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NANO LEAVES: A PATH TO SUSTAINABLE FUTURE

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Abstract

Energy resources are exhausting day-by-day. Now it's very difficult to find new energy resources. But if we make effective use of renewable energy resources we can definitely decrease the rate of utilization of non-renewable energy resources [1-4]. Some of these renewable energy resources are sunlight, wind and heat. In this paper a new way of generating electricity from nature is presented [2]. The energy system which is to be explained is solar botanic renewable energy system. The energy harvesting trees are super eco-friendly synthetic trees which make use of renewable energy from the sun along with wind power, are an effective clean and environmentally sound medium of gathering solar radiation and wind energy [4]. The artificial trees are implanted with Nanoleaves, a composite of nano-photovoltaic nano-thermovoltaic and nano-piezo sources transforming light, heat and wind energy into eco-friendly electricity [4-5]. This paper begin with an overview of nano leaves and Bio- mimicry concept.

Keywords- Synthetic, botanic Photovoltaic, thermovoltaic, piezoelectric, nanoleaf.

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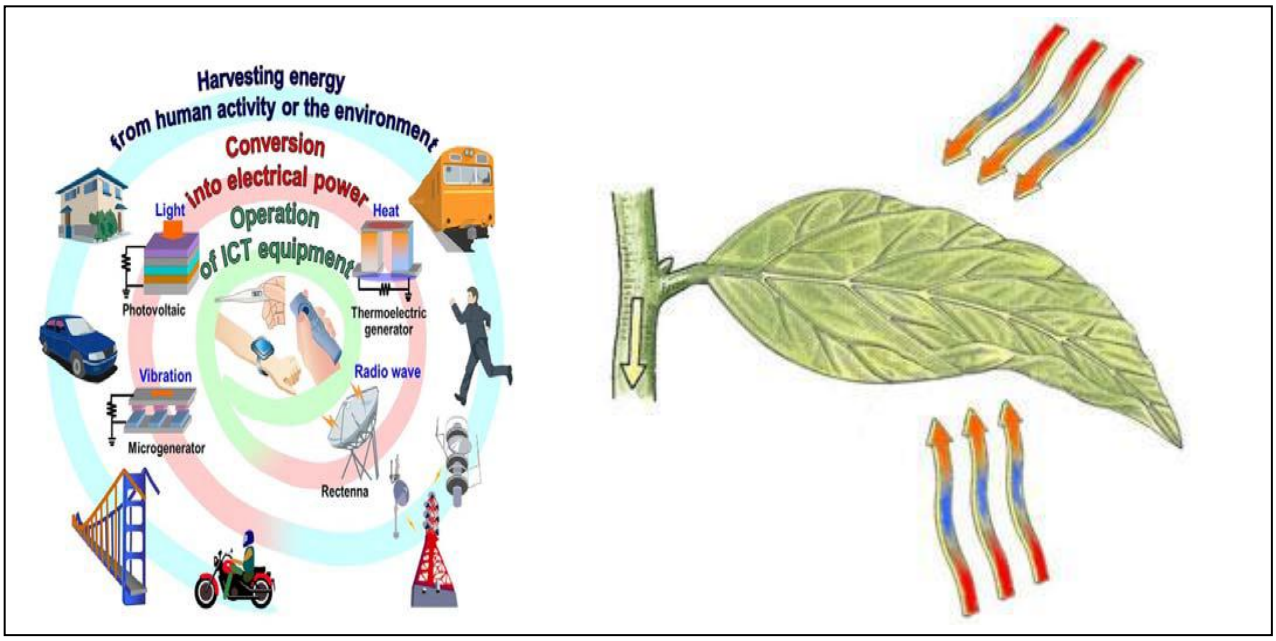
I. INTRODUCTION

