Development and Testing of Arduino Timer Socket

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Abstract: - The rapid growth in semiconductor devices and the need for energy conservation has given rise to the adoption of embedded systems and automation for easy operation of electrical appliances, this prompts many consumers to embrace the technology to ease the usage of electrical appliances and to curb energy wastage. This study deals with the development and testing of the Arduino microcontroller timer socket outlet for electrical appliances. The system was developed for the users to predetermine the ON or OFF time of any electrical appliances connected to it while the user attends to other things. Major components used are Arduino UNO microcontroller, relay, RTC timer, Liquid Crystal Display (LCD), and the 13 Amps socket outlet which powered any electrical appliances at a preset time. The design was implemented and tested with a mobile phone, toasting machine, and an electric cooker respectively. The results show that the system makes the next generation of homes safer and smarter. Consequently, it is cheaper, reliable, and easy to operate, which contributed effectively to the usage of a microcontroller for automation and convenient operation of electrical appliances whenever needed.

Key-Words: - Arduino, Electrical appliances, LCD, Microcontroller, Socket, Timer

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1 Introduction

The Incessant rise in technology has changed the ways society adapts to new trends, as it makes it extremely convenient and snappy to achieve a task, which makes most difficult tasks seamlessly easy and more efficient [1, 2]. Presently, there are several products/appliances in the market today that make us control devices automatically, either by voice command or remote control [3, 4]. Consequently, the swift growth in semiconductor devices and the need for energy conservation has given rise to the adoption of embedded systems and automation for easy operation of electrical appliances [5], this prompts many consumers to embrace the technology to ease the usage of electrical appliances and to curb energy wastage. [6] stated that wireless communication and automation remain key parts of technological development. According to [3] automation can be defined as the use of control systems and information technologies to reduce the need for human work when performing any task.

Appropriate quality should be maintained in any electrical and electronic devices (socket outlets, switches, electrical fitting, etc.) since they all pose danger to the users when misused [7]. It is worthy of note that the absence of a timer in modern electrical appliances has led to a lot of accidents, which has also reduced the lifespan of some equipment due to overuse or overcharged. Similarly, many users have lost an appreciable number of properties and lives due to negligence or incessant power outages. This Arduino timer socket is used to switch OFF/ON any electrical appliances at a preset time through a relay switch after the specified time set in minutes or seconds, which helps to reduce the hazard rate.

Presently, many remote-controlled appliances these days have electronics components/parts that are never turned off unless you turn them off at the wall socket [8]. It is worthy of note that automation is introduced to eradicate the damage of electrical /electronic devices which are continuously in charging mode whenever we forget to switch off the supply to the device. The use of automated devices has helped to solve a lot of problems in our present world and building a timing device will help to prevent damage to devices, monitor device operation, mobile phones, computing devices, etc. The control timer provides controls to domestic appliances based on present timing [9]. Which when incorporated into household appliances or devices will ease the operation of usage and also boost the efficiency of the device [1].

Timers are an integral part of many real-time embedded systems, similar to setting an alarm clock. It is also applicable in consumer products, transportation, security systems, etc.

The two major kinds of timers are electronics and mechanical [10], the timers which can be configured

to set a time interval are called programmable timers [11]. The programmable timer is usually designed with different capabilities that would be flexible to customize by the users and it is regarded as an integral part of the present-day embedded system [12].

Arduino based countdown socket timer with digital display system will prevent over usage of electrical appliances and prevents hazard that can occur due to the negligence of the users, it can be incorporated into many electrical appliances or used to control the working time of appliances such as washing machine, televisions, cooker, toasting machine, microwave ovens, etc.

Several works on literature related to the study on the advancement of technology have been reviewed and [13] developed a dual socket-outlet timer that automatically switches off a piece of equipment or electric appliances connected to one or both of the two sockets automatically after a selected time ranging from 1 to 100 minutes. Thus, preventing and reducing the danger of electric fire outbreak, also [14] presents an intelligent power outlet system that can be controlled wirelessly and that has been specifically designed to monitor electrical events in low-current loads. Similarly, [15] introduced a hybrid distribution board that can supply both the DC and AC concurrently, which when encouraged will minimise power consumption. [16] worked on time delay and load current delay protective device for controlling the air-conditioner unit. [17] created a system that allows users to control the devices for each socket, which reduces excessive use of electricity in a situation the user forgets to shut down the device.

2 Materials and Methods

It is ethical when developing or constructing any devices or appliances to find a durable and high-quality product that costs a little and works for a period of a long time.

The main part of the development includes Arduino UNO, relay, DS 1307, transistor, LCD screen, resistor, socket outlet, etc. However, this circuit can be used for time applications such as irons, heaters, geysers, ovens, toasters, blowers, dryers, fans, hot air guns, etc.

The block diagram of the Hybrid Distribution Board is shown in Figure 1.

