An efficient home automation system using IOT: A case study to benefit people with motion disability.

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Abstract

Due to its multiple benefits, home automation is becoming increasingly popular. Local networking or remote control can be used to accomplish this. The goal of this work is to create a basic home automation application on the Raspberry Pi and the method for doing so was created in the Python environment, which is the default programming environment offered by the Raspberry Pi. The results suggest that the proposed algorithm for home automation is well-implemented. The switching action was indicated by LEDs.

Keywords: *Raspberry Pi , home automation, Python*

Introduction

Because of the convenience technology affords, 21st-century homes will become increasingly self-controlled and automated, especially when used in a private residence. A home automation system is a device that allows consumers to operate a variety of electric appliances. Wired communication is used in many existing, well-established home automation systems. This isn't a problem until the system is developed ahead of time and installed during the building's physical construction.

1.1 Overview

Smart home automation solutions based on the Internet of Things are designed to monitor and control the attributes you want to manage. Wi-Fi devices, for example, use Internet protocols to collect and distribute data. Sensors or detectors on each device then report to a central home automation hub. Sensors broadcast and receive commands to one or more hubs, which then relay the results to the cloud network. The architecture shown here allows personal devices to interact with the system remotely.Wireless systems, on the other hand, can be extremely beneficial to automation systems. Wireless technologies such as Wi-Fi and cloud networks have advanced in recent years, and wireless systems are now utilised every day and everywhere.

1.2 Advantages of Home Automation

Wireless systems, such as Wi-Fi, have been increasingly popular in home networking in recent years. Wireless technologies also provide various advantages in home and building automation systems that are not possible with a wired network alone.

1)   Lower installation costs: First and foremost, because no cabling is required, installation expenses are greatly reduced. Wired systems necessitate cabling, which is costly in terms of both material and expert wire laying (for example, into walls).

2)   System scalability and easy expansion: Deploying a wireless network is especially advantageous when the network needs to be expanded due to new or modified requirements. Unlike wired systems, where cabling extension is time-consuming. As a result, wireless installations are a critical investment.

3)   It's really convenient to be able to control anything with your fingertips. You never leave home without your wallet, keys, and cell phone. We can simply monitor our home and control everything with only a touch of a finger because we always have our

smart phone with us.

4) We don't have time to care about our home because we live in such a fast-paced environment. We can save time going back to our house and making sure everything is in order with home automation, such as if the kids close the door from school or turn on the lights when you return home.

5) This is the most significant benefit of home automation. The ability to dim or turn on/off the light at a certain time will save the homeowner a significant amount of money. With correct automation in window shades and an automated thermostat, you can save money by controlling the temperature in your home. You can also conserve gas by not driving back home if you forget to turn off the lights or lock the door.

1.3 How IOT(Internet of Things) solves the problem

Let's take a deeper look at the Internet of Things (IoT) before moving on. The term "Internet of Things" refers to all technologies that allow a device to connect to the Internet.

Such systems are reliant on data collection. The information is then utilised to monitor, control, and transfer data to other devices over the internet. This enables certain actions to be launched automatically whenever certain circumstances exist. Consider the smart kettle as an example. Once the kettle reaches a certain temperature, it can be programmed to switch off automatically. It may also send the user a notification about it.

Apply the same principle to your entire home and all of your devices. That is an IoT-enabled smart home. Rather than having to manually go up to the device and take action, those actions can be performed with the push of a button. Most smart IoT home automation gadgets these days can be controlled using an app or even voice commands.

Consider what it would be like if you didn't have to do any of these things. To put it another way, the smart house will know when to execute particular activities and will do so automatically. This is where home automation and IoT will go in the future.

2. Literature Survey

i) Bluetooth based home automation system using cell phones:

Home appliances are connected to the Arduino BT board at input output ports via relay in a Bluetooth-based home automation system. The Arduino BT board's programme is written in the high-level interactive C language for microcontrollers, and the connection is established via Bluetooth.

