Application of Python Programming Language in the Implementation of Low Voltage Electrical Appliances: Implications to Nigeria Computer Education Curriculum

Garba Suleiman

Department of Computer Science, School of Science, FCT College of Education, Zuba, P.M.B. 61, Garki, Abuja, Nigeria.

Abstract

The resolution of societal issues is required for the development of a society, which can be accomplished by developing, promoting, and improving education and information. Energy prices have been rising in tandem with societal demand. In this age of technological advancement, particularly in ICT, several systems have been developed to control and conserve the amount of electricity used in our homes, offices, and communities while also preventing disasters. Nigeria's educational system is constantly upgrading and updating the curriculum to meet global standards, necessitating the need to ensure that what students learn in class is actually put into practice. In light of these considerations, the focus of this research was on Developing and Implementing a Home Electrical Appliances Control System, which is a method of controlling electrical appliances in the home. The goal of the project was to control the ON and OFF times and states of household electrical equipment. To control each electrical device, an Arduino Nano was incorporated into the design and programmed to work in tandem with a mobile application. The system was tested and found to be functional in accordance with the specifications required by tertiary institutions curriculum most especially Students undergoing computer science course in Nigeria Tertiary Institutions to acquire the required skills and knowledge in the curriculum's programming language

Keywords: Appliances, Arduino, Curriculum, Implication, Institution.

Introduction

Education is widely regarded as one of the most fundamental means of ensuring one's own survival and well-being, as well as the survival and well-being of society. The introduction of formal education is regarded as the bedrock of national progress and the surest path to achieving all long-term objectives. As a result, no nation, government, business, or family can have an effective impact and long-term success in their day-to-day operations unless their citizens are educated and have problem-solving skills.

One of the primary benefits of computer science is the availability of job opportunities. To improve human capability at all educational levels, the Federal Government of Nigeria (FGN) incorporated computer science into the Nigeria educational system's curriculum. In light of this, computer science provides relevant skills for increasing capacity, such as design, implementation, programming, and problem-solving abilities, and is viewed as a means of developing some capacity in students in general.(Suleiman, 2020).

According to (Abo-zahhad et al., 2015) The rapid change in human lifestyle is a result of the emergence of digital information. Using electricity is crucial because it is one of the primary energy sources that is essential to modern life. As time passes, technology continues to advance, leading to the creation of new methods for the simpler, safer operation of electrical equipment for improved power management in homes and workplaces. When leaving their homes, the majority of people invariably leave the lights, fans, and other appliances on, wasting energy and wasting money. Although being personally present or close to the home environment is not always possible, great effort should be made to forecast future energy usage while continuously monitoring and managing all building energy use.

This paper was designed and implemented to allow home owners to turn ON and OFF linked devices using an APP on their smartphone using Bluetooth. Since most houses in the rural areas and those with low income earners do not use high voltage systems in their houses settings, it is also intended for low voltage devices.

Literature Review

Individuals must focus on solving specific problems in order for a society to develop, which can only be accomplished through the application of knowledge. Human development entails acquiring relevant knowledge, skills, and resources in order to achieve greater results. Electricity conservation has become increasingly important as energy prices and scarcity have risen (Adekunle, 2019). (Isyanto et al., 2020)design and implemented a Google Assistant IoT-based smart home voice commands for disabled people. This system would allow

disabled people to control electrical equipment such as televisions, lights, and fans using Google Assistant voice commands on smartphones. To turn on or off electrical equipment, users do not need to move. When the pronunciation is correct, the Google Assistant application will accept voice commands. Voice commands are easier to use than typing text messages. When compared to text, users benefit from convenience. Users only need to send voice commands to the Google Assistant Application, and the system will automatically display the text messages we mentioned earlier, eliminating the need for users to type text messages.

(Howedi, 2016)designed and developed a prototype for a low-cost, user-friendly, scalable, and reliable smart house system using an integrated system of hardware and software. The hardware, which included an Arduino Uno, servo motors, a temperature sensor, a motion sensor, and a battery, was used to create a smart house system prototype. The software included the Arduino integrated development environment (IDE), which was used to compile the code in hardware, and MIT App Inventor for Android mobile phones, which was used to interface a mobile handset with hardware. Furthermore, Sweet Home 3D software was used to make the prototype design more professional. The system was evaluated in comparison to previous works, and it was demonstrated to six experts in order to obtain feedback on the prototype. The prototype's testing revealed that the system was integrated, practical, and simple to use, and that any new device could be easily integrated into the system.

A GSM-based SMS-based prototype of an electric appliance control tool was proposed by (Nasution et al., 2017) . The GSM protocol was chosen because it is independent of the platform of mobile devices. Here, a GSM SIM 900 and an Arduino were used to control a relay module. The relay module worked in accordance with SMS orders, and the mobile device then received command feedback. For testing purposes, ten (10) different types of input strings were used as command controls. The relay functioned in accordance with the orders sent from the input string submitted, and feedback messages from the previously given command were provided.

