Journal of Engineering and Applied Sciences
MEDWELL PUBLICATIONS

Design and Implementation of Automatic Selector Switch with up down Protection for A.C 220 Volts Feeders

Jabbar Shatti Jahlool
Computer Technique's Engineering Department, Dijlah University College and Baghdad, Iraq

Key word: Selector switch, arduino, three phase, transformer, relays and LCD

Corresponding Author:
Jabbar Shatti Jahlool
Computer Technique's Engineering Department, Dijlah University College and Baghdad, Iraq

Page No.: 394-399
Volume: 16, Issue 17, 2021
ISSN: 1816-949x
Journal of Engineering and Applied Sciences

Abstract: The proposed design in this paper is to design and implementation of automatic selector switch with high and low levels protection for A.C 220 volts. The purpose of this research to avoiding using of a manual selector switch inside the customers electric power supply cabinet. The mains goals of the proposed design are, first avoid approaching anyone from the homes electric power supply cabinet through design of an automatic device to perform the conversion of right electric power line without human intervention. Second, supply safe and stable electrical power for homes in all time and ensure the operation of household appliances without any stopping time. There'd, provide the protection of household appliances from the high rise to the level of input voltages to more than 250 volts, or falling the level to less than below 175 volts, in addition to displays the output status of the system in a Liquid Crystal Display (LCD) and Light Emitting Diode (LED). The proposed design is done by using Arduino Uno board, step down transformer, drivers, relays, LCD and some of capacitor, resistor and diodes. The prototype design result implementation are shown in Table 1 and the Fig. 4, 5, 6 respectfully.

INTRODUCTION

Implement extension of power electric wires inside houses in Iraq are carried out through distribution individually the load lines corresponding to 3-phases inputs of the electric power supply network. So that one line is allocated for supply light load appliances like illumination point, fans, water pumps, television, satellite, refrigerators and etc. The second and there'd lines allocated for heavy loads appliances like air conditioners, water heaters, electric heater etc, so that the home heavy loads distributed between these two lines. Therefore, the concentration of importance is in the source of processing the line of illumination. The manual selector switch are used for this purpose for change to right line if any damage or fault occur of any one of the three input power phases. But the use of manual selector switch have some problems, first this process is currently taking place by hand, therefore, it is requires the presence of human to conduct the switch, this is of course complex because that required to presence a person in the house in a permanent manner, in addition, it is possible the damage cause at night time when sleeping. Second the risks resulting from the approach of any one from 220 v A.C voltage source that may be occur lost of life. For this reason one primary concern and more importantly of electric power customers

are focus on the provision of uninterrupted power supply, safety, reliability and economy. Therefore the using of automatic selector switch is the best solution to all these problems.

The important factors like reliability and safety are implemented by using automatic switch phase selector[1]. Design, simulation and implementation of automatic phase selector and changeover switch for 3-phase supply are used, but this design don't limited or explain the amount of load can be used for this circuit[2]. A current sensing strategy used for design system for three phase automatic selector. This design depend on the op-amp as a comparator. The disadvantages of such designs may cause oscillation and fluctuation in the selection of the right phase[3]. Construction of a real laboratory Automatic Transfer Switch (ATS) and three phase selector by using electro mechanical relays and comparators are implemented[4]. Automatic method for detection and correction the fault in three-phase electrical power feeders design depend on using micro controller are implemented[5]. A real time selector switch was designed depend on using logic gates with assistance of power electronic components. The approach in the proposed design in this paper using automatic selector switch device for selection one of the three input phase A.C 220 volt and output one right line that usage for illumination line. In addition to protection the home appliances from increasing the voltage level to high value greater than 250 volt or decrease to low level less than 175 volt. Also to display the phases status after correct decision will implemented.

DESCRIPTION THE SYSTEM

The proposed design divided in to three main units and one sub unit. The main units are the power unit (PWU), Processing Unit (PU) and the Output Decision Implementation Unit (ODIU). The sub unit is supply unit for Arduino (SUA). These units can be implemented by hardware and software to cover the whole system requirements Fig. 1. Represent the block diagram of the proposed system design. The Arduino board represent the mind of the design will process all system analysis to output right decision depend on the proposed algorithm by using the sketch Arduino software. For the PWU, the inputs are 3-phase A.C 220 volt and through which the processing method will output three lines with low level D.C voltage. Each low level line corresponding to the values of one of the three input phases A.C 220 volts. The three low level lines voltages connect to the three analog input ports (A0, A1 and A2) of the Arduino board. The Arduino board represent the PU. In this unit, reading and analysis operations are achieved by checking the level voltages of the three phases. if its within the required level range (175 to 250) volts or not then, its output correct decision in the form of a three control signals denoted as (cph1) the control signal for phase one, (cph2) the control signal for phase two and (cph3) control signal for phase three. These three control signals will be sending to ODIU. The ODIU it's a hardware circuit implemented the job of connect the right phase to the illumination line depend on the received decision from PU. The ASU subunit will used to supply the Arduino board by 8 volt D.C.