Energy harvesting is defined as capturing minute amounts of energy from one or more of the surrounding energy sources, accumulating them and storing them for later use. Energy harvesting is also called as power harvesting or energy scavenging [1-5]. With recent advances on wireless and micro-electromechanical systems (MEMS) technology, energy harvesting is highlighted as the alternatives of the conventional battery. In the view point of energy conversion, human beings have already used energy harvesting technology in the form of windmill, watermill, geothermal and solar energy [3]. The energy came from natural sources, called renewable energy, is emerged as future power source due to limited fossil fuel and nuclear power instability such as Fukusima nuclear crisis. Since the renewable energy harvesting plants generate kW or MW level power, it is called macro energy harvesting technology [7-9]. On the contrast, micro energy harvesting technology is focused on the alternatives of the conventional battery[8]. Micro energy harvesting technology is based on mechanical vibration, mechanical stress and strain, thermal energy from furnace, heaters and friction sources, sun light or room light, human body, chemical or biological sources, which can generate mW or μW level power as shown in figure no. 1. Energy harvesting as an alternative technique that has been applied to solved the problem of finite node lifetime and it refers to harnessing of energy from the environment or other energy sources for converting it to electrical energy [10-12]. In this process the energy is collected from the environment. Examples of such energy sources include light, thermal gradients, vibrations, electromagnetic wave, etc [6-9]. One of the emerging nanotechnologies related to renewable energy is nano leaves and stems of artificially created trees or plants [5]. They are an emerging form of renewable energy through collecting energy from the sun and wind and converting it to electrical energy[1-2]. The leaves are distributed throughout artificial trees and plants, and when operating at optimum efficiency can supply a whole household with electricity[10-12]. They are intended to harness energy provided by the wind and sun, thereafter converting it into electrical energy as shown in figure no 2.



Source: http://www.fujitsu

Figure: 1 Overview of energy harvesting

Source: http://www.alt-energy.info

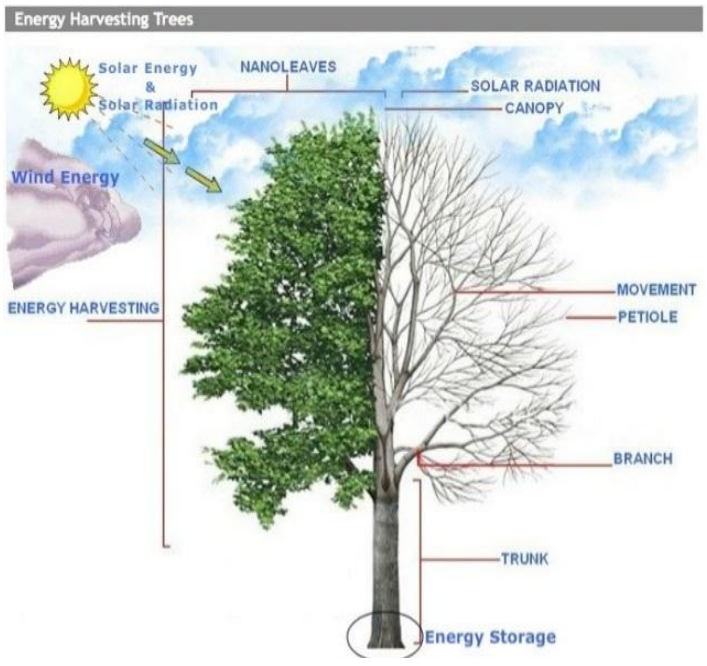
Figure: 2 Energy releasing from tree

II. USE OF NANO TECHNOLOGY

Nanotechnology is the combination of science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers at the nano-scale. 'Nano' in Greek means dwarf and material, when reduced to nano dimension (10^{-9} metre =1 nanometre) shows drastic changes in physical, chemical, magnetic, optical, mechanical and electrical properties [13-14]. This promises exiting applications in bioscience, medical science, polymers sector, environment, electronics, cosmetics, security and variety of other fields. Nanotechnology is a molecular manufacturing or more simply building things the size of one atom or molecule with programmed precision[14]. In the last decade nanotechnology became one of the high priority areas of funding in advanced as well as emerging economies primarily due to the 'promise' this technology demonstrated; of providing solutions in high technologies and also possibility of new pathways for mitigating pressing developmental issues Enormous energy efficiency by virtue of tiny size and enormous surface area per unit mass, enables nanoparticles to transform and revolutionize various fields of technology including aerospace, aviation, homeland security, national defense, energy, environmental improvement, information technology, medicine, transportation, biotechnology, agriculture etc[3-6].

