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A Narrative Mechanism on Design of Smart home controller based on raspberry pi Using Internet of Things

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ABSTRACT:

Automation is not a new idea in our modern life. Large businesses and wealthy homeowners have already implemented this technology for years now. In recent years saw this concept getting more accessible to very home owner, due to cheaper cost, easier to setup and used modular concept and also higher internet penetration rate. However, none of this system really focused on the needs of the handicapped and the elderly, thus the aim for this project. This niche group of people has different needs than other type of user. Similar to other home automation system, it is able to control electrical appliances remotely from a Smartphone, laptop or any Wi-Fi enabled device, but it can be configured to do specific task depending on the user needs. Furthermore, monitoring features can be added to enable other family member to monitor the disable and the elderly via the internet, and remotely control attached devices. It is hoped that it will provide a better quality of life, while reducing the electricity wastage by giving user the power to control, conserve and react according to user needs, or also can be done by using the scheduling function for automatic operation of home appliances.

Keywords: *Raspberry Pi, Home Security, PIR Sensor, Home Automation, IOT*

INTRODUCTION:

This system provides a wireless remote control solution for controlling the lights and fan via Wi-Fi capable handheld devices such as Smartphone, adding convenience and also reducing electricity wastage. While this concept is not new, all of this only appeals to tech savvy user, due to the complexity, feature and price, which are not important for this project target user. In this project, appliances such as light and fan that connected to the Main Control Unit (MCU) still can be controlled remotely from a computer screen or a smart phone. This is performed by using a very simplistic Graphical User Interface (Graphical User Interface, GUI), which is easily used and understandable for the target user. This system can also be equipped with the monitoring function by including a web camera to the MCU for a live video feed, or from wearable electronics wore by the user which for example include heartbeat sensor.

Block Diagram:

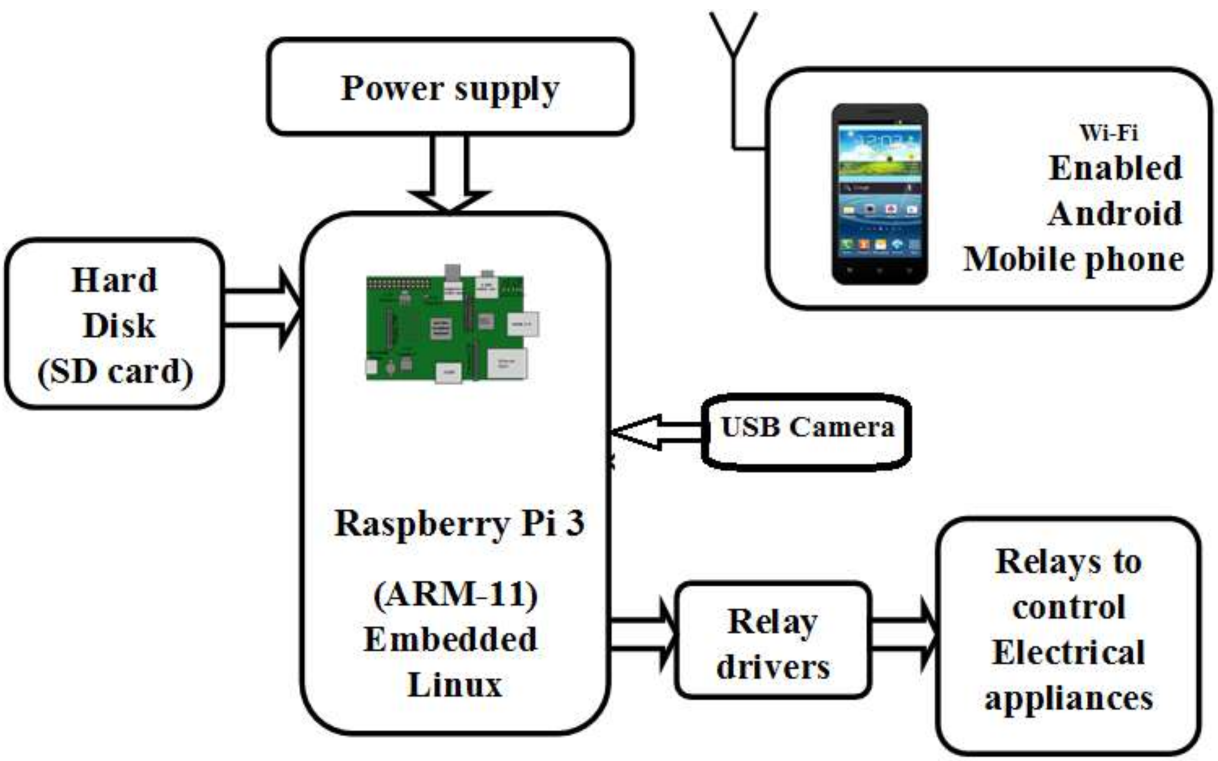

Figure1: Rasberry Pi

The major building blocks of the project are:

