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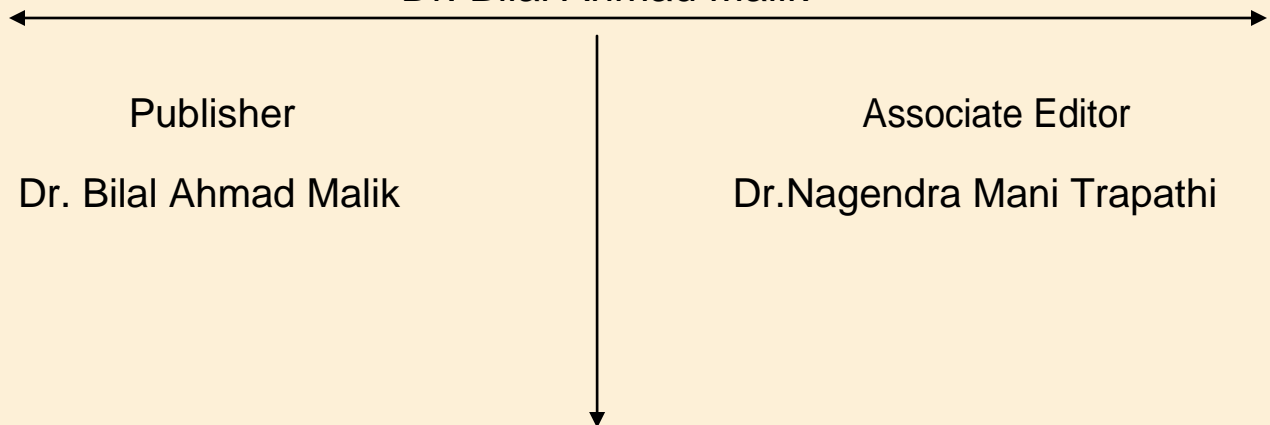
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AUTOMATIC SHUT OFF/ON EXTENSION CORD

SALVADOR A. LORIA JR., PH. D.

Chairman, Department of Electrical Engineering, Nueva Ecija University of Science and Technology in Cabanatuan City, Philippines

ABSTRACT

This research project was to address two main issues/problems in the field of electrical engineering namely: electrical safety and energy savings. Specifically it aimed to design and develop a device named automatic shut off/on extension cord where its primary purpose are: to protect the lives, homes and properties against fire caused by electrical abnormalities; and to reduce electrical consumption by controlling the time of operation of our electrical loads. Also it determined the performance of the device in terms of effectiveness, reliability and safety.

The research project underwent the following stages: (1) identification and selection of the materials used; (2) design of the automatic shut off/on extension cord; (3) procedure in the construction and assemble; and (4) testing the effectiveness of the project.

This research project innovate the operation of ordinary extension cord to enhance its security measures. The project was installed by three safety features – voltmeter, circuit breaker & timer. The modified automatic shut off/on extension cord was utilized and tested and found safe and effective to use. It is also reliable since there is no record of interruption and delay response when it used on different time settings.

Keywords: *Extension Cord, Timer, Breaker, voltmeter*

I. INTRODUCTION

Energy conservation is the primary concern of energy industry. It can be achieved by performing simple actions such as turning off lights or equipment if not in use, efficient and wise usage of electricity and reducing the time of using electrical loads. Two of the hottest issues in the domain of electricity today are: (a.) the issue on electrical safety, and (b.) the issue on energy savings. Most of the fire incidents today were reported to have been

due to malfunction of electrical appliances, overloading, short circuit, left connected appliance to power source, etc. How many people were being killed? How much money had been lost? How many properties were destroyed? How many buildings/houses were burned? These questions pointed to lack of electrical safety. Another problem that we are facing today is the shortage of electricity. In fact last year, this issue became controversial in the Philippines when generation rate get higher because of the massive shut-down of the different power plants. Today, the world is experiencing energy shortage because of the increasing demand for energy sources each year. Every time a new gadget is introduced to the market, more energy is required. These two reasons prompted the researcher to conduct/develop this research project. This can be of help to address/minimize the two above-mentioned problems.