PROPOSED SYSTEM FLOW CHART

The algorithm approach to the proposed design start by the continuity testing the first input phase (phase one), if its right value within the range (175 to 250 volt), continue to convert this phase to output illumination line by set (cph1) and don't care the other two control signals (cph2), (cph3). At the same time, the LCD will display the word (ph2 = D.C, ph3 = D.C and ph1 = OK). While when there is a defect in this phase, whether it is a cut or out of permissible limit (175 to 250) volts. The device automatically stops this phase from pass and change state to check the second phase. The analysis will repeated to check phase two if it fulfills the requirements as above its transfer the output power feeding to this phase by setting (cph2), reset (cph1), don't care (cph3) and write the word (ph1 = F, ph3 = D.C and ph2 = OK) at LCD. If not the process change to read the there'd phase if it fulfills the requirements its transfer the output power feeding to there'd phase by setting (cph3), reset (cph1)and (cph2) then write the word (ph1 = F, ph2 = F and ph3 = OK) at LCD. When there is a defect in all three inputs phases, the device will cut off the processing of electrical power to illumination line, by reset all control signal (cph1), (cph2) and (cph3). This is in order to protect the equipment from damage. And write the word (ph1 = F, ph2 = F and ph3 = F). The above process (algorithm) will implemented by writing a program called sketch run by the Arduino. As soon as a sketch code is downloaded to Arduino. Arduino starts implementing the program's steps that represent the reading and analysis to output correct decision and the process continues in a circular loop. This is demonstrated in Fig. 2.

CIRCUIT CONNECTION AND IMPLEMENTATION

The circuit connections of the proposed system are shown in the Fig. 3. This circuit as denoted above divided to three units. The first unit is the PWU, consist of the following components: 3-step down transformers (220/12 volt 400 mA or 1 Amp), 3-bridge rectifier, 470 µF capacitor as a filter, 2.2 Ω, 1.5 Ω for each phase as a divider to down the D.C voltage from 12 v D.C to 5 v D.C which is known as (ph1in, ph2in and ph3in)