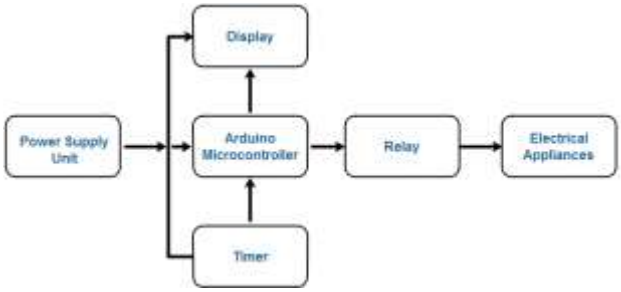

Fig. 1. Block Diagram of the System Operation

The design criteria are to count down a preset time to zero and trigger ON or OFF the output load. The programmable feature allows it to work with different time inputs and for this development, the time format is HH:MM: SS.

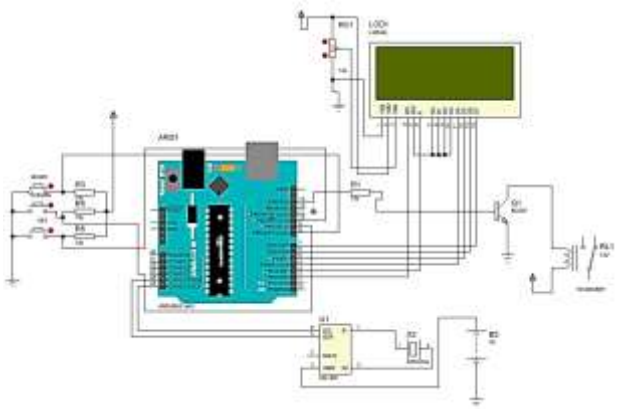

Figure 2. Circuit Diagram of the System

2.1 Development Procedure

The following materials are selected for the implementation of the design.

Selection of Material

The following are the main components of the design:

i. Arduino UNO Microcontroller
ii. Resistors (Fixed and Variable)
iii. 30A, 5V Relay
iv. Ds 1307 RTC Timer
v. Push Button Module
vi. Liquid Crystal Display (LCD)
vii. NPN Transistors BC 547
viii. Main Switch
ix. Socket Outlet Output (13A)
x. Project Casing

Arduino UNO

It is a form of printed circuit board that incorporates an integrated circuit on it, which accepts written input and provides a desirable output based on the commands or functions send to it. Arduino has 6 Analog Input/output pin and 14 Digital Input/output pins making a total of 20 input/output pins [18].

Figure 3. Arduino UNO Microcontroller

Liquid Crystal Display (LCD)
It is an electronic display module used in various applications and devices such as calculators, signage, watches, computer monitors, televisions among others. with two major registers; the command and data. It consumes less electrical power which makes it more popular in battery-powered electronic equipment.

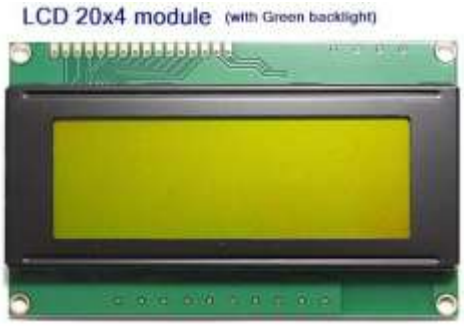

Figure 4. Liquid Crystal Display (LCD)

Resistors
It is known as a two-terminal passive electrical component used to limit the flow of current flow. It can also be used to adjust signals levels, divide voltages, bias active elements, and terminate transmission lines, among other uses.

Figure 5. Resistor

DS1307 Real Time Clock
It is in a form of an Integrated Circuit (IC) that keeps track of the current time even when the equipment is not powered. Its features include automatic switching, accurate timekeeping, and also consumes less power.

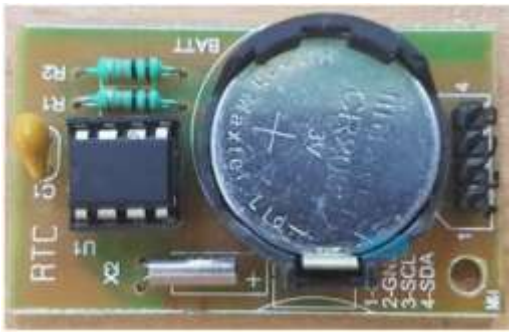

Figure 6. DS1307 Real Time Clock

Relay
it is known as an electrically operated switch that opens or closes an electrical switch at a preset time. Mostly used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

Figure 7. Relay

NPN Transistors BC547
It is a solid-state electronic semiconductor device with three terminals used for regulating, controlling, amplifying, and generating a signal in an electronic component.

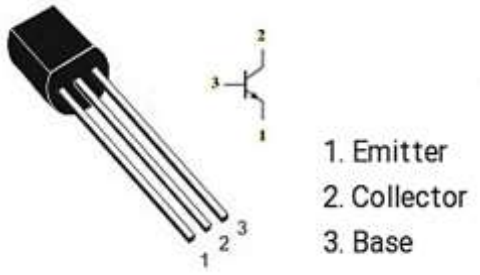

Figure 8. NPN Transistors

Push-Button Module
The push-button module allows detection in states of high or low from the onboard momentary push button. 100% Arduino Compatible. Features: Operating voltage output: 3.3 to 5V max. Digital input.

