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Differential Evolutionary Algorithm for Energy Efficiency Improvement on Mobile Cloud Computing

M.R. Sudha[a] and M. Sornam[b]

[a]*Research Scholar, Department of Computer Science, University of Madras, Chepauk Campus, Chennai – 600 005 Tamil Nadu, India.*
E-mail: sudha.mr@ktr.srmuniv.ac.in

[b]*Associate Professor, Department of Computer Science, University of Madras, Chepauk Campus, Chennai – 600 005 Tamil Nadu, India.*
E-mail: madasamy.sornam@gmail.com, Corresponding Author

Abstract: This paper is focused on to improve the existing devices of function with a green initiative, such as solar energy, a Differential Evolutionary Algorithm is used to implement the reduction of energy to mitigate radiation. Green computing and energy efficiency improvement have been important and intense research topics in mobile cloud computing. Today, the momentous augment of mobile users and well-built business interests in cloud computing and services drive a developing prospects and needs in mobile cloud computing. This brings a new attention to energy saving in mobile cloud computing and services. Mobile devices are able to run entirely on the use of renewable sustainable energy. Almost everything nowadays is used and based entirely on mobile computing, which includes a smart-phone, laptop, tablet, smart watches, calculators and any other computing device. The main objective is to find greener ways to run the mobile devices concentrated with less radiation and more output.

Keywords: *Solar energy; mobile cloud computing; energy efficiency.*

1. INTRODUCTION

In our fast growing world of technology, advancements are being made almost every day, for a single software update, a mobile computer can run as almost like a new device. Imagining with the implementation of reducing the energy consumption and implementing efficient ways to improve and move a device better. Nowadays, a majority of the systems in place actively run software for you, but current algorithms are still developing to find the best, most suitable one to reduce its carbon footprint. Imagine the world where mobile computers are energy efficient, fast reliable actively making its memory, processing and graphics more intense with the use of a renewable energy resource such as solar implementation [1]. In 2013, Cisco's Index predicted mobile Internet data traffic to increase 13-fold from 2012 levels over a five year period as shown in Fig. 1. Even more significant, the index forecasts total mobile data to increase the compound annual growth rate (CAGR) of 66% across enterprise markets [2]. Tablet device sales were also jumping from 19 million in 2010 to 69 million in 2011, and an annual growth of 263%. The continuous increase in annual sales and the evolution of technology, it is reasonable to expect that shortly there will be an enormous amount of computing power available from tablets and smartphones all over the world.