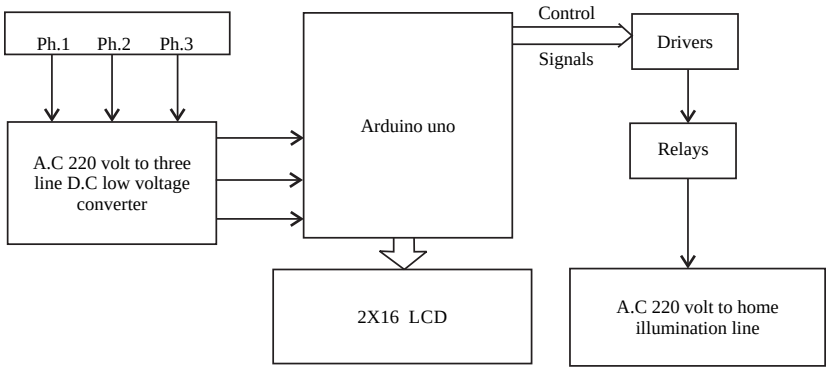

Fig. 1: Proposed automatic selector switch block diagram

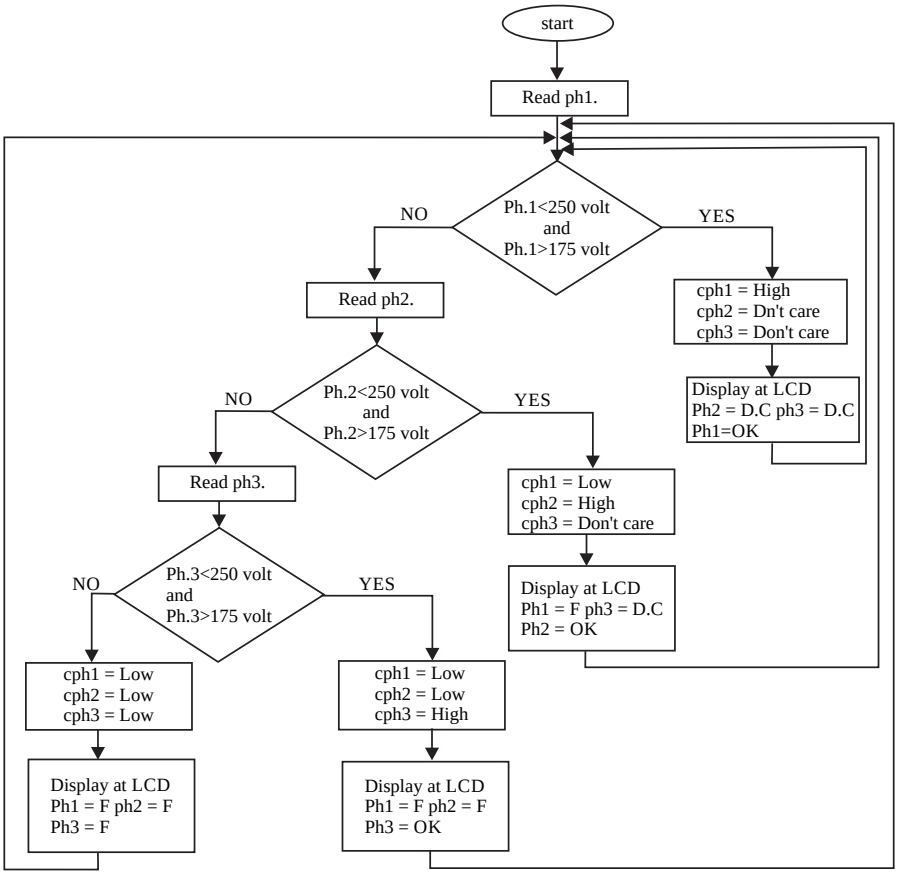

Fig. 2: Proposed system flow chart

corresponding to three input phases. These three D.C voltages will connect to Arduino analog inputs (A0, A1 and A2) compatible with input voltages' of each phase. The operating code is writing and downloads to Arduino board. The code perform the calculation and analysis process and out by a decision showing which phase must be connected to the home illumination line to supply the home appliances with 220 volts depend on the priority and level checking of each phase within the required range (175-250 volt).

Arduino Uno board is the central component of the system, so that represent the PU. This device is used in large applications, because ease of the handling, connection and programming. Important things and other features generate a desire of direction to use such devices, like a very wide range of applications from simple project