This project is similar to the operation of an ordinary extension cord. However, it was enhanced/ modified to level up the security measures against electrical abnormalities. It looks simple but quite helpful to extend electrical safety and energy savings. The researcher made modifications on the simple extension cord and converted it into an innovated and fully developed one. This research project was designed for saving power consumption and preventing hazardous accident caused by overloading and other electrical related problems.

This device was constructed using specific materials like: wires, outlet box, outlet cover, circuit breakers, timer, clamps and wire nuts. The researcher employed two safety features such as voltmeter - where the users can see if there is an over or under voltage in the system, and a circuit breaker – where in case there is overloading, malfunction, abnormality, and short circuit, the breaker will automatically trip off to isolate the load from the system. A relay was used to avoid/minimize electrical arching and physical damage on the project. The essential feature of the project is the timer, when users had left plug-in appliances, power source would automatically cut off after reaching the setting time. Users can control/set the time of operation of their electrical appliances depending on their needs.

Objectives of the Study

This research study was meant to innovate the operation of an ordinary extension cord where its primary purpose is to protect the lives of the people, homes and properties against fire incidents caused by electrical abnormalities. It also saves energy by controlling the time of operation of electrical loads.

Specifically, this study is intended to design and develop an Automatic Shut Off/On Extension Cord that is safe, reliable and effective to use.

II. METHOD AND PROCEDURE

The research method used in this project was the experimental research and development cycle. Background data were collected in order to determine the primary information required to continue with the development of the research output. There were six phases covered in conducting this study

Phase 1: Planning and Consultation

This first phase of study included collection of data and information, designing of circuit and selection of materials.

Phase 2: Construction

- Making the prototype - after completing the design and layout, a prototype was constructed assimilating all the required components within the circuit itself.
- Preliminary testing—testing the operation of the project.
- Inspection - involved troubleshooting of the project.

Phase 3: Design revision

Reevaluation of the design was done relative to the preliminary testing.

Phase 4: Testing

Initial tests were done to determine the capability of the project to perform in the desired loads.

Phase 5: Evaluation

Examining the device in terms of its safety, reliability and effectiveness.

III. RESULTS AND DISCUSSIONS

Figure 1 shows the operational block diagram of the project. It can be seen, a circuit breaker was installed to protect the system against electrical abnormalities. A timer was used to set the time of operations of the load which would trigger the relay switch to perform its switching function. Voltmeter was placed to notify the users if there is over or under voltage in the source. Fuse was also installed to serve as an additional protection.