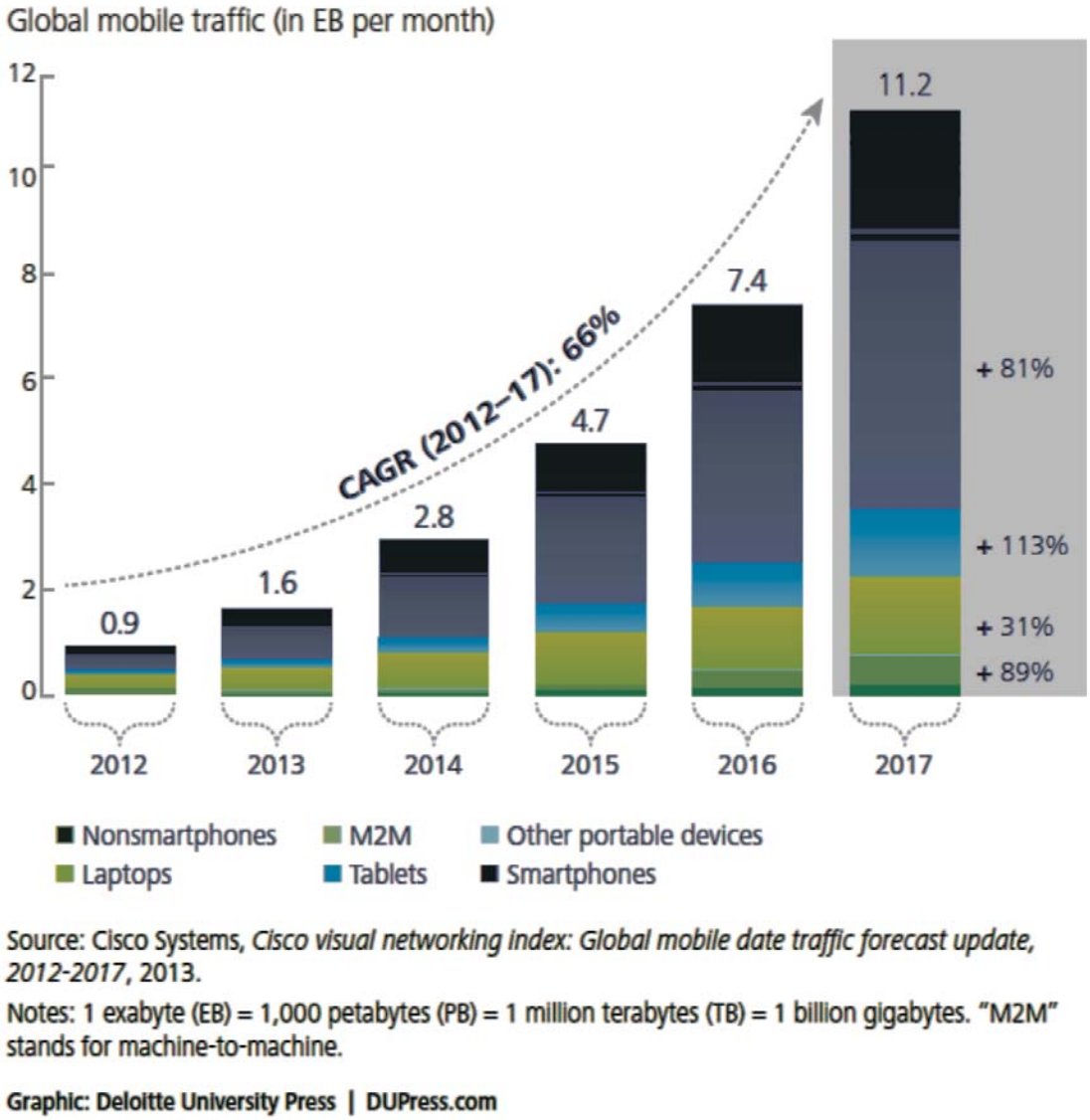

Figure 1: Mobile Cloud in Exabyte (EB) per month, global 2012-2017

Solar is the closest renewable resource, which has a lot of renewable advantages compared to wind/ water (which is currently becoming a scarce resource). This paper is structured as follows. Section II provides background and review of the literature on mobile cloud computing. Section III describes the solar powered mobile devices. Section IV describes that implementation way forward on a mobile computer with a greener side. Finally, Sections V and VI discussed that results, concludes and future directions for this research.

2. BACKGROUND ON MOBILE COMPUTING

Mobile Cloud Computing (MCC) is a technology that leverages unified elastic resources of different cloud network technologies functionality, storage, and mobility [3]. It provides a multitude of mobile devices anywhere and the channel of Internet of heterogeneous environments and platforms based on the pay-as-you-use principle. Researchers explained that the MCC is three foundations, namely cloud computing, mobile computing, and networking [4]. The amplify of mobile users is one of the driving forces for cloud computing service bring

to mobile users over the wireless Internet [5-7]. In 2008, InformationWeek reported that 78 percentage of IT organizations weren't responsible for tracking—or managing—datacenter power usage, while 75% of them received no compensation whatsoever for reducing their consumption [8]. The mobile devices are connected to the cloud-based resources dominantly through the risky channel of the Internet via the wireless medium, though an Internet-free connection to nearby or private resources is also possible. Therefore, the remote computing and data transmission completed in collaboration with mobile clients, cloud-based resources, and sophisticated wireless technologies. According to the classification of cloud-based resources, four possible architectures depicted in Fig. 2, can be reasonable for Mobile Cloud computing.