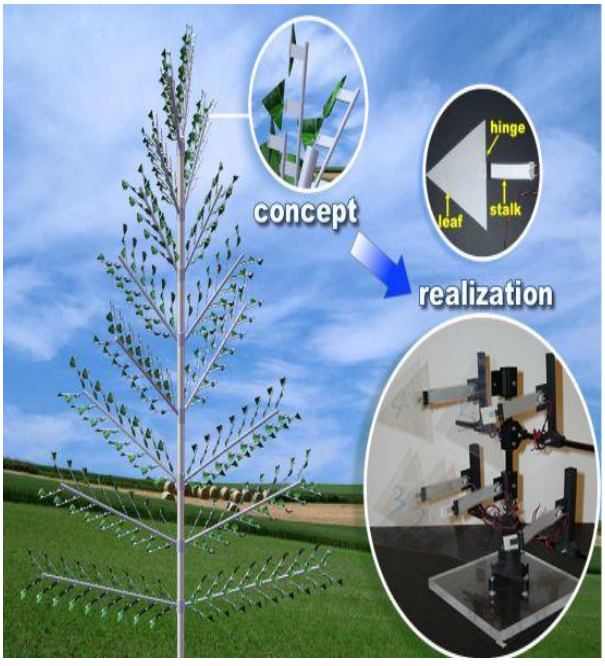
III. NANO TREE

Nano tree is an artificial tree which makes use of renewable energy from sun, wind and collecting solar and wind energy Generally artificial trees cannot carry out photosynthesis naturally [4]. The artificial tree will produce the electrical energy by using both (wind as well as solar) energies. Energy harvesting refers to scavenging energy or converting energy from one form to the other [1-8]. A widespread and popular technique of energy harvesting is converting solar energy to electrical energy[5]. Solar energy is uncontrollable—the intensity of direct sunlight cannot be controlled—but it is a predictable energy source with daily and seasonal patterns. Other techniques of energy harvesting convert mechanical energy or wind energy to electrical energy [4-9]. The high efficiency "nanotree" photoelectrode research enables practical H2 production or Volatile organic compounds (VOCs) remediation using PEC(photo electro chemical cell) with high efficiency by using earth abundant materials and low-cost fabrication figure no.3. This will have long-term, ongoing, positive impact on the most imminent energy and environmental issues - clean energy and energy sustainability, environmental remediation, and therefore, have great benefits to our humanity today and tomorrow[10-12].



Source :www.slideshare.net

Figure.3 Nano Tree



Source:www.greenoptimistic.com

Figure .4 Energy Harvesting "Piezo-tree" Concept

IV. BIOMIMICRY CONCEPT IN NANOTREES

Biomimicry is a developing science attempting to solve human difficulties by adapting and implementing nature's systems to human technology [6-7]. Biomimicry and Nanoleaf technology are intrinsic to each other. This is accomplished by way of the use of nature's design with synthetic trees, shrubs, plants and flowers all developed with nano-leaves engineered photo-voltaic (PV) cells. This emerging yet brilliant method of energy creation is both clean and renewable with a broad range of applications [2-6]. In biomimicry concept, trees are fitted with nanoleaves. The nano-leaves have been specially designed to imitate the natural process of photosynthesis (an organic mechanism by which plants absorb the light emitted by the sun and CO2 in the atmosphere, turning it into nutrients and oxygen). The artificial trees will even copy the natural recycling process of carbondioxide to oxygen conversion [6-8]. It is only recently that nano-leaves technology started to progress to even more advanced levels; It can now harvest thermal energy in addition to solar. The nano-leaves transform the whole solar spectrum of light; Converting detectable light, infrared and ultraviolet into electricity as shown in figure no 4. This works in conjunction with the piezo-electric generators that convert wind energy into electricity providing efficient, cost effective and attractive looking solutions, while providing the sustainable electric power [8-9].

V. Overview of Nanoleaves Technology

Solar Botanic's artificial leaf called the "Nano leaf". A very thin photovoltaic film on one side of Nano leaf converts the light from the sun into energy. On the other side of the Nano leaf thin thermo voltaic film converts the heat from the solar energy into electricity [3-4]. Small amounts of piezoelectric power are generated by stalks connecting to a branch. Nano leaf is thin like a natural leaf and the wind outside forces pushes the Nano leaf back and forth, and in petiole, twig and branches mechanical stresses appears [2]. When thousands of Nano leaves flap back and forth due to wind millions of Pico watts are generated. Stronger the wind and more energy is generated. A small part of the sunlight is reflected by Nano leaves that strikes them. Rest of the spectrum and the green light is efficiently converted into electricity [3]. Nano leaves converts the visible light and invisible light, known as infrared light or radiation, which can feel only. In Nano leaves has unique combination of photovoltaic and thermo voltaic and converts thermal

radiation into electricity. Solar Botanic's Nanoleaves create electricity in three ways as shown in figure no.5:

1. Nanophotovoltaic generators in the leaf directly convert solar energy to electricity.

2.Nanopiezo generators can also convert wind energy in to electrical energy.

3.Nanothermoelectric cells convert solar heat to electricity.

