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Smart Home System using IOT

Oladiboye Olasunkanmi Esther, Rufai Mohammed Mutiu, Adigun Johnson Oyeranmi

***Abstract*— One of the primary purposes of technology is to ease life through automation. The home is one of the places that gets the most traffic, hence justifying the necessity of home automation. The concept and prototype implementation of an efficient home automation system using IOT devices are presented in this work. These frameworks offer assistance in meeting the needs of the physically, disabled and elderly in households. Additionally, the idea of home automation can raise the standard of living in houses. The technology makes use of a wireless Bluetooth device to give users access to their smartphones. It demonstrates the conception and application of a cheap, adaptable, and secure home automation system.**

***Index Terms*— IOT, Home Automation, Bluetooth.**

I. INTRODUCTION

Automation systems for homes and buildings are widely utilized nowadays[1]. However, they provide more luxury, particularly when used in a private setting. It has helped advance the development of medicine and increased social contact, simple transportation, the capacity to participate in entertainment and media, among other aspects of our everyday life. Numerous people now rely on technology to connect with pals and save information like photos, videos, papers, and music as a result of the development of numerous technologies like mobile phones and laptops. Numerous gadgets now use the internet as a common interface to simplify peoples' daily tasks. People now have the knowledge and tools necessary to search for information, store it on the cloud, and manage it more effectively. Since its inception, the number of people using mobile phones and the internet to connect with one another has grown significantly, making it one of the primary ways of communication.

The Smart Home gives consumers the ability to regulate energy use and enhance savings by managing lights, window coverings, and monitoring usage as more people become conscious of how to make their homes more environmentally friendly. Users are more interested in using their smartphones to operate their appliances due to their mobility and technological capabilities. Users are able to complete duties before getting home thanks to the automatic appliance control. Using mobile remote control applications, the smart home control system offers a solution for assistive technology, particularly for the elderly and disabled. Around 72% of respondents, according to a research in [iNetworks, 2015], claimed that doors that can be secured from a distance are the most crucial qualities when it comes to the most sought smart home gadgets. Smart homes are becoming more and more common, however because to their complexity and expense, some demographics, such the elderly and disabled, may find them difficult to utilize. Every message delivered across the network incurs an extra fee when GSM is used for communication. The suggested system should also offer an intuitive GUI interface for monitoring and control. The ideal solution to this issue is to utilize a web server, as opposed to native apps, which must be designed separately for each type of device, a single website can reach consumers across many various types of mobile devices.

A smart home control system is presented in this study to replace manual household management. By incorporating autonomous home appliances based on sensor reading and user manual buttons in a designed online interface, less staff is needed while overall safety is increased. The control system was able to work effectively and efficiently thanks to the automated function based on sensor data. The idea of IP networking applications and devices in the home allows the control of home appliances from anywhere using a laptop, mobile phone, tablet, or smart TV as long as these devices have internet connectivity. Developers and consumers alike will find the website convenient, especially the old and disabled.

II. RELATED WORKS

A. Home Automation

Home automation, often known as a smart home or smart house, is construction automation for a dwelling [2]. A home automation system will keep an eye on and/or regulate features of the house such the lighting, entertainment, and appliance systems. It could also contain elements of home security like alarm systems and access control. Home appliances that are online are a crucial component of the Internet of Things ("IoT").

Typically, a home automation system links controlled items to a main smart home hub (sometimes called a "gateway"). Wall-mounted terminals, tablet or desktop computers, mobile phone applications, or Web interfaces that may also be available off-site over the Internet are all options for the user interface for system control.

Despite the fact that there are several rival suppliers, open source solutions are receiving more attention. The current state of home automation, however, has drawbacks, such as the absence of standardized security measures and the deprecation of older devices without backwards compatibility.

Home automation offers a significant potential for data exchange among family members or trusted third parties for personal security, and it may eventually lead to energy-saving

Oladiboye Olasunkanmi Esther, is a lecturer in the Department of Computer Technology, Yaba College of Technology, Yaba, Lagos Nigeria.
Rufai Mohammed Mutiu, is a Chief lecturer in the Department of Computer Technology, Yaba College of Technology, Yaba, Lagos Nigeria
Adigun Johnson Oyeranmi, is a Chief lecturer in the Department of Computer Technology, Yaba College of Technology, Yaba, Lagos Nigeria

measures with a favorable environmental impact.