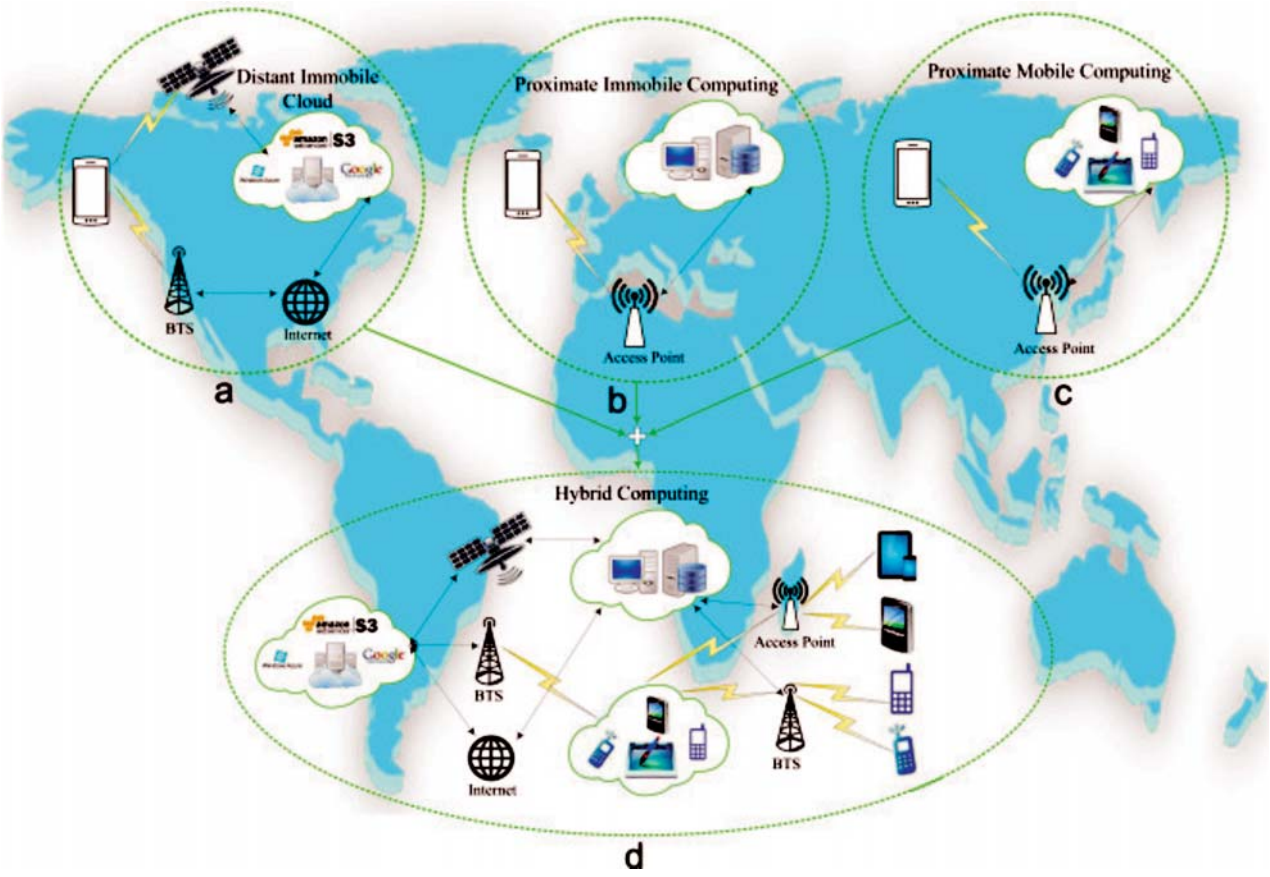

Figure 2: Four mobile cloud computing architecture models – (*a*) distant immobile clouds perform elastic computing, (*b*) proximate immobile computing entities near the user perform elastic computing, (*c*) proximate mobile computing entities in user vicinity perform elastic computing on behalf of user and (*d*) hybrid model converges varied types of cloud-based resources to perform elastic computing.

3. SOLAR POWERED MOBILE DEVICES

The target of the aim is to have a way of charging the mobile phone without using any regular electric plug. So we are using the traditional technology of solar panels. We want to include the solar panel on the back of a cell phone. But it is not something we add in the back of a mobile phone; the solar panel will be part of the phone. The sun rays will get in touch with the solar cells of the solar panels and the energy produced will be converting into electricity to charge the phone. The solar cells have to be fragile and light. The size (length and width) will depend on which phone the customer uses. Indeed, every phone on the market do not have the same size, so that make different sizes of solar panel (large product line) to fit each phone. From the beginning, commercially start with most modern phones, like I-Phones or Samsung.

