Performance Analysis of Heat-Based Smart Phone Charger

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***Abstract*—Smart phone services have become all encompassing in these modern life activities. These phones operate with batteries that provide the necessary electrical power. The batteries' stored energy often got used up; and the conventional electrical power charging sources like public power supply, generating sets, solar devices among others are not only unreliable but most times totally unavailable in some villages and camp settlements. There was then the need to produce simple, inexpensive and easily accessible battery chargers for the phones. This paper therefore studies and analyzes the performance of a locally-made, off-grid and renewable energy power phone charger. The device output voltage, current and hence power has been tested at varying degrees of temperatures. Finally it was tested with different heat sources like, charcoals, Gas- burner, kerosene stove, wood stove, and Camp and Barbecue fires for heat source efficiencies. The results prove that charcoals and gas-burner heat sources are the most efficient heat source for operating the heat-smart- phone charger.**

Keywords-Smart Phone; Thermoelectricity; Barbecue; Seebeck Effect; Nano-Technology

I. INTRODUCTION

Ideally, the basic necessities of life are food, clothing and shelter. However, civilization, modern-life style and technological developments have forced some other necessities like Phone services onto mankind. In many rural areas of Africa and other developing countries of the world, peoples try to manage their lives without some amenities like electricity and sanitation, Nuwayhid RY etl (2003). Many of them find it difficult to do without Phones. Phones are fast becomming indispensable companions to both the urban dweller, rural and nomadic group of the entire populace. The simplest of these phones has important features like touch-lights, radio reciever, time piece, mailling facilities apart from the normal making and answering voice calls. These Phones are powered by batteries which need recharging on regular basis for optimum operations. In order to recharge these phones batteries, people do walk for miles to some common cell phone battery charging centers. "The upgrade technology system on cell Phones today makes life easier for everyone in rural areas but our major challenge is when it comes to charging them in the villages we have little or no electrical power supply," says one irritated rural customer. (Susan P. Wyche, 2007). Some people who are tired of searching for opportunities to charge their phones just lose interest completely and eventually they will find out their "SIM" cards are de-activated as well. This is one of the last conditions the telecom industries will allow…… losing a networked customer.

Alternative electrical power sources like car batteries; diesel generators, solar installations and entrepreneurial charging kiosks do exist, but all have peculiar limitations. Most of them are expensive, inconvenience and required maintenance and hence becomes unaffordable or even unavailable. In other cases hunters, hikers, mountain climbers and backpackers in the bush always move with smart phones that are equipped with some other electronics gadgets. These gadgets are powered up by batteries to keep them running and so need electricity to charge up the batteries. Spare batteries and solar chargers often being used to support are often been used up and the sun rays are very weak or even unvailable for the solar chargers. Other alternatives are either too expensive or impracticable in such rural and outdoor areas. This necessitated the use of heat-based smart phone charging system. This heat-based charging gadget utilizes heat from heat sources like, charcoals, Gas-burner, kerosene stove, wood stove, and camp and barbecue fires.

II. REVIEW OF RELATED LITERATURE

This heat-based charging gadget avails phone users with a local technology for charging phones. It harvests and converts these heats to provide the required electrical energy to charge phone batteries. This device harvests and directly converts these heats into electrical energy to charge our phones. This device works with the principle of thermoelectricity. Thermoelectricity means the direct conversion of heat into electric energy (Rowe DM, 2006). A thermoelectric power generator is a solid state device that provides direct energy conversion from thermal energy (heat) due to a temperature gradient into electrical energy based on “Seebeck effect”. The thermoelectric power cycle, with charge carriers (electrons) serving as the working fluid, follows the fundamental laws of thermodynamics and intimately resembles the power cycle of a conventional heat engine. The heat collector here is an arrangement designed to collect and transfer heat from the heat source into the system. In order to optimize this heat collection and transfer process, aluminum sheet is used to fabricate the concave heat transfer base. This plate collects as much heat as possible from the cooking stove, wood or gas while the blade can be pushed into the fire flames for better heat collection and transfer. This physical phenomenon where materials develop an electric potential due to temperature difference is known as thermoelectric effect Riffat SB, Ma X, (2003). Here, the thermoelectric modules are positioned in-between the heat harvester. The temperature differences the hot and the cold sides of the heat harvester produce some quantity of electricity. Thermoelectric modules simply convert a temperature differential across the device, and resulting heat flow through it, into a voltage via the Seebeck effect. The polarity of the output voltage is dependent on the polarity of the temperature differential across the thermoelectric modules. Reverse the hot and cold sides of the thermoelectric modules and the output voltage changes polarity.