(Yaghmaee, 2018)proposed smart energy monitoring, which can measure power consumption and power line parameters and send them to a central server via an intermediate Gateway on the Internet. The system can control the electrical appliances, turning them off during peak hours and on during non-peak hours as needed. Some of the advantages of the proposed system include: full design in accordance with IoT standards and protocols; and the ability to function as both a Web Server and a Web Client.

(Lee et al., 2020)proposed using popular instant messaging software to create an easy-to-use smart home control system. Users control household appliances via instant

messaging software, reducing the need for multiple applications of the same type to be installed on the same smart device. The familiar interface and simple method of operation can make consumer electronics products easier to use for first-time users. This method also eliminates the need for users to relearn the operation method when installing new devices.

The concept for a realtime smart home automation system based on an Arduino microcontroller board and the LabVIEW platform was presented by (Soliman et al., 2017) . The proposed automation system is made up of two main hardware components: a personal computer (PC) serving as a home main server and containing the LabVIEW platform management, and an Arduino microcontroller board. A variety of appliances and sensors are linked to the microcontroller board. The home appliances can be automatically monitored, controlled, and accessed in response to any signals generated by related sensors or by the system user. The proposed system's architecture and process flow charts have been developed. A hardware realization for three operational home appliances: temperature management, light energy saving, and security camera based on an ultrasonic distance detection sensor has been developed to evaluate the reliability and effectiveness of the proposed system. The proposed system is demonstrated to be simple, cost effective, and adaptable, making it a suitable and promising candidate for the future of smart homes.

Methods

Hardware Implementation

This section focuses on the hardware design of the main control board. The hardware block diagram in the main control board is shown in Fig 2 and fig 3. It consist of Andruino board which serves as the system's brain, receiving and sending signals to the appropriate parts of the electronics devices. For example, when a high is sent from the Bluetooth (via the mobile app) to the Arduino, it turns on the appropriate device. A broadboard was used to connect several components without having to join them. It has a series of holes connected by connections within a set of holes. It's split into two sections: the center, where connections are linked horizontally, and the outer, where connections are linked vertically. The electrical current is connected directly to the main control board, separating the regulator and relay circuit. The voltage regulator is built from a common reliable regulator circuit that includes a transformer, rectifier, and regulator. A 220V power supply was used to regulate the flow of current and to meet the voltage requirements of the main control board's specific components. Furthermore, the low voltage activating switches will be used to replace the existing switches.

Fig 2: Hardware Component Connection (Back view)

Fig 3: Hardware Component Connection (Inner view)

Software Component Development

Python programming language was used to create Android applications. The Android Software Development Kit (SDK) includes all of the tools required to create Android applications (API). The Android SDK includes tools for compiling code as well as packaging data and resource files into an archive file with the ".apk" extension known as an Android package. The application was then installed on Android devices of the user because an Android's application framework enables the creation of extremely feature-rich and novel applications. Fig 4 shows the flow of the application and fig 5 is the mobile application control system.
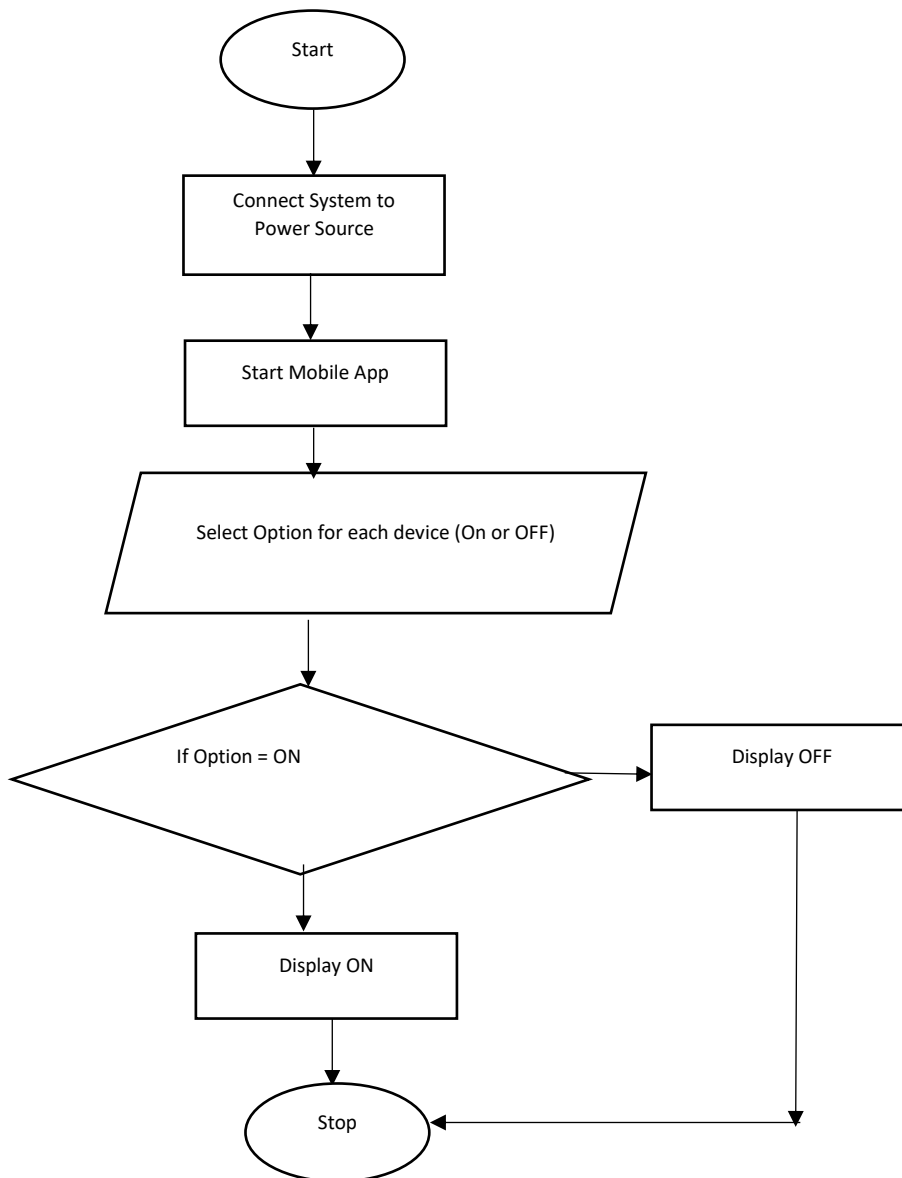