A yield of 10% means that if 1000W from sun rays touches the cells, 100W of electricity produced. Indeed, the charger of a mobile phone only requires 5 Watts when charging. After trying different yield of solar cells, it has to take a panel of 6V. To prove this fact use a formula P=V*I with P power in Watts, V voltage in Volts, and I intensity (or current) in Amperes. So when the solar radiation is maximum (that means 1000W/m² = 10A), the yield would be P = 6*10 = 60W 6%. Using 6V cells means that even if the solar radiation is minimum, then mobile charging can be possible in any way. Given the fact that, if we need 5W only means we have to put a small resistance in the circuit to avoid short-circuit to happen. The product was first aware in China because of lower costs, especially labor cost.

Current mobile operating systems support the implementation of mobile client applications without paying much concentration to efficient mobile resource management. It includes applications running in the background, scanning for Wi-Fi network and synchronizing email account during the night when mobile users are sleeping. Many ad-hoc techniques are available to minimize draining of power by these applications. They are insufficient to save enough energy on mobile devices. Mobile computing is broken up into various explanations, but the simple one is a more human interacted way, in which a computer is expected to be transported through its usage and of its transmission of data via voice, message, the internet, etc. Mobile computing involves mobile communication and its hardware and software.

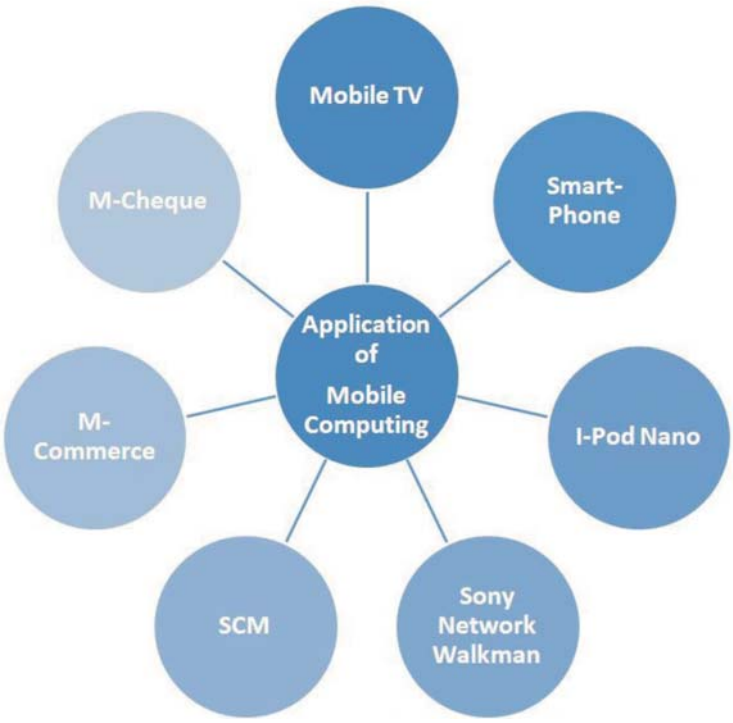

Figure 3: Applications of Mobile Cloud Computing

Mobile computing systems have large number of applications as shown in Fig 3 explains mobile computing has recently made Mobile TV which to make TV viewing on tiny cell phones easier and cheaper. A Smartphone is a mobile phone with additional computing functions such as SMS, MMS, E-Mail, Address Book, Web Browsing, Calendar, Bluetooth, Speaker Phone etc. An innovative application of mobile computing is the iPod-Nano from Apple. The Apple iPods made it possible to listen to one's favorite tunes anytime and anywhere. It can be also used for viewing photo albums, slide shows, and video clips etc. A green incentive can be any renewable form of energy and under careful analysis, solar power is best as its advantages, outputs and results was simply spectacular when implemented on a mobile device. As learned from a prototype of cloud-

based mobile service, the Stratus [9], a bundle of energy-efficient techniques are strongly required but still in suspense [10-11], such as, data aggregation to bunch up sporadic transmissions, asymmetric dictionary-based compression, and efficient algorithms for cloud selection and service replica sharing. Also in order to balance the tradeoff between communication energy and computing energy, more challenges are yet impending [12], like the effective estimation of computational requirements and QoS demands, energy-aware middleware for automatic decision between local and cloud processing, and the adaptive provisioning considering the dynamics of wireless links and user activities.

4. IMPLEMENTATION AND WAY FORWARD ON A MOBILE COMPUTER WITH A GREENER SIDE

Energy produced from the sun is the optimal method for electricity generation as it is available everywhere and sustainable renewable source. The most popularity technology is Photovoltaic (PV) technology in the current world.