Only authorised users are permitted access to the appliances, which is protected by a password. For wireless communication, a Bluetooth connection is formed between the Arduino BT board and the phone. The python script is utilised in this system, and it can be installed on any Symbian OS environment, making it portable. For receiving feedback from the phone, which indicates the device's state, one circuit is designed and executed.

ii) Zigbee based home automation system using cell phones:

The system is built and deployed utilising Zigbee to monitor and control the home appliances. Network coordinators keep track on device performance and save it. This is accomplished through the use of a Wi-Fi network, which employs a four-port standard wireless ADSL contemporary router. The network SSID and Wi-Fi security parameter are already set. The message is initially processed for security purposes by the virtual house algorithm, and after it is declared secure, it is re-encrypted and forwarded to the home's real network device. The Zigbee controller relayed messages to the end over the Zigbee network. The virtual home algorithm's safety and security of all messages it receives. Zigbee communication is useful for reducing the cost of the system and the intrusiveness of the system's installation.

iii) GSM based home automation system using cell phones:

GSM-based home automation is attracting investigation because of mobile phones and GSM technology. We evaluated SMS-based home automation, GPRS-based home automation, and dual tone multi frequency (DTMF)-based home automation primarily for GSM communication.

The system makes use of a transducer, which converts machine functions into electrical signals that are then sent to the

microcontroller. The system's sensors translate physical properties such as sound, temperature, and humidity into a different quantity, such as voltage. The microcontroller analyses all signals and converts them into commands that the GSM module can interpret. Based on the command received by the GSM module, choose a suitable communication method from SMS, GPRS, or DTFC.

iv) Wi-Fi based home automation system using cell phones:

The server, the hardware interface module, and the software package are the three essential components of a Wi-Fi-based home automation system. The server and the hardware Interface module communicate with each other via Wi-Fi technology. The same technique is used to access the server-side web application. Because the server is linked to the internet, remote users can use a compatible web browser to access the server's web-based application.

The current home automation system's software is divided into two parts: server application software and microcontroller (Arduino) firmware. The Arduino software, which is written in C and runs on an IDE, is included with the microcontroller. The Arduino software is responsible for collecting events from linked sensors, then applying actions to actuators and preprogramming them on the server. Another task is to generate reports and keep track of history in the server database.

v) Raspberry pi home automation with wireless sensors using smartphone:

The Raspberry Pi was used to create a home automation system based on the algorithm and subject of an email. Raspberry Pi is certain to be a reliable platform for implementing powerful and cost-effective smart home automation. In numerous aspects, Raspberry Pi home automation is superior to conventional home automation solutions.

For example, when combining DTMF (dual tone multi-frequency) with home automation, the call tariff is a significant disadvantage, which is not an issue with their proposed way. Because this method simply uses the previously established web server service provided by G-mail, the design of the web server and the memory space necessary are bypassed in Home Automation utilising the web server. The switching action was identified using LEDs. This system is both efficient and adaptable.

2.2 Functional Description:

2.2.1 Raspberry Pi: The Raspberry Pi is a small, low-cost computer the size of a credit card that connects to a computer monitor or television and utilises a conventional keyboard and mouse. It's a capable small device that allows individuals of all ages to learn about computers and programming languages like Scratch and Python. It can do everything a desktop computer does, including accessing the internet and watching high-definition video, as well as spreadsheets, word processing, and gaming.

Furthermore, the Raspberry Pi can communicate with the outside world and has been utilised in a variety of digital maker projects, including music machines and parent detectors, as well as weather stations and tweeting birdhouses with infrared cameras. We want to see youngsters all across the world using the Raspberry Pi to learn how to write and understand how computers function.

2.2.2 Relay board: Computer boards featuring a variety of relays and switches are known as relay boards. They are meant to manage the voltage supply and have input and output terminals. For each of the onboard relay channels, relay boards enable separately programmable, real-time control.

2.3 Use cases of IOT

For the aged and disabled -

Focuses on allowing elderly individuals and people with disabilities to remain secure and comfortable at home. Home automation is becoming a feasible choice for seniors and persons with disabilities who would rather stay in their own homes than go to a healthcare centre. For security, entertainment, and energy conservation, this field use much of the same technology and equipment as home automation, but it is tailored to older persons and people with disabilities.