B. *Components of an Home Automation System*

From a technological standpoint, home automation is composed of the following five components:[3]

i. Devices Under Control (DUC)
ii. Sensors and Actuators
iii. The Control Network
iv. The Controller
v. Remote Control Devices

1) *Devices Under Control*

These are components that are connected to and managed by the home automation system, such as household appliances or consumer electronics.

a) *Sensors*

They serve as the home network's eyes and ears. There are sensors for a variety of uses, including sensing movement or noise as well as monitoring temperature, humidity, light, liquid, and gas [8]. The hands of the home network are the actuators. They serve as the smart network's actual means of operation in the outside world. Mechanical actuators, such as pumps and electric motors, and electronic actuators, such as electric switches and dimmers, are available depending on the sort of interaction needed.

b) *The Control Network:*

It offers the communication between the controller and the remote control devices on the one hand, and the controlled devices, sensors, and actuators on the other. Currently, there are three primary technological possibilities for control networks for home and building automation:

i. Power line Communication.
ii. Wireless Transmission.
iii. Wire line Transmission

Due to cheaper component and installation costs, power line communication and wireless transmission-based control networks predominate in residential home automation. On the other hand, industrial building control applications and the luxury residential market both use wire line control networks.

2) *The Controller:*

It is the computer system which serves as the automation system's brain. It uses sensors to gather data and remote control devices to accept orders. Using actuators or communication channels like a loud speaker, email, or phone, it responds to orders or a set of predetermined rules.

The widespread use of smartphones and tablets has eliminated the need for specialized automation control devices, which is one of the primary factors contributing to the rising popularity of home automation systems in the domestic market. Almost all of the home automation systems now on the market offer mobile apps for smartphones and tablets. Additionally, improvements in voice recognition have enabled voice control in smart homes.

3) *The Remote Control Devices.*

It works by connecting to the home controller's home automation software. To do this, they can either connect to the controller directly over the control network or through any other interface the controller offers, such as WLAN, the Internet, or the phone network. As a result, the possibility of remote building control through Internet or the mobile telephone network is now a function that is offered by default when using smart phones as a home remote.

Examples:

Function:

i. Real-time video monitoring in each door camera
ii. In-house call among VDPs and sub phone
iii. Brightness and volume control with OSD menu
iv. Various model of cameras can be connectable

C. *Smart homes Model*

In this section, we discuss a number of home automation techniques and procedures from a security perspective. We discuss the positives, negatives, and security issues of each technology [6].

1) *Bluetooth based home automation system using cell phones:*

In this approach, Relays are used to link the home appliances to the Arduino BT board at input and output ports. The Arduino BT board's software is written in the high-level interactive C language for microcontrollers, and Bluetooth is used for connectivity. Only authorized users are permitted access to the equipment thanks to the password protection that is offered [7]. For wireless communication, a Bluetooth connection is made between the Arduino BT board and phone. The Python script used in this system is portable and may be installed on any Symbian OS environment. For receiving input from the phone that shows the device's state, one circuit is created and put into use.

III. METHODOLOGY

The software development methodology used in this research can be described as a mix of the incremental development model and Evolutionary Prototyping approach. The project was broken into smaller segments (e.g. functionality and features) and for each segment the objectives and constraints were determined. They were then developed, tested and, if needed, refined. Finally the next iteration was planned. By using the Evolutionary Prototyping approach, the system is continually improved and built upon.

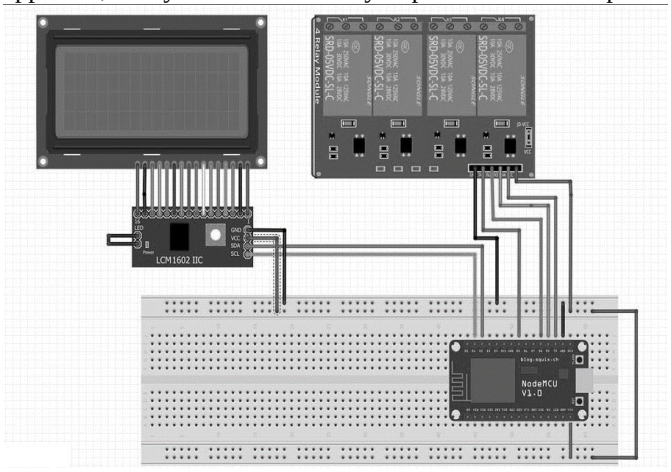

Figure 1: Systematic Diagram

As an example of the development method, the following paragraph describes the process of creating the command-control functions. A simple command-control function on the Application was built. It used a small table in the database to store, in plain-text, just the name and password of the user.

