hacked, the whole house can be in the hands of the hacker and be a very dangerous issue. The aim is to invent and implement budget-friendly automated systems. When utilizing Wi-Fi-enabled devices, it's crucial to ensure that the connectivity remains cost-effective and accessible. It's imperative to ensure that the connection is strong and does not get disconnected at any point as it will lead to a variety of problems and cause the system to shut down and stop working. When using IoT-based systems, it is important to make sure that the devices are long lasting and simultaneously affordable and very easy to use. It is simultaneously very important that the users know what to do and how to do when there is a problem based on the connections and devices and when new devices are installed. When employing voice clients, it's crucial to ensure they are configured to detect voices across various audible ranges. This capability is vital for promptly recognizing any emergencies, including the faintest or least audible sounds.. Due to those challenges, domestic automation structures are nonetheless an upcoming place and want greater human beings to be acquainted with the idea and knowledgeable sufficient to put in those of their homes.

Framework Implementing Voice Recognition System

To ensure ease of access and adaptability, our proposed smart home management model is centered around utilizing a voice recognition system as its foundation. While voice recognition systems present inherent errors and challenges, they remain one of the simplest and most adaptable systems for use. There are lots of clever improvements developing which can be created with the aid of using huge corporations together with Amazon’s Alexa, Apple’s Siri, and Google’s OK Google. These include voice assistants, which serve as prime examples of innovative technologies built around voice interaction. The 3 fundamental steps on this voice recognition-primarily based totally are: 1. The detection and interpretation of voice commands through a module and microphone. 2. Identifying the command using the module and micro controller simultaneously.

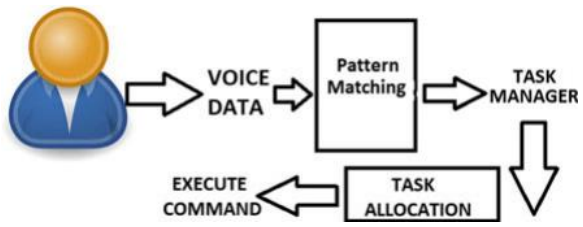

Fig. 2 Framework for voice recognition model

3. Sending the control signals to the respective devices based on the commands given and the groups they are in. Proposed framework with the The ASR (Automatic Speech Recognition) system operates much like other ASR algorithms. Voice data is captured by the microphone and promptly analyzed for patterns. Based at the suit found, the related challenge supervisor allocates the applicable challenge to execute, and finally, the voice-primarily based totally machine receives performed for the clever domestic management. For this purpose, we have used an automatic speech recognition (ASR) system which is an automated computerized process of decoding and analyzing oral speech. A typical ASR-based system (Fig. 2) Operates by receiving acoustic inputs from a speaker, which are then analyzed using a pattern, method, or algorithm, resulting in an output typically corresponding to a task assigned by the user. ASR collects the voice enter and right now prepossessing of this gathered facts starts, observed through cleansing of this facts to dispose of any type of noise related to this voice facts. Once data is clean, then further analysis gets started which can be pattern recognition or matching and identifying the pattern, if pattern is found and match voice command gets executed.

Conclusion

This paper suggests integrating IoT within a secure infrastructure model distributed across multiple platforms, including remote locations, with AI voice control. We present a model for smart home automation systems, addressing several key challenges, including:
(i) The necessity for various underlying technologies to integrate voice-based control for improved ease-of-use.
(ii) Concerns regarding security, privacy, and affordability leading to a lack of trust and usability.
(iii) The lack of awareness among users about the application of machine intelligence to fully leverage the potential of smart technology in controlling IoT devices within a home environment is a significant challenge. This original research has yielded three primary contributions. Firstly, the development of a voice-recognition AI engine functioning as a personal assistant robot capable of being trained with user voice and remotely controlling various IoT sensors and devices via a smartphone. Secondly, the introduction of a unique model offering low-cost, scalable, and easily configurable end-to-end security for IoT devices, addressing potential privacy threats associated with third-party services. Thirdly, the illustration of several use cases in a typical home environment to showcase the practical viability and deployment of a secure and user-friendly system, facilitating sustainable adoption of smart home technology among consumers.

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