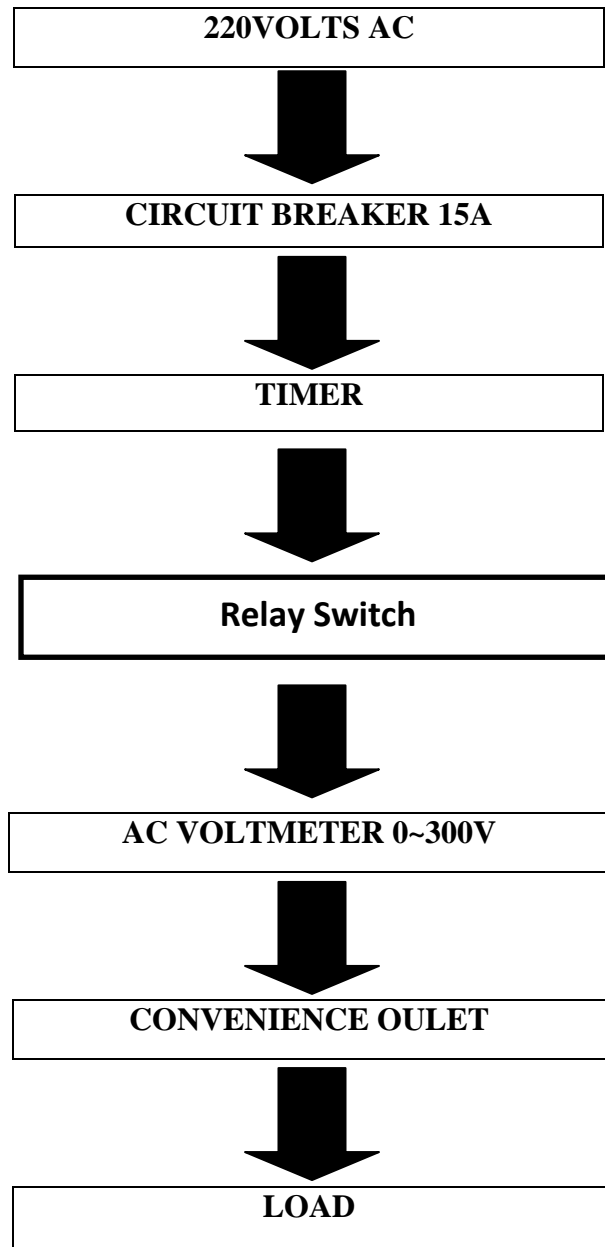


Figure 1

Block Diagram of the Automatic Shut Off/On Extension Cord

Figure 2 illustrates the schematic diagram of the Automatic Shut Off/On Extension Cord with lines 1 and 2 as the main lines. The current is flowing to line 1 then to the breaker which is the main switch of the system. A relay is placed in series with line1 which control the switching/shifting of the system. The timer is in series with line 1, where the current is rectified from AC to DC using the bridge type diode. As the direct current passes through the diodes, the positive and negative output of the rectifier is parallel to the battery. The battery (1.2 V dc) will be the primary source of the timer. The transistor will serve as the triggering component of the timer to switch on/off the relay electrically. Therefore, the operation of the automatic shut on/off extension cord is an electrically switching system.

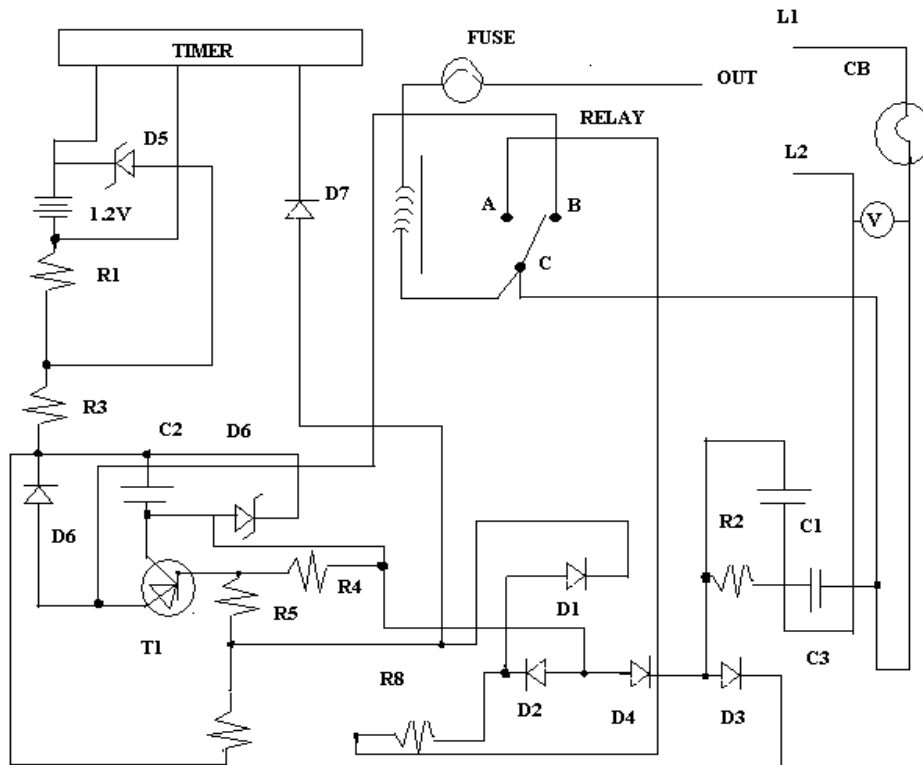


Figure 2
Schematic Diagram of the Automatic Shut Off/On Extension Cord

The actual image of the prototype of the project is shown in Figure 3. Voltmeter, circuit breaker and fuses are the safety features of the project, while the timer controls the time of operation of electrical loads, which eventually leads to energy savings.