A. SYSTEM DESIGN

1) Systematic Diagram

This phase describes the process of how different components of this project are assembled together right from the least components/devices to the major ones. It actually contains all necessary diagrams and flowcharts for the design process. The major purpose of the system design process is to provide sufficient detailed data and information about the design, construction and implementation of the project.

2) System Architecture

The core of the proposed smart home automation system consists of two main hardware components: the PC home server and the Arduino microcontroller board which is flexible, inexpensive, offers a variety of digital and analog inputs, serial interface and digital and PWM outputs.

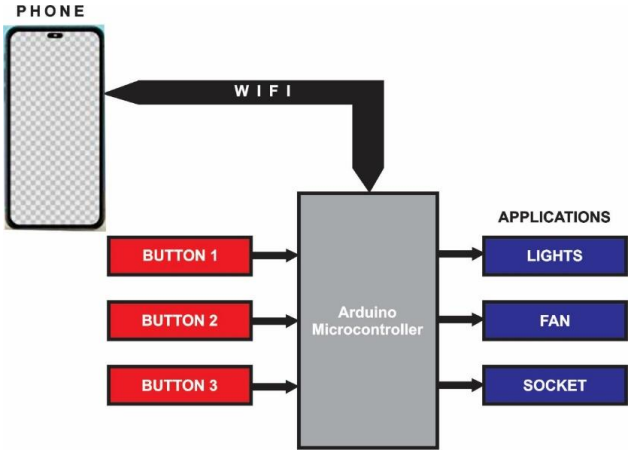

Figure 2: Architecture Diagram

3) Working Principle

The device is a Wi-Fi based control. It makes use of NodeMCU which controls the whole effective functionality of the project. When the device is plugged in and switched ON, the device initializes and after few seconds it becomes fully online. To use the Wi-Fi control, an application is

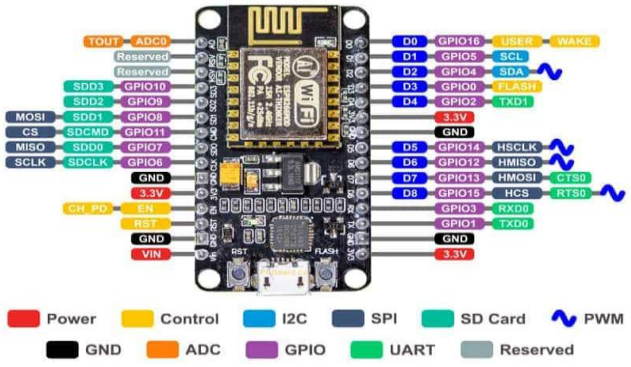

Figure 3: NodeMCU

connecting with other devices and an internal programmer for programming it from a computer. As a result, NodeMCU is a full board that comes with everything needed to connect to an external peripheral and is simple to program using a computer. NodeMCU boards are widely accessible.

Power Pins: There are four power pins. VIN pin and three 3.3V pins.

VIN can be used to directly supply the NodeMCU/ESP8266 and its peripherals. Power delivered on VIN is regulated through the onboard regulator on the NodeMCU module – you can also supply 5V regulated to the VIN pin

3.3V pins are the output of the onboard voltage regulator and can be used to supply power to external components.

GND are the ground pins of NodeMCU/ESP8266

I2C Pins are used to connect I2C sensors and peripherals. Both I2C Master and I2C Slave are supported. I2C interface functionality can be realized programmatically, and the clock frequency is 100 kHz at a maximum. It should be noted that I2C clock frequency should be higher than the slowest clock frequency of the slave device.

GPIO Pins NodeMCU/ESP8266 has 17 GPIO pins which can be assigned to functions such as I2C, I2S, UART, PWM, IR Remote Control, LED Light and Button programmatically. Each digital enabled GPIO can be configured to internal pull-up or pull-down, or set to high impedance. When configured as an input, it can also be set to edge-trigger or level-trigger to generate CPU interrupts.