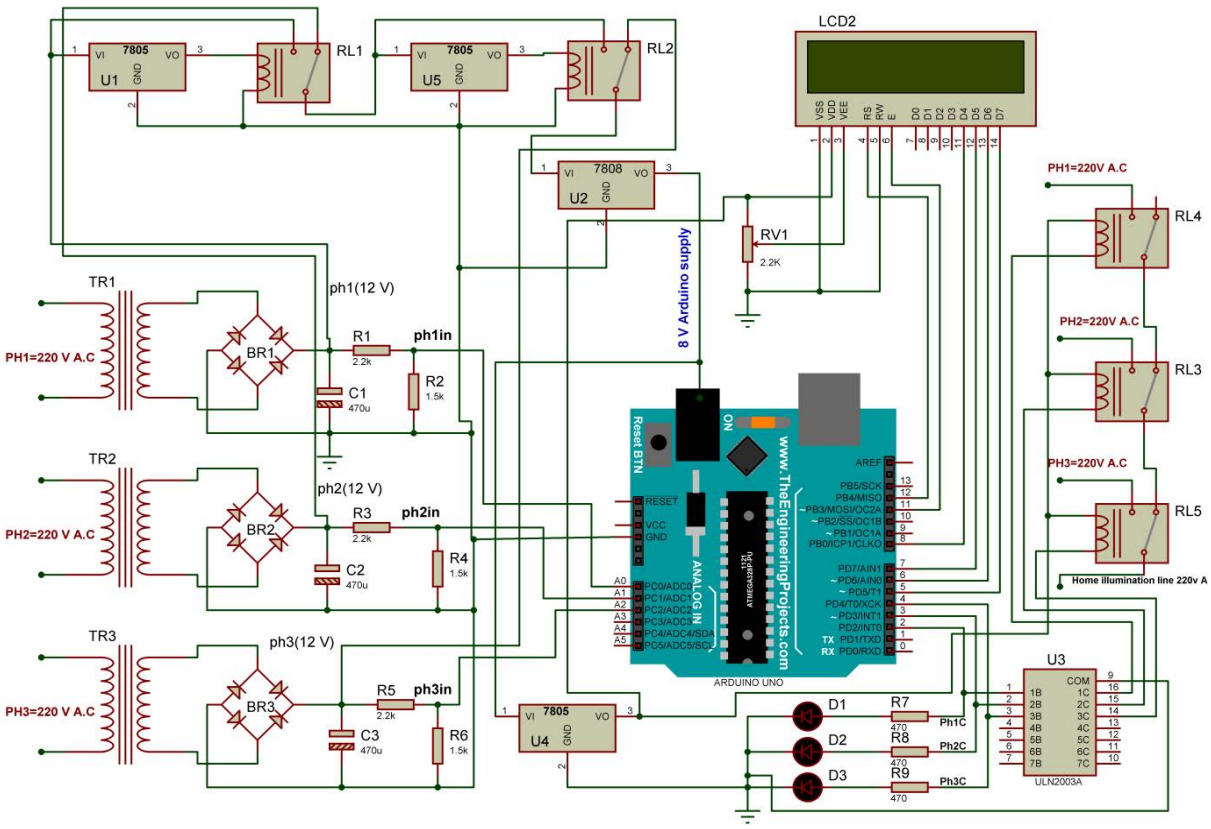

Fig. 3: Final proposed circuit diagram

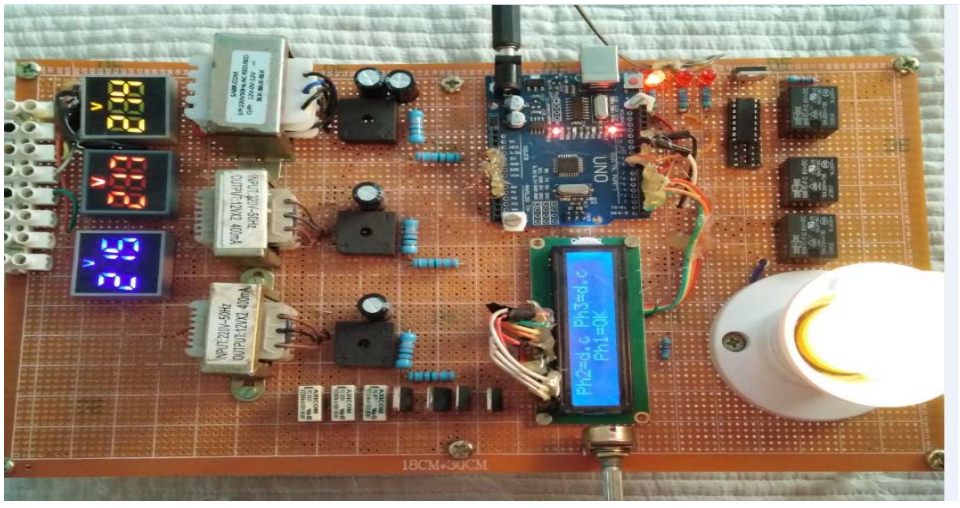

Fig. 4: Prototype implementation circuit at normal operation

to complex, high quality, low price and ease of availability without any trouble[6]. It is an ideal solution for different control applications, because it have (14) inputs digital lines and (6) analog lines. Arduino have 8 bit microcontroller based on the ATmega328, 16 MHz ceramic resonator, SRAM 2 kb and flash memory 32 kb. The code written for Arduino is known as a sketch. The software used for developing such sketch for Arduino is known as the Integrated Development Environment IDE[7].

The component (U1, U2, U5, RL1 and RL2) represent the ASU subunit are used as a source to supply the Arduino for (8) volt which ensures continuity of processing supply to Arduino board.

The components (D1, D2, D3, R7, R8, R9) as a part of ODIU are used as indicator to detect which phase as active, depending on three output control signals cph1, cph2 and cph3. The other ODIU components (U4, U3, RL3, RL4 and RL5) with control signals are used for transfer output 220 volts A.C to home illumination line depend on phase priority which calculate by system algorithm. The U3 it is high voltage and current seven NPN Darlington transistors used as driver to connect relays components. Finally the LCD is used to display the system status. The prototype of physical connection of the circuit shown in Fig. 4.