The other alternative energy Resource obtained from the energy market. To make the PV energy most worthy and cost -effective, the primary task of the research community and industry is to improve the power efficiency of PV systems.

The parameter filtration of solar cell plays a vital role in the simulation and design calculation of PV system. In this paper, to moving to quick and appropriately filter the solar cell parameters, the proposed technique of Differential Evolution (DE) Algorithm is adapted. The single diode model of the solar cell explained as the foundation for the extraction problem. The analysis carried out using current-voltage (I-V) capabilities which focus that the innovated (New DE).

DE algorithm is a based linear algorithm involves the population vector of fixed-size randomly. This community explained by adopting mutation, crossover and selection operators. This process is repeated through the generations the stopping criteria, predefined maximum iteration or a satisfactory fitness value achieved. The algorithm aims to develop a new population by putting points in the current population with better points. A repeated process the population is guided towards the global minimum.

The steps of the DE algorithm are

BEGIN Algorithm

1. {Initialization}

   Create an initial population

2. Evaluate each individual in the population
3. Find out the vector with the lowest cost
4. While the termination criterion not reached do
   a) Mutation
   b) Crossover
   c) Evaluation and Selection
5. {Return}

   END Algorithm

Table 1 shows extracted parameters and RMSE value of DE are compared with GA and PSO. It is clear to observe that DE provides best RMSE value among GA and PSO.

Table 1
Extracted parameters using different methods for single diode model

Parameters	*DE*	*GA*	*PSO*
I_{ph} (A)	0.7508	0.7606	0.7518
I_O (μA)	0.3530	0.3545	0.3645
R_s (Ω)	0.036	0.035	0.033
A	1.32	1.45	135
RMSE	$9.86X10^{-4}$	$9.76X10^{-4}$	$9.5X10^{-4}$

Where

I_{ph} (A) – Cell generated photocurrent

I_O – Reverse saturation of current diode

R_s – Series resistance

Renewable energy resources are included in attention of recent years as alternative means of generating power in the world. The foundation behind this is for promoting serious contribution of environmental recyclable friendly resources like solar energy, wind energy, biomass, geothermal, hydro, wave energy etc in mass power production in many countries. The worldwide demand is of electric power with greater efficiency. Solar photovoltaic system is not only providing reliable and environmentally recyclable but also could feasible for rural and remote areas as an only source of energy. Solar photovoltaic is a semiconductor device that produces DC power when sunlight shines on the photovoltaic. It is static, and free of any gas or toxic emissions and so requires little operation and maintenance costs

The simple green computing incentive is the implementation of solar energy panels on existing hardware and implements the necessary software to revolutionize the mobile computers operating system. By manufacturing a customized solar panel, with panel enhancements and design made different from that of a conventional solar panel used in generating power for large systems (grids). By improving the algorithm of operating systems software, we can go a step further and implementing an algorithm capable of converting energy into productivity of computers software, with its hardware working hand in hand to show a powerful understanding of the complexity of a computer [13]. Simple tweaking the existing energy saver implemented on new computers, we can use a solar panel that will connect with a USB port of PC, which will then directly charge a mobile computers battery. For smart-phones and tablets, we can do the same but with a mobile solar panel, which is durable and strong enough to withstand elements such a wear and tear.

A solar powered mobile computer can and will have the power to revolutionize the IT industry, it will create a more sustainable and reliable device. This is what smart mobile users need. Imagine we stuck in a natural disaster and our mobile device is powered by light? This can go a long way in developing more advanced technology and help its energy consumption. The battery that would be charged has to be a long lasting, durable and reliable. It has to be continuously in the loop to cover all areas of energy. The battery has to be made of top of the range lithium with advance engineering. The battery has to be capable of converting the suns energy into kinetic energy/friction energy as shown in fig.4.

This can be converted into a mobile energy for mobile devices by simply creating the right module size, the lithium charged battery which can act as the charge controller and battery while the inverter will help in using the energy efficiently [14]. It has to be continuously operating for it achieves ultimate efficiency. To achieve that, we can do anything with the energy generated.