III. METHODOLOGY

In this paper, we are looking at harvesting and directly converting heat into electrical energy enough to charge our smart-phones batteries. Many thermoelectricity developers have produced different kinds of power supply units using this same principle Weiling L etl (2003). An arrangement for the developmental processes of harvesting heat from open fire to electricity is shown below.

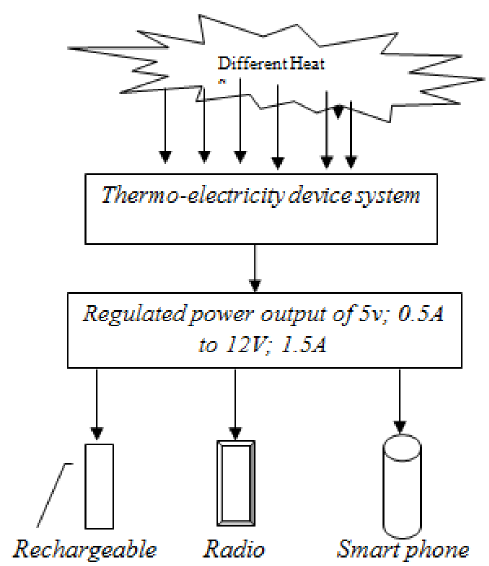

Figure 1. Operational arrangement of heat-to-electrify charger device.

This one works with the principle of thermoelectricity which appeals to African communities with special reference to off-grid dwellers. The major different is on how heat is harvested: the first one goes directly into the fire while the other is positioned in proximity with fire so as to harvest heat from the fire. In this work, our production was based on the technology that harvests heat by placing it in close proximity with the heat source.

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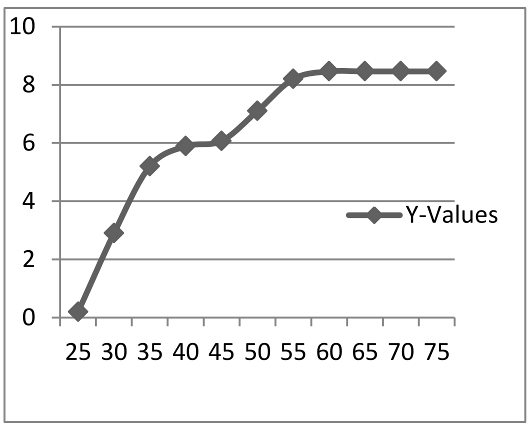
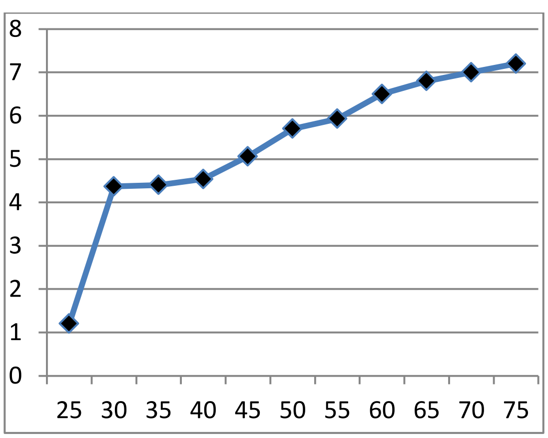
IV. Analysis and Presentation of Results