RESULTS

The normal operation of the system as shown in Fig. 4. Above. Depend on reading and checking process implement by the Arduino code. The priority of checking start by analysis the phase connect to analog input (A1) then to analog input (A2) final to analog input (A3) . If the first phase (connect to A1) its right phase that achieves the requirement, means that it exists and its voltage level range between the (175 to 250) volts, therefore it is output to supply the illumination line for home, if not change to second phase (connect to A2) and so on Table 1. Demonstrate all working status of the device.

Some Cases of the System Working: When all the phases are existing, but phase one weak level less than 175 volts and the other phases have right level between the range (175 to 250) volts. In this case, the PU will a decision issued as a control signal at the following status: reset cph1, set cph2 and don't care phase three. In this case the working behavior of the circuit as shown in Fig. 5. That means the ODIU will connect the phase two to illuminations line, the second LED will lighted and LCD will display the word (ph1 = F, ph3 = D.C, ph2 = ok) this means, phase one fault, phase three don't care and phase two represent the output phase that connect to illumination line Fig. 6. Explain another case for the working of the system represented by the following inputs. Phase one have low level (less than 175 volts), phase two cut and phase three have right level. At this case, the issued decision for PU will reset cph1, cph2 and set cph3. Depend on the PU decision, the ODIU will

Table 1: All working status of the device

Input level voltage A.C. volt				
Phase 1	Phase 2	Phase 3	Illumination line output	LCD display status
175-250	X	X	Phase 1	Ph2 = D.C. Ph3 = D.C. Ph1 = Ok
X<175	175-250	X	Phase 2	Ph1 = F Ph3 = D.C. Ph2 = Ok
X>250	175-250	X	Phase 2	Ph1 = F Ph3 = D.C. Ph2 = Ok
0	175-250	X	Phase 2	Ph1 = F Ph3 = D.C. Ph2 = Ok
0 or <175 or >250	X<175	175-250	Phase 3	Ph1 = F Ph2 = F Ph3 = Ok
0 or <175 or >250	M>250	175-250	Phase 3	Ph1 = F Ph2 = F Ph3 = Ok
0 or <175 or >250	0	175-250	Phase 3	Ph1 = F Ph2 = F Ph3 = Ok
0 or <175 or >250	0 or <175 or >250	0 or <175 or >250	0	Ph1 = F Ph2 = F Ph3 = F