Figure 3
Actual Image of the Automatic Shut Off/On Extension Cord

Description of the Materials Used:

1. Mini Size Rocker Switches with Built-in Circuit Breaker

Key Specification

- Lighted or non-lighted
- Built-in with circuit breaker
- Rating: 2 to 15A 125V AC, 60Hz
- Interrupt capacity: 30A 32V DC/250V AC
- Initial contact resistance: 50mΩ maximum



- Insulation resistance: 100M Ω min, at 500V DC
- Dielectric strength: 1,250V AC for 1 minute
- Electrical lifespan: 6,000 cycles
- Housing: nylon 66, UL rated 94V-2 minimum
- Lamp: neon
- Terminals: silver-plated brass
- Contact arm: bi-metal
- Contact: silver alloy

2. 48-Volt DC Electrical Mini PCB Type Power Relay

- Up to 30A switching in SPST
- 30A carrying current

Contact Data	
Contact Form	1A,1B,1C
Rated Load	20A 240VAC
	30A 240VAC
	½HP 240VAC
	1HP 120VAC
Contact Resistance	≤100m Ω
Electrical life	10 ⁵
Mechanical life	10 ⁷
Coil data	
Coil Rated Voltage	5-48VDC
Coil power	0.93W
Pick-up Voltage	≤75%
Drop-out Voltage	≥10%
Coil and Contacts	2000VAC/1MINUTE
Contact to Contacts	1500VAC/1MINUTE



3. Analog Voltmeter

Description:

- Analog AC 0-300V Volt meter
- Dimension (W x H x D): 70.9mmx61.4mm x 48mm
- Center cut hole: 51.5mm (2.025")
- Bolt distance (each side): 48.5mm (1.9")
- Bolt diameter: 2.9mm (0.114")
- Bolt cut-hole diameter: 3.0mm (0.118")



Model: AC 300V

Description: AC 300V Analog Volt Meter

Operating power: NA

Input: AC

Type: Analog

Digit: Needle

Operation of the Automatic Shut Off/On Extension Cord

This unit is a direct plug-in timer intended to control the electronic power of the appliances to prevent electrical failure that can lead to possible fire incidents, also, it helps to minimize electrical consumption of the load.

Features:

- 8 keys Timer Function
- Time settings are including HOUR, MINUTE and WEEK.
- 12 hours / 24 hours time format

1. Initial Operation

- a. Depress **MASTERCLEAR** key to refresh system screening within 6 seconds.
- b. Use sharp object (e.g. pencil) to depress **MASTERCLEAR** key to delete all information you have set up before.

2. “Week” key for the Switch-On and Switch-Off Time

After depressed **TIMER** key to enter the settings status:

- a. Depress **WEEK** key to select the day’s group wishes to switch-on the appliance. The day’s group will advance in the sequence of MO TU WE TH FR SA SU.
- b. Depress **HOUR** key once from `0’~`23’ or `1’~ `12’.
- c. Depress **MINUTE** key once from `00’~`59’.
- d. When in setting status, it runs into current time if no pressing is made within 20 seconds.
- e. Be sure to depress the **RESET/RECALL** key to reset or cancel all systems.

NOTE: Pressing key **HOUR** or **MINUTE** or **TIMER** for more than 3 seconds, a fast run-through is carried out 4 times per second.

3. Clock Function

When in Timer Status:

- a. LCD shows week, hour and minutes, e.g. 12 hours will be performed AM or PM on.
- b. Depress **CLOCK** key with `WEEK` simultaneity perform MO~SU.
- c. Depress **CLOCK** key with `HOUR` simultaneity perform 1~12.
- d. Depress **CLOCK** key with `MINUTE` simultaneity perform 00~59.
- e. Depress **CLOCK** key with `TIMER` simultaneity 12 hours / 24 hours-time format

4. Manual Operation

The LCD displays the output status as

AUTO: Under settings status, it is in ON or OFF status.