Control-

Many of today's domestic appliances, from broilers and refrigerators to deadbolts and cooling devices, can be managed organically using projects on PCs, phones, and tablets. In many cases, the control of all of these gadgets works even while you are out of the house and can change them, which means you could close the door from the airport, check on the dog from anywhere in the country, or confirm that you turned off your stove from the supermarket or another store.

Savings- With all of the connected electrical devices, such as learning coolers, smart sprinklers, wirelessly enabled lighting, tracking electricity retailers, and water heating and cooling modules, we will be able to save energy and mone**y.**

Convenience- Having the majority of your lounge and room lightings switched on as you approach your property remotely, the home theatre and TV machine consequently playing your favourite melody, and the front entry opening naturally when you approach it with hands full of shopping is perhaps the most end rich highlights of the astute and home. In any case, peace and tranquilly aren't just about living a lavish and simple life; clever locks can also enable you to grant access to a certain group of individuals at specific times and not in general, allowing you to avoid having to stay at home and hand over a key. Similarly, a sensor that alerts you when your fridge is empty or out of stock invites you to "plan" your entrance or exit from anywhere in the world.

Security- They are such clear, associated replies for well-being for the sharp home that are sensibly evaluated alternatives for each security-verified framework. CCTV cameras, connected

development sensors, and astute smoke alerts can all be viewed remotely from within or outside a building via video live, email, and pre-written reports.

3. Technical Approach

The automatic control of technological gadgets in your house is known as home automation. Because these gadgets are connected to the Internet, they may be operated from afar. Devices can trigger one another with home automation, so you don't have to operate them manually via an app or voice assistant. You can, for example, set your lights to turn off when you normally go to bed, or set your thermostat to turn on the A/C about an hour before you return to work so you don't have to come home to a stuffy house. Home automation makes life easier and might even save you money on utility expenses such as heating, cooling, and electricity. With Internet of Things devices like security cameras and systems, home automation can also lead to increased safety.

3.1 Proposed System:

As we enter the twenty-first century, transactions between people and computers are breaking down traditional barriers and entering a new realm. Phones have become an integral part of our daily lives in today's massively innovation-driven environment. Cell phones aren't just for talking on the phone. With the use of cell phones, we are attempting to infer arrangements that provide better monitoring on local devices. The contemporary contraption includes a large number of equipment that may be controlled by switches in our homes.

Those devices can be physically turned on and off whenever they are required. This contraption is far less reliable and vulnerable to electric attacks. Similarly, the subject's vitality waste tends to be a focal point. The proposed task is to administer our cell phone's systems to all machines via a smart trustworthy circuit. The proposed device has astute practical insight circuits that are connected to house hardware. Every single household appliance's reputation can be built with the help of a buyer from afar using a person's cell phone.

3.2 Proposed System functionality

The proposed system will provide the following features:

1. watch the going with alerts:

2. Control lights

3. It can likewise control the following machines:

4. Lights on/off/diminish

5. Fan on/off

6. On/off various apparatus

3.3   Procedure given for the proposed system

The system method entails programming a prototype gadget to work robotically and be controlled via a mobile application. The first stage in the prototype format will be to create a

chronology and read related works. We can begin implementing the layout and automation approach for the executable after looking into the benefits and drawbacks of past studies on the issue of home automation systems. The project's timeline is determined by the project's flowchart.

1) If a user wishes to switch on or off any home appliance he first needs to open the application integrated with the appliance and then press the button as displayed on the screen.

2) As soon as the button is pressed the application will send a message to the server through API containing the information about the action performed by the user.

3) The server will then send the desired instruction to the Raspberry Pi using IOT techniques and will wait for the execution of the instruction.

4) Raspberry Pi is an integrated device having all instructions already loaded by the programmer accordingly for different actions performed by the user.

5) The signal is then received by a relay board which is an array of relays and switches having both input and output terminals.These are independently programmable. These boards help in switching appliances by controlling the flow of voltage through them.

3.4   Home Automation with IoT:

The internet of things, also known as IOT, is a new technology that allows us to operate hardware objects over the internet. We propose to use the internet of things (IoT) to control household appliances, thereby automating modern homes via the internet. This setup simulates house illumination and a fan with three loads. Our user-friendly interface makes it simple to control these household appliances over the internet.