Figure 9. Main Switch

Main Switch
It is an electromechanical operated switch used for opening or closing a circuit.

Figure 10. Main Switch

Socket Outlet
A socket outlet is a device, provided with female contacts, which is intended to be installed with the fixed wiring, and intended to receive a male plug attached to its end [19]. The general arrangement of socket outlets is similar to that of switches in accordance with the BS 1363 sockets, most of the sockets used for domestic and commercial use are designed to accept 5A, 13A, 15A plugs. The output socket used in this project is a 13A socket outlet that gives out a 230V ac supply that can power any devices and appliances such as Vacuum cleaner, Air-conditioning system, Blender, Cooker, Pressing iron, etc.

Figure 11. Socket Outlet

3 Results and Discussion

The construction of an Arduino timer socket was technical and involved great care to avoid the damage of components used. The results are displayed in the plates below.

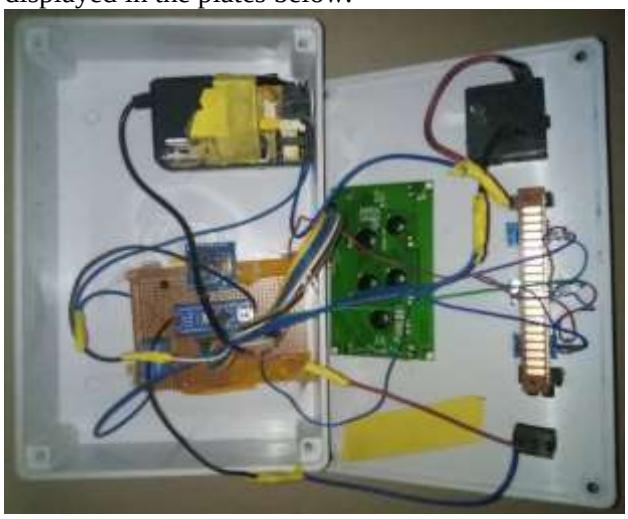

Figure 12. Inner view of the developed system

Figure 13. Constructed Arduino Timer Socket Unpowered.

Figure 13 shows a well labelled Arduino Timer Socket, where the LCD is known as the Liquid Crystal Display and SSO after the 13 Amps means Single Socket Outlet.

Figure 14. LCD Screen when the System is Powered.

Figure 14 displayed the output on the LCD screen when the system developed is powered, the 00:00:00 means that the current time must be set before timing the device, which is explained as

follows, from the left-hand side, the first two zero is for the hour in 24-hour time format, the second two zero at the middle is for the minute and the last two zero by the right is for seconds.

(a) (b)

(c)

Figure 15. Device A under test (Mobile Phone)

Figure 15 comprises a, b, c. Figure "a" shows a present time when the device is powered ON to charge a mobile phone, Figure "b" shows when both the mobile phone and the device are under working conditions, while Figure "c" displays when the device is OFF. Hence, the timer system runs a countdown with a "Dev is ON" message, while the device plugged is operational while a "Dev is OFF" message to signify the end of the set period and automatically switches off the phone charger.

(a) (b)

Figure 16. Device B under test (Toaster)

Figure 16 comprises a & b. Figure "a" shows a present time when the device is powered ON to power a toaster for even toasting when used for toasting a bread, the red indicator light on the toaster shows that the toaster is operational. Similarly, Figure "b" displays when the device is OFF.

(a) (b)

Figure 17. Device C under test (Electric Cooker)

Figure 17 comprises a & b. Figure a shows a present time when the device is powered ON to power an electric cooker, the red ring light on the electric cooker shows that the cooker is operational. Similarly, Figure b displays when the device is OFF. With the aid of a proper simulation in accordance with the above-stated circuit diagram, a functioning timer system is designed and constructed following the project aim to control and monitor the usage of the electrical appliances to minimize energy consumption and unnecessary accidents.

4 Conclusion

An Arduino timer socket has been developed and constructed. The prototype of the developed system worked according to the specification and quite satisfactorily. Its adoption or implementation in our domestic appliances will reduce human stress in operating electrical appliances and help to automate our household appliances at a present time. For Instance, if a mobile phone is preset to charge for a preset time, it will switch off the supply accordingly, which prevents overcharging and

makes the battery life of the mobile phone more durable. The developed system will boost the reliability, durability, and efficiency of any appliances or devices it is connected to. Consequently, it contributed positively to the usage of the Arduino microcontroller for automation and embedded system for convenient operation of electrical appliances whenever needed.

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Contribution of individual authors to the creation of a scientific article (ghostwriting policy)

Najeem O. Adelakun carried out the simulation and wrote the research article.
Samuel A. Omolola worked on the methodology.
Najeem O. Adelakun has organized and worked on results and discussion section.
Najeem O. Adelakun & Samuel A. Omolola was responsible for the proofreading of the manuscript.

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