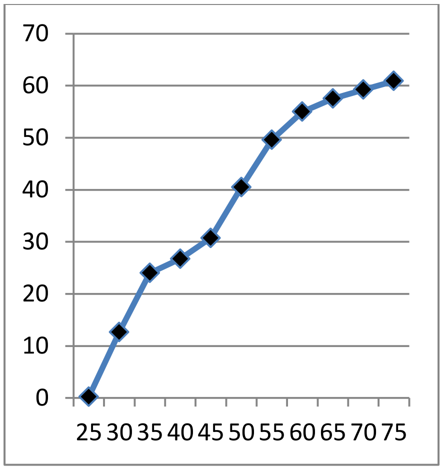
X-axis Temp degrees C	Y-axis Voltage
25	0.20
30	2.90
35	5.20
40	5.89
45	6.07
50	7.10
55	8.20
60	8.46
65	8.46
70	8.46
75	8.46

Figure 2. Relationship between source temperature and voltage.



X-axis Temp in degrees C	Y-axis Current in mA
25	1.20
30	4.37
35	4.40
40	4.54
45	5.06
50	5.70
55	5.93
60	6.50
65	6.80
70	7.00
75	7.20

Figure 3. Relationship between temperature and current output



X-axis Temp degrees C	Y-axis Power in mW
25	0.24
30	12.67
35	24.01
40	26.74
45	30.721
50	40.47
55	49.60
60	55.00
65	57.52
70	59.22
75	60.90

Figure 4. Relationship between source temperature and power output

V. CONCLUSIONS.

The results of the tests and experiments prove that this heat-to-electricity conversion device authentic. Moreover it is observed that best results come when the intensity of the heat absorptions and disseminations on the thermoelectric device are maximized. It is therefore recommended the elements like heat blowers and sinks be incorporated in the design and construction. The increasing concern of environmental issues of emissions, in particular global warming and the constraints on energy sources has resulted in extensive research into innovative technologies of generating electrical power and thermoelectric power generation have emerged as a promising alternative green technology. There are vast quantities of heat waste discharges into the earth's environment much of it at temperatures that are too low to recover using conventional electrical power generators, Min G, (2004). However, thermoelectric power generation comes with a technology of direct conversion of waste-heat energy, into electrical energy and hence power. This technology is being utilized in a number of useful applications due to their distinct advantages. There are micro- and macro-scale applications depending on the potential amount of heat waste energy available for direct conversion. Micro-scale applications included those involved in powering electronic devices, such as microchips. Since the scale at which these devices can be fabricated from thermoelectric materials and applied depends on the scale of the miniature technology available. Therefore, it is expected that future developments of these applications tend to move towards nano-technology.

REFERENCIES

[1] Rowe DM. Thermoelectric waste heat recovery as a renewable energy source. Int J Innov Energy Syst Power 2006; 1: 13-23.

[2] Rowe DM. Thermoelectrics, an environmentally-friendly source of electrical power. Renewable Energy 1999; 16: 1251-1265.

[3] Riffat SB, Ma X. Thermoelectrics: A review of present and potential applications. Appl Therm Eng 2003; 23: 913-935.

[4] Nuwayhid RY., Rowe DM. Min G. Low cost stove-top thermoelectric generator for regions with unreliable electricity supply. Renewable Energy 2003; 28: 205-222.

[5] Weiling L, Shantung TU. Recent developments of thermoelectric power generation. Chin Sci Bull 2004; 49(12): 1212-1219.

[6] Min G, Rowe DM, Kontostavlakis K. Thermoelectric figure-of-merit under large temperature differences. J Phys D: Appl Phys 2004; 37: 1301-1304.

[7] http://www.customthermoelectric.com.

[8] http://www.ferrotec.com.