ON: The unit is permanent controlled in ON status.

OFF: The unit is permanent controlled in OFF status.

ON → AUTO → OFF

Special Technical Data:

Voltage:	220V~/60Hz
Installation:	Plug-in Type
Rating:	220V~AC/16A/3600W
Setting Time:	1 Minute
Operating Temperature:	-10...+40 Degree Celsius
Accuracy:	±1 Min/Mon.
Battery:	NIMH1.2V>100hrs.

Effectiveness and Reliability of the Automatic Shut Off/On Extension Cord

To describe the effectiveness of the project, it was tested to different electrical loads and to measure its "OFF & ON" time delay. It can be seen from Table 1 that the time ON and OFF delay is negligible and approximately 0 sec. This means that the device response immediately at the required time setting.

Table 1
The Performance of the Automatic Shut Off/On Extension Cord In
Terms of Effectiveness

TRIALS	LOADS	ALARM TIME "ON" DELAY (SEC)	ALARM TIME "OFF" DELAY (SEC)
1	ELECTRIC FAN 45W	0	0
2	FLAT IRON 1000W	0	0
3	RICE COOKER 250W	0	0
4	REFRIGERATOR 250W	0	0
5	TELEVISION 250W	0	0

It can be seen from Table 2 that there is no recorded tripping, interruption or malfunction of the project. This means that the project is capable of withstanding different conditions.

Table 2
The Performance of the Automatic Shut Off/On Extension Cord In Terms of Reliability

TRIALS	LOAD	TIME OF OPERATION IN MINUTE	TIMES OF MALFUNCTION
1	ELECTRIC FAN 45W	15	0
2	FLAT IRON 1000W	30	0
3	RICE COOKER 250W	45	0
4	REFRIGERATOR 250W	60	0

The total cost of the project is approximately P2145.00 (seen in Table 3). It looks expensive compared to ordinary extension cord but it could not compensate the capability of the project to protect property, home and lives of people.

Table 3
Cost of the Automatic Shut Off/On Extension Cord

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	AMOUNT
1	PC.	VOLTMETER 0-300V	200.00	P200.00
1	PC.	CIRCUIT BREAKER 15A	180.00	180.00
1	PC.	LCD	350.00	350.00
1	PC.	PCB	180.00	180.00
1	PC.	PLUG	80.00	80.00
1	PCS.	UNIVERSAL OUTLET	120.00	120.00
7	PCS.	RESISTOR	2.00	14.00
7	PCS.	DIODE	3.00	21.00
4	PCS.	CAPACITOR	30.00	120.00
1	PC.	BATTERY BANK 1.2 VOLT DC	100.00	100.00
1	PC.	RELAY -1HP,120V ½HP,240V	300.00	300.00
1	PC.	TRANSISTOR	45.00	45.00
10	PCS.	SOLDERING LEAD	10.00	100.00
1	PC.	3METERS #16/2 FLAT CORD	300.00	300.00
1	PC.	HOUSING	35.00	35.00
			TOTAL AMOUNT	P2145.00

IV. CONCLUSION

After careful observations, series of tests and evaluations of the project, the researcher came up with the following conclusions:

1. The design and operation of the project is simple and can be easily understood. Advanced knowledge in electricity and electronics is not required to understand the circuit design.
2. The **Automatic Shut Off/On Extension Cord** is effective and reliable in providing security, safety and savings electrical consumption.

V. RECOMMENDATIONS

After several months of fabricating the Automatic Shut Off/On Extension Cord, the researcher presented the following recommendations and suggestions for further improvements of this research project:

1. To drive bigger loads, it is necessary to complement a magnetic contactor on the switching mechanism of the device.
2. Researcher may improve the development of the device by utilizing different timer circuits in order to sequence the control of two or more different loads. Further, it is advised to use remote control for easy and convenient encoding of time setting.

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Ph No: 01933212815

Email:- nairjc5@gmail.com, nairjc@nairjc.com , info@nairjc.com

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