Our preferences for music, temperature, and lighting, as well as the times we get up, eat, and go to bed, are all known to smart IoT sensors. Smart plugs, lighting, and security systems all assist to make our lives easier. We don't have to worry about our home security when we aren't there because they are simply regulated using a smartphone app.

3.5   Challenges in Home automation implementation

In today's marketplace, the digital space and contemporary technological expansion in the world, as well as smart home automation, are establishing their importance. Smart houses have highly developed technology such as automated door openers and lighting control systems that bring numerous concrete energy efficiency benefits. IP-enabled cameras, security alarms, object motion sensors, and connected door locks all contribute to a safer and more secure house. In order to achieve these levels of automation in home control, innovative technology is required, which allows timeless and seamless interaction between the sensors of various home equipment. The following are some of the most significant issues in the field of home automation.

3.5.1 Access to the Internet

When it comes to propelling these smart devices, Internet access and stability are still uncertain and, in some situations, simply insufficient. This can be a huge roadblock, especially in India, where smart panels and home control are still in their infancy.

3.5.2 IoT-Enabled System Costs

When it comes to most sorts of technology, Indian consumers are quite picky when it comes to investing in convenience and technology. When the concept of home automation becomes more widespread and important across the country, this problem may be solved. Even other devices, such as smart wearable fitness bands, have yet to gain traction in India, owing to the high cost.

3.5.3 Market Supply Shortage

The perception among global market players is that the Indian market isn't ready or educated enough for modern gadgets or products. As a result, Indian customers are unaware about Internet of Things (IoT) systems or smart home products. The lack of a competent staff to install statewide IoT enabled smart systems is also limiting IoT adoption.

3.5.4 Infrastructural Systems

Smart electricity grids, smart drainage/ sanitation systems, smart water supply, and similar smart building management systems, which are indistinguishable and key aspects of smart houses, are

far from widespread. Replacing these ancient building structures is one of the most difficult challenges we face.

3.6 Feasibility analysis:3

This project is economically, technically, and operationally feasible since it can be done utilising low-cost electronic and software technology.

3.6.1 Feasibility from a financial standpoint

This project uses an Android phone and a few low-cost electronic components such as the Raspberry Pi computer, camera modules, and relay switches to make it cheaply feasible to build.

3.6.2.Feasibility from a technical standpoint

This project is based on wireless technologies and embedded systems that are quite contemporary in terms of technology. As a result, technology favours it greatly.

3.6.3 Feasibility of Operation:

This software will have a very simple, user-friendly interface, making it pretty nearly usable by anyone who has never used an Android phone before. Controlling home appliances with a push of a button could be useful for physically challenged people as well. As a result, it is practicable.

3.6.4 Low cost operations :

The cost of an IoT deployment is determined by a number of factors, including the hardware and software costs. A smart home automation system's software does not cost a lot of money. A basic android app to turn on/off a switch would take roughly 80 man hours to develop. A server and IoT hardware, such as a board, controller, switches, and relays, would be required to host the application. The key difference between arduino and raspberry pi boards is that arduino boards are microcontrollers, whilst raspberry pi boards are microprocessors. For smart home automation, we only needed a board that supported bit pins, which the arduino board does. The Raspberry Pi pins are programmatically controlled.

4. Conclusions and future scope

These types of Home Automation Systems are necessary since humans sometimes make mistakes and forget to turn off appliances when they are not in use, and in this situation, they are important in order to use power efficiently and safely. Home Automation is a significant step forward in the technological growth of the appliance sector, as well as another strategy for avoiding human errors and lowering energy usage.

The advancement of the stage for home robotization promotion will be contingent on a couple of key changes in the Automation progression, for example, advancements in Wireless Automation blueprints and, moreover, a decrease in regard appears as the market begins to perceive Home mechanisation use in greater volumes. Here are a few instances of what we expect throughout this period of the business:

• Major corporations such as Philips, Siemens, and Schneider will, over time, release true mass market mechanised items that interface with UI, but at a lower cost point than they are now, allowing more people to afford them.

• Solution commitments will gradually shift to a more straightforward structure, where clients will be able to buy and employ Automation items independently, aside from two or three core components.

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