VI. METHODOLOGIES

Instead of causing problems for the environment with the abundance of carbon footprint, we should come up with some practical solution to clean energy sources have become appealing [3]. Solar power keeps the surrounding cleaner and healthier [4]. Photovoltaic cells that harness the solar power is an attractive option for capturing light and generating power. The nano-technology was initially developed to harness solely solar energy. However, nowadays it has widespread uses [5-7]. It exploits various alternative sources of energy like wind, solar and thermal energy. Furthermore, these highly advanced artificial plants and/or trees use tiny cells to capture energy:

A. Thermal Energy: This is captured through the use of thermo voltaic (TV) cells which convert thermal energy into electricity by using semiconducting materials (a material which is between a metal and an insulator; its conductivity increasing with temperature rise)[7-8].

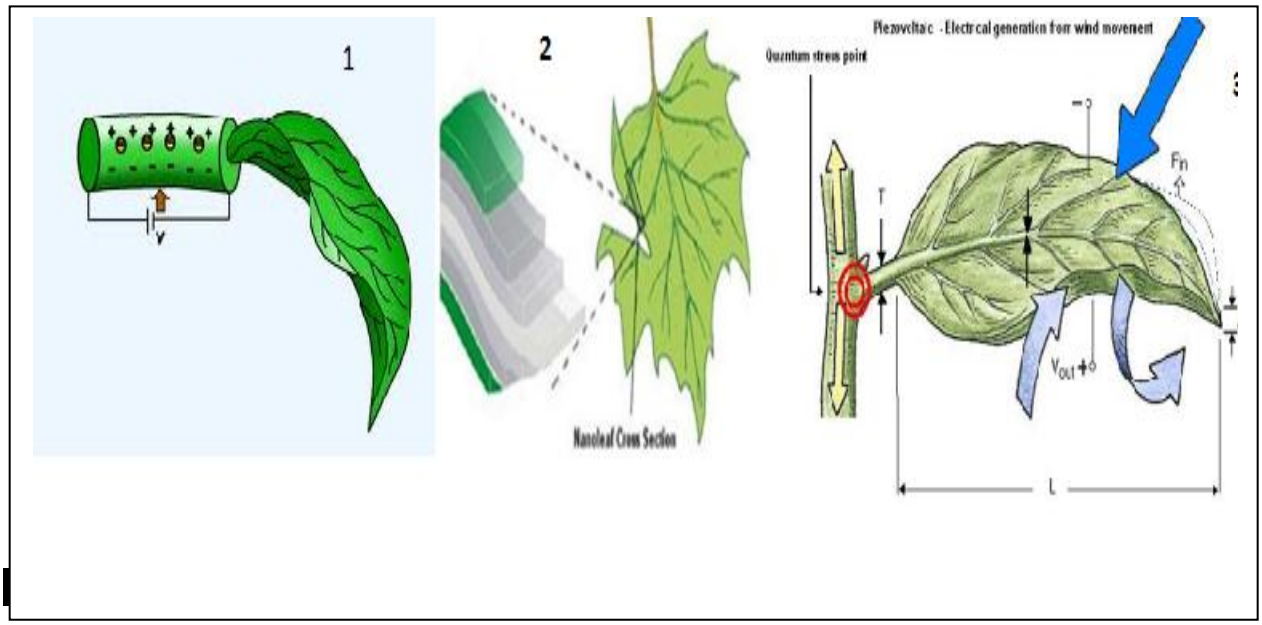


Figure 5. Different ways to create electricity

B. Light Energy : There are also tiny photovoltaic cells (PV) incorporated in the nano leaves. These small PV cells capture the light rays emitted by the sun. The light is then converted into electricity [7].

*C. Kinetic energy :*Kinetic energy is harnessed through movement. The wind produces motion in stems and branches. This motion is collected via piezovoltaic (PZ) cells. The PZ has semi-conducting devices incorporated into the artificial structure of trees and plants. The PZ and the semiconducting devices convert typical wind energy (kinetic energy) into electricity[8-9].

VII. PERFECT TREES FOR NANOLEAVE TECHNOLOGY

Two main kinds of trees are used in this technology.

A.The Broad leaf Trees: The Broad leaf Trees can provide between 33500 KWH AND 7000KWH per year, in addition to providing shade, breeze, and beauty[1-4].

B. The Solar Botanic Trees: These Trees provide between 2500kWh and 7000kWh per year. These trees are good for mountainous regions and hill sides, as they provide good sound absorbers. Solar Botanics has also planned a variety of smaller artificial shrubs for your smaller electrical needs, like appliances. Solar Botanic has Nano leaf roof and wall carpets that can be easily installed with various leaf designs [6