1. Power Supply.

2. Raspberry Pi 3 processor.
3. Android smart phone.
4. 4-Relay board with driver.
5. USB camera

Software's used:

1. Embedded Linux programming.
2. Express SCH for Circuit design.

LITERATURE SERVEY:

Smart home is not a new term for science society, it is been used from decades. As electronic technologies are advancing, the field of home automation is expanding fastly. There were various smart systems have been proposed where the control is via Bluetooth [7], internet etc. Bluetooth capabilities are good and most of current laptop/desktops, tablets, notebooks and cell phones have built-in adaptor that will indirectly reduce the cost of the system. But it limits the control to within the Bluetooth range of the environment while most other systems are not so feasible to be implemented as low cost solution. In Wi-Fi based home automation system is presented. It uses a PC (with built in Wi-Fi card) based web server that manages the connected home devices. The system supports a wide range of home automation devices like fans, lights, other home appliances. A similar architecture is proposed in where the actions are coordinated by the home agent running on a PC. Other papers such as also presented internet controlled systems consisting of a web server, database and a web page of websites for interconnecting and handling the devices

The Internet of Things: An ongoing trend in embedded devices is to have all embedded devices connected to the Internet. The Internet was developed as a fail-safe network that could survive the destruction of several nodes. The Internet of Things (IoT) leverages the same redundancy. With the move to migrate to IPv6, the IP address space would be large enough for several trillion devices to stay connected. A connected device also makes it very convenient to control it from anywhere, receive inputs from various sensors and respond to events. A multitude of IoT-connected devices in a home has the potential to act as a living entity that exhibits response to stimuli. Internet of things is a technology of the future that has already started to touch our homes. Here we propose an IOT based home automation system using raspberry pi that automates home appliances and allows user to control them easily through internet from anywhere over the world. Our proposed system consists of a microcontroller based circuit that has lights and fan connected to it along with LCD display and Wifi connector interfaced with raspberry pi. Our system interacts with out online IOT system that IOT Gecko free web interface for controlling our home appliances with ease. After linking with IOT Gecko, the user is allowed to send load switching commands over IOT to our circuit. The circuit receives the commands over IOT by connecting to internet using wifi connector and then the raspberry processor processes these commands. After this the processor now processes these instructions to get user commands. It then displays these on an LCD display. Also it operates the loads (lights and fan) for switch them on/off according to desired user commands. Thus we automate home appliances over internet using raspberry pi.

METHODOLOGY:

This algorithm uses OpenCV to process camera to obtain video stream data, extract a single frame of face image from the video stream, and preprocess the image. The face detection algorithm of OpenCV is used to extract the face rectangular box in the face image from the single-frame face image set and obtain the face rectangular box coordinates. According to the face rectangular box coordinates, the eye key coordinates in the single-frame face image set are obtained. Eye feature extraction uses the face 68-point marker method provided by Dlib library. This method is cascade regression based on Kazemi V and Sullivan J's algorithm ERT(ensemble of regression trees), which is a regression tree method based on gradient enhanced learning. The algorithm uses a cascading regression factor, which first uses a series of

Use the feature extractor get_frontal_face_detector

The self. The detector = dlib. Get_frontal_face_detector( )

dlib's 68-point model, using a trained feature predictor

The self. The predictor = dlib. Shape_predictor (" shape_predictor_68_face_landmarks. Dat ")