ADC Channel The NodeMCU is embedded with a 10-bit precision SAR ADC. The two functions can be implemented using ADC. Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. However, they cannot be implemented at the same time.

UART Pins NodeMCU/ESP8266 has 2 UART interfaces (UART0 and UART1) which provide asynchronous communication (RS232 and RS485), and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 & CTS0 pins) can be used for communication. However, UART1 (TXD1 pin) features only data transmit signal so, it is usually used for printing

Figure 4: Blynk

log.

SPI Pins NodeMCU/ESP8266 features two SPIs (SPI and HSPI) in slave and master modes. These SPIs also support the following general-purpose SPI features:

4 timing modes of the SPI format transfer

Up to 80 MHz and the divided clocks of 80 MHz

Up to 64-Byte FIFO

SDIO Pins NodeMCU/ESP8266 features Secure Digital Input/Output Interface (SDIO) which is used to directly interface SD cards. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

PWM Pins The board has 4 channels of Pulse Width Modulation (PWM). The PWM output can be implemented programmatically and used for driving digital motors and LEDs. PWM frequency range is adjustable from 1000 µs to 10000 µs (100 Hz and 1 kHz).

Control Pins are used to control the NodeMCU/ESP8266. These pins include Chip Enable pin (EN), Reset pin (RST) and WAKE pin.

EN: The ESP8266 chip is enabled when EN pin is pulled HIGH. When pulled LOW the chip works at minimum power.

RST: RST pin is used to reset the ESP8266 chip.

WAKE: Wake pin is used to wake the chip from deep-sleep.

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2) Smartphone

A smartphone is a small, portable gadget with built-in computing and mobile phone capabilities. Their more powerful hardware and robust mobile operating systems set them apart from other feature phones and enable wider software, internet (including web browsing over mobile broadband), and multimedia functionality (including music, video, cameras, and gaming), in addition to basic phone features like voice calls and text messaging. Smartphones frequently have several metals-oxide-semiconductor (MOS)

Figure 5:Transformer

integrated circuit (IC) chips, a range of sensors that can be used by built-in and external software, including a magnetometer, proximity sensor, barometer, gyroscope, accelerometer, and more, as well as support for wireless communication protocols (such as Bluetooth, Wi-Fi, or satellite navigation).

3) Blynk App

This is the app that is installed in the mobile phone which is configure with the phone to interact with the NodeMCU to control the home appliances.

4) Transformer

A Step-down voltage of 230 V AC to 12V transformer with a maximum current of 1Amp.

Specifications:

- Voltage: - 2 x 12V
- Current: -1 x 1000mA
- Power rated: - 24VA”

5) LED display

Figure 6: LED Display

An LED display to show the status of the devices connected to the system.

Specifications:

- Model: EDS803
- Appearance Size:50.8×30.48×2.8mm
- Visual Area Size:45.72×16.51mm
- Display Mode: TN, positive display
- Polaroid Type: semi-transparent
- Visual Angle: 6 O'CLOCK
- Connection Type: metal pin
- Driving Way: static
- Driving Voltage: 5.0

6) Relay module:

A relay module is used to connect various devices to NodeMCU. Relays have at least 3 input and 3 output pins as listed as follows:

Input Pins

Vin: this is where to supply voltage, usually 5v

GND: also called ground. Its connected to the negative part of the supply and has a voltage of 0v

Signal pin: this controls the switch of the output pins when voltage signal is been supplied to this terminal.

Output Pins

Common: this where the main supply is connected to be switched to the load

Normally Close (NC): this is internally connected to the common terminal when voltage is not supplied to the relay. The load will be connected to it based on the configuration required

Normally Open (NO): this terminal only connected to the common pin when signal is passed to the relay after been connected to the power supply. The load will be connected to it based on the configuration required

7) Light bulbs

A light bulb is required to demonstrate home automation.

8) Socket

A socket is required to demonstrate home automation, in which anything plug to this socket can be switched ON/OFF.

C. SYSTEM SETUP

In our home automation system we have shown how we can control two devices using internet of things (IOT). The NodeMCU is the microcontroller.