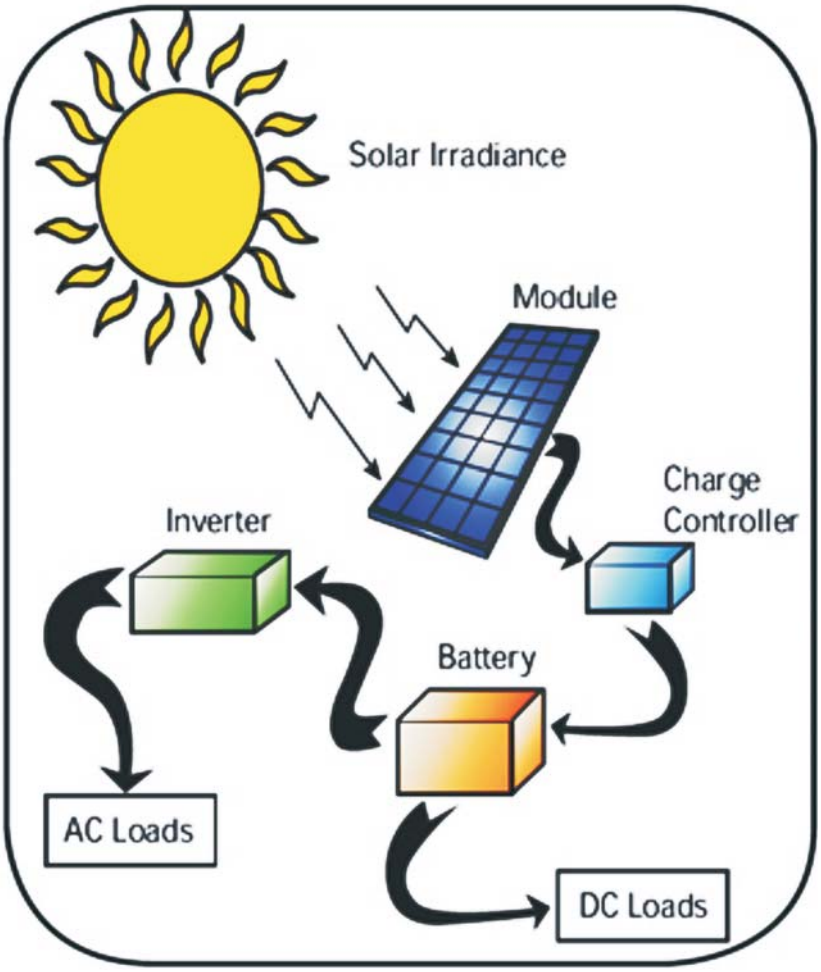

Figure 4: Solar panel changes its energy into useful energy (power)

5. RESULTS AND DISCUSSION

The major discussion that we have an implementation of process algorithm set up or how solar power is the suitable and sufficient energy providing. This understand that the application of the costs implicated in producing and analyzing solar panels in a micro-size way. The mobile devices needed to small solar panel systems. The performance of DE is assessed for extraction of single diode model of the solar cell and compared with those of GA and PSO.

A few ways that we are already achieving success in green mobile computing is as follows:

Development and improve the computer software to maximize the CPU output and input from energy intake. Performance and operation of renewable energy used in mobile computing is very attractive. Mobile technology equipment is generated more efficiency through the solar best power and battery performance. And implementing operating systems that are better and more advanced than before to cope with optimizing energy consumption and the ever-advancing computer Processes. Mobile cloud computing developments of globally innovative production based solar power networks and improving disposal recycling practices Green computing is already achieving success and continues with the ever growing world of technology [15-17].

6. CONCLUSIONS

Mobile cloud computing constantly updating, upgrading but the energy issue is still the problem. Starting one step at a time, anything is possible. Slowly but surely we can achieve our implementation of integrating a solar energy convert and panel on to a mobile device. It just requires intense study and understanding with the correct algorithm. Companies have to undertake conscious schemes to reduce the amount of energy consumed at the data hubs. The movement of less-energy-consumption was pioneered by Google by initiating eco-stable computing and innovating on use of renewable sources of energy. Google also joined hands with Climate Savers Computing Initiative to respond effectively to the emerging eco-issues in cloud computing. Experimental results established that the proposed DE method can capable to extort the parameters of single diode solar cell models accurately. The Differential Evolution Algorithm is provided more accurate and strong solution, attain higher achievement rate, and congregate faster. This can be achieved on a small platform but its large scale implementation will have positive rewards in our ever advancing world of technology.

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