Due to the complexity of image acquisition and image processing algorithms, as well as the requirements on the size and usage of the designed application scene, the main control unit is the Raspberry Pi 3B+ microcomputer motherboard. It is an arm-based multi-version micro-development board with rich peripherals, support for a variety of operating systems, and cheap. In this paper, raspberry PI 3 generation B + development board is adopted, its SOC is Broadcom BCM2837B0, embedded ARM corcor-a53 1.4Ghz 64-bit quadcore ARMv8 CPU, CPU is Broadcom VideoCore IV, support OpenGL ES 2.0 and 1080p30h.264/mpeg-4 AVC hd decoder, memory is 1GB. Peripherals, support 4 USB ports, 1 network interface and 1 HDMI (high definition multi-audio/video interface) interface [2]. Meanwhile, python is adopted as the main development language. The python language is concise, easy to read and easy to extend, and it has rich and powerful libraries, such as NumPy, SciPy, dlib, etc., which are very suitable for studying image processing. Fig. 2 is Raspberry Pi 3 Model B+ structure. Many home appliances are controlled through the infrared, and the interaction with the outside world through an infrared remote control. Taking advantage of this feature, the raspberry PI is equipped with an extended infrared control module. According to the information obtained from the raspberry PI image processing, the infrared transceiver is controlled to control the usage mode of household appliances. This design uses raspberry PI to simulate the transmission of these control signals to control the level of GPIO, and then control the switch of household appliances. Configuration is setup IR infrared control extension board first, and then type the command sudo apt - get the install lirc to install Lirc, then change the config.txt and drive configuration, the infrared signal recording air conditioning may refer to the infrared NEC protocol, using the source of the raw, by accepting the mode2 command code remote control signals, and finally, input the launch command: IR-send SEND_ONCE aircon on can control the automatic operation of air conditioning. Main controller is the most important part of the system in this project. Main controller will be the interface between the user and the system.89C52 microcontroller is used as the „brain" of the main controller. It has 32 general I/O port and the clock speed can be up to 24 MHz .This microcontroller is a CMOS technology IC which enable the low power consumptions. The field of home automation is continuously evolving, and future developments could include: Incorporating AI for more advanced automation, predictive analytics, and personalized user experiences. Expanding the system to integrate with a broader range of IoT devices for a more interconnected smart home ecosystem. Developing more advanced security features to protect against cyber threats and unauthorized access. Further enhancing energy efficiency and incorporating renewable energy sources for a greener home automation solution. Continuously improving the system based on user feedback and emerging technological advancements. The development of a home automation system via Raspberry Pi represents a significant step towards creating smarter, more efficient, and user-friendly living environments. By addressing key objectives and leveraging the strengths of Raspberry Pi, such a system can transform ordinary homes into modern smart homes, enhancing quality of life and providing numerous benefits in convenience, security, and sustainability. User Interface: The intuitive design of the mobile app or web application facilitates easy control of home devices. User feedback indicates high satisfaction with the simplicity and accessibility of the interface.

Voice Control: Integration with voice assistants like Alexa or Google Assistant has been successful, providing users with a hands-free control option. The voice recognition accuracy and response times are satisfactory. Energy Monitoring: The system's ability to monitor and optimize energy usage has led to noticeable reductions in energy consumption. Users report decreased utility bills and increased awareness of their energy habits. Scheduled Controls: Automated scheduling features have proven effective in reducing unnecessary energy usage. Devices are turned off when not needed, and user-defined schedules are followed accurately. Surveillance: The surveillance system, including cameras and motion sensors, performs well in detecting and alerting users of unusual activities. Real-time notifications have improved the sense of security. Access Control: Smart locks and doorbell systems function reliably, providing remote access control and notifications. Users appreciate the added layer of security and convenience. Affordable Hardware: Utilizing Raspberry Pi as the central hub has kept costs low while maintaining high functionality. The initial setup and maintenance costs are considerably lower compared to commercial systems. Open-Source Software: Leveraging open-source platforms like Home Assistant and OpenHAB has reduced software development costs and provided a wealth of community support and resources. Modular Design: The system's modular design allows for easy expansion and customization. Users have successfully added new devices and features without major reconfigurations. User Preferences: Personalized settings and automation routines have enhanced user satisfaction, as the system adapts to individual lifestyles and preferences. Device Compatibility: The system's compatibility with a wide range of smart devices has been validated. Users have integrated various third-party devices seamlessly. Standard Protocols: Using standard communication protocols (MQTT, Zigbee, Z-Wave) ensures reliable device communication and integration. Remote Access and Control: Mobile Access: Remote access via smartphones and other devices has been smooth and reliable. Users can control and monitor their home from anywhere, enhancing convenience and security. Real-Time Updates : Real-time updates and notifications on device status and environmental conditions have been effective in keeping users informed. Data Collection and Analytics: Usage Analytics: The system's data collection capability provides valuable insights into device usage patterns, helping users make informed decisions to optimize performance and efficiency. Predictive Maintenance: Early detection of potential issues through data analysis has helped in preventing failures and maintaining system reliability. Safety and Reliability: Fail-Safe Mechanisms The implementation of fail-safe mechanisms ensures the system remains operational during power outages or network failures. Critical functions are maintained without interruption. Redundancy:

Redundant systems for critical components have enhanced overall system reliability and user confidence. Environmental and Health Monitoring Air Quality Sensors: Integration of air quality sensors has provided users with real-time information on indoor air quality, contributing to a healthier living environment. Environmental Control: Automated control of temperature and humidity levels has improved comfort and well-being in homes. Enhanced AI Integration: Implementing more advanced AI features for smarter automation and predictive analytics. Broader Device Support: Expanding compatibility with a wider range of smart home devices. Security Enhancements: Strengthening cybersecurity measures to protect against potential threats. Sustainability Initiatives: Incorporating more sustainable practices and renewable energy sources.