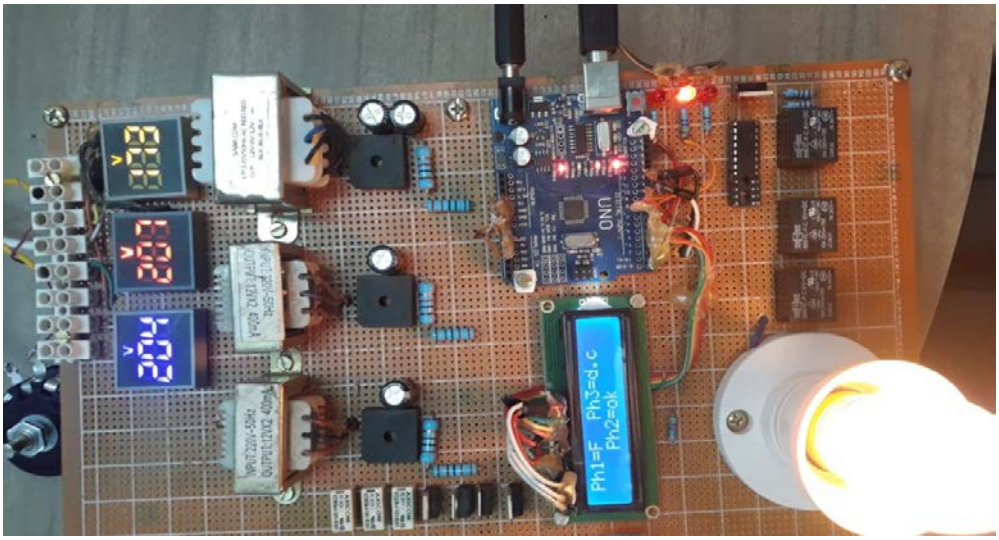

Fig. 5: Three-Phase exist but phase one at low level

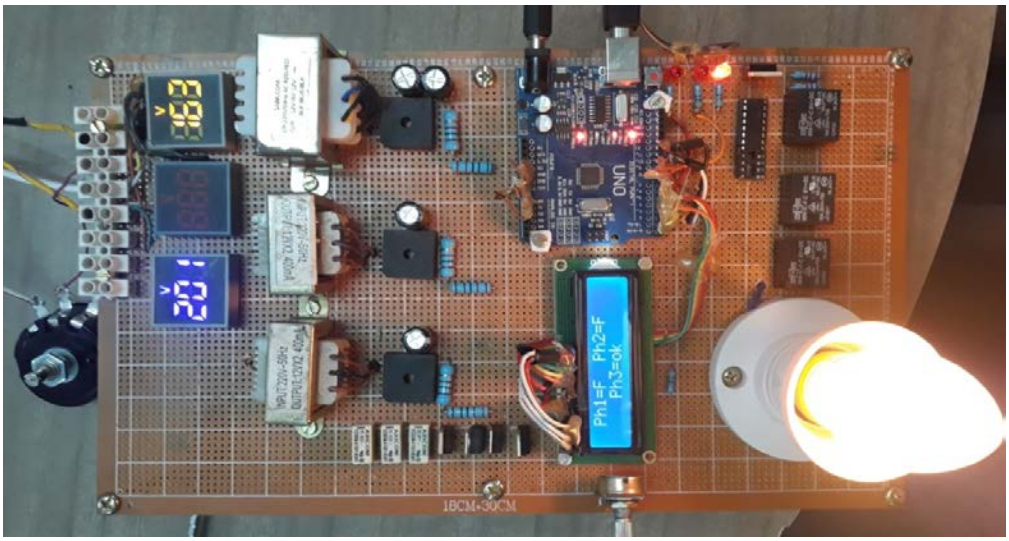

Fig. 6: Phase one low level, phase two cut and phase three right level

connect the phase three to illuminations line, the there'd LED will lighted and LCD will display the word (ph1 = F, ph2 = F, ph3 = ok) this means, phase one fault, phase two fault and phase three represent the output phase that connect to illumination line.

CONCLUSION

At this work, design and implementation a prototype of automatic selector switch with up down protection tools. The design was carried out in two parts, hardware and software, then assembly these parts together for output with successfully device. By using this design ensure continuity of supply the home illumination line by electric power without human interventions. The requirements of using this type of devices may cover a wide range places like homes, hospital, warehouse, offices, bankes, indisterials, factores, study halls and various workplaces. This system based on Arduino board, therefore its very useful because its easy to understand and meantenance in addition to other features like small size ,low power consumption, low cost, simplicity and reliability. Testing and verification of the system in both parts hardware and software was performed and the proper functioning is ensured. In the future, it's possible to upgrade the system by adding some facility to enable the customers to change to manual selection instead of automatic selection that may be use as assistance method in case of happen damage or any fault on the device.

REFERENCES

1. Gupta, A.K. and C. Singh, 2015. Automatic cost effective phase selector. Int. J. Adv. Res. Electr., Electr. Instrum. Eng., 4: 3920-3925.
2. Ofualagba, G. and E.E. Udoha, 2017. Design and simulation of automatic phase selector and changeover switch for 3-phase supply. Int. J. Novel Res. Electr. Mechan. Engin., 4: 28-35.
3. Nweke, F.U. and R.C. Iwu, 2015. Design and construction of automatic three phase power system selector. IOSR J. Appl. Phys., 7: 11-14.
4. Oritselaju, O. and F. Oladipo, 2015. Automatic transfer switch with three phase selector. Int. J. Sci. Eng. Res., 6: 82-87.
5. Jahlool. J., 2018. Automatic detection and correction the fault in electrical power feeders based microcontroller. J. Electr. Electron. Syst., 7: 1-6.
6. Louis, L., 2016. Working Pprinciple of arduino and using it as a tool for study and research. Int. J. Control Autom. Commun. Syst., 1: 21-29.
7. Badamasi, Y.A., 2014. The working principle of an Arduino. Proceedings of the 2014 11th International Conference on Electronics, Computer and Computation (ICECCO), September 29-October 1, 2014, IEEE, Abuja, Nigeria, ISBN:978-1-4799-4108-7, pp: 1-4.