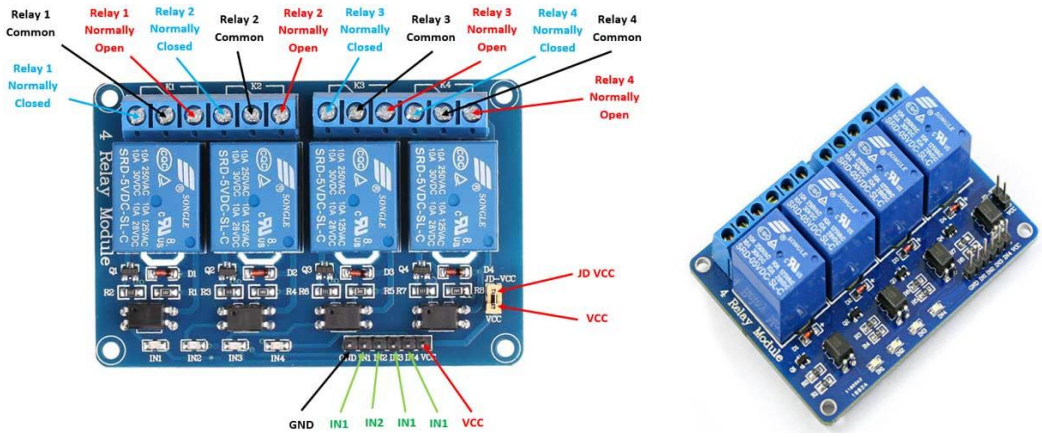

Figure 7: Relay Module

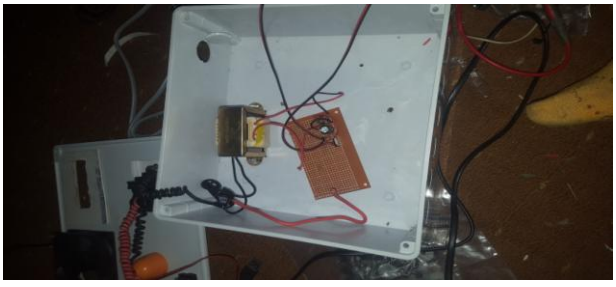

Figure 8: System Setup

Programming NodeMCU using Arduino IDE

NodeMCU board should be modified using a code so it can interface with the application. Arduino IDE gives an environment to develop a code that will be transferred to the board for the project to work

IV. SYSTEM EVALUATION

The advantages of smart home systems are its most important feature. Benefit actually just means "time saver," and in today's environment where everything is moving more quickly, every second counts [5]. The majority of the technology we use today is benefit-based, such as how quickly computers and phones complete tasks and how quickly cars get us where we need to go. Smaller home conveniences will be appealing because they enable the user to save time as well.

The dishwasher, washing machine, and microwave oven are just a few of the convenient technology that are already present in the average home. These technologies tend to be more mechanical in nature, and the number of electronic conveniences in the home is frequently far lower. The purpose of smart home systems is to spread awareness of the advantages of technology. For instance, a user of a smart home system won't have to wander around turning off lights; instead, they can save a little bit of time by just clicking a button on their phone or by setting the lights to turn off after a set period of time. Smart home systems will enable users to play music from wherever they are, without having to go to their computer, find the song, and verify that it is in a format that can be played on their sound system. Perhaps there is music on the user's computer that they would like to listen to on a sound system.

The smart home offers a wide variety of additional little conveniences. Another important aspect of the rise of smart home systems is security. When a system is sufficiently advanced, home security becomes a potent instrument that gives the user control and peace of mind. The use of security technologies significantly reduces crime. Any criminal will be discouraged from committing a crime by the mere sight of a camera. Luxury, on the other hand, is less concerned with price and will not suffer as much from high price due to significant value loss.

V. CONCLUSION

The prototype design and execution of the smart home control system have been described in this study. Firstly, it presents a thorough literature study on the carrier mode, wired and wireless protocols, and application architecture of smart home systems. Next, the hardware design utilizing NodeMCU is demonstrated. The system's functioning flowchart was addressed. Finally, a more thorough discussion on prototype implementation and test field design took place. The prototype just has one fan with speed control, one socket, and one bulb (outlet). Additionally, the Bluetooth automation's actual implementation was shown. Relays provide seamless appliance integration with the smart home management system. The result of this study is a dependable home automation system that can aid with remotely turning appliances on and off while also managing energy usage and safety precautions.

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