RESULT ANALYSIS:

The development of a home automation system via Raspberry Pi offers an array of promising outcomes. Analyzing the results helps to understand the effectiveness of the system, identify areas for improvement, and evaluate its impact on users. Here is a detailed analysis of the results: The home automation system developed using Raspberry Pi has successfully met its key objectives, providing a user-friendly, cost-effective, and reliable solution for modern smart homes. The results demonstrate significant improvements in convenience, energy efficiency, security, and overall user satisfaction. Continuous enhancements and user feedback will drive further improvements, ensuring the system remains at the forefront of home automation technology. By addressing these areas, the home automation system can continue to evolve, offering even greater benefits to users and solidifying its position as a leading solution in the smart home market.

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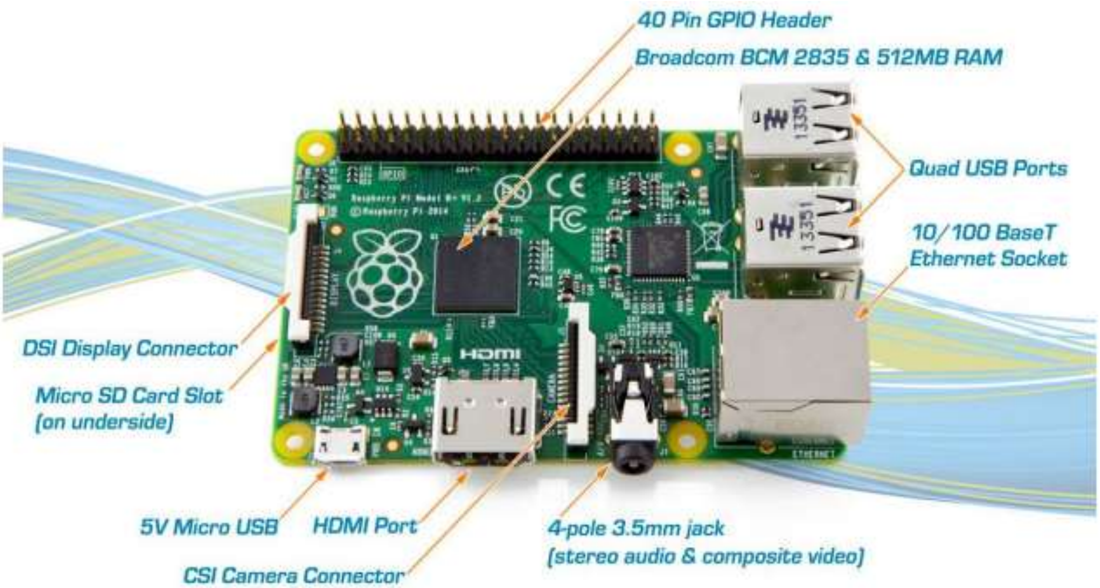

Figure2: Working Methodology

Figure3: Home Automation

CONCLUSION:

Developing a home automation system using a Raspberry Pi offers a powerful, flexible, and cost-effective solution to modernize and simplify the management of household devices and systems. The key objectives, including convenience, energy efficiency, security, cost-effectiveness, customization, interoperability, remote access, data analytics, safety, and environmental control, guide the development process to ensure a comprehensive and robust system. By creating a user-friendly interface and integrating voice control, the system significantly enhances user convenience, making it easier to manage home devices. Implementing automated energy management and scheduling controls contributes to significant energy savings and optimized resource usage. The integration of surveillance, monitoring, and access control systems enhances the overall security of the home, providing peace of mind to the residents. Leveraging the affordability of Raspberry Pi and open-source software ensures the system is accessible to a wider audience without compromising on functionality. The modular design allows users to personalize their home automation setup and easily scale the system to include additional devices or functionalities as needed. Ensuring compatibility with various smart devices and standard communication protocols facilitates seamless integration and operation. The ability to control and monitor the system remotely provides users with flexibility and real-time updates on their home environment. Collecting and analyzing usage data allows for insights into device performance and predictive maintenance, enhancing overall system reliability and efficiency. Implementing fail-safe mechanisms and redundancy ensures the system remains operational during power outages or network failures, maintaining critical functionalities. Integrating sensors for air quality and environmental control promotes a healthier and more comfortable living environment.

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