Fig. 4. Flowchart Diagram of the Application

System Coding Snapshot

Define the following constants:
- relay1 = 2
- relay2 = 3
- relay3 = 4
- relay4 = 5

Setup:
- Initialize serial communication with a baud rate of 9600
- Set relay1, relay2, relay3, and relay4 as outputs
- Turn off relay1, relay2, relay3, and relay4

Loop:
- While there is serial data available:
  - Read the incoming data character by character and store it in a string called readString
  - If the character '#' is detected, break the loop and continue to process the data

- If readString has a length greater than zero:
  - Print the value of readString to the serial monitor
  - If readString is "off", call the function switchallon
  - If readString is "on", call the function switchalloff
  - If readString is "d1off", turn off relay1
  - If readString is "d1on", turn on relay1
  - If readString is "d2off", turn off relay2
  - If readString is "d2on", turn on relay2
  - If readString is "d3off", turn off relay3
  - If readString is "d3on", turn on relay3
  - If readString is "d4off", turn off relay4
  - If readString is "d4on", turn on relay4
  - Reset readString to an empty string

Function switchalloff:
- Turn off relay1
- Turn off relay2
- Turn off relay3
- Turn off relay4

Function switchallon:
- Turn on relay1
- Turn on relay2
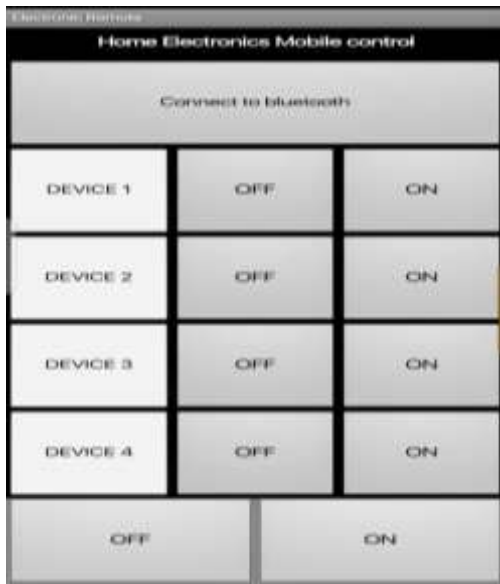*- Turn on relay3*
- Turn on relay4

Fig 4: Mobile Application Screenshot showing ON and OFF

Conclusion and future work

The system communicates with a programmed Andunio Nano and a mobile application via a Bluetooth connection in this work. The user easily operates the home appliances by touching the developed phone screen and dictating the ON and OFF of any of the connected devices via a remotely. This work investigates a method of reducing stress in the elderly, as well as physically challenging people in society and those living in rural areas, through the use of low voltage devices that allow them to control and monitor their power consumptions while also preventing device loss. It also enables offices to manage their electricity consumption and save money on electricity bills by simply turning these devices on and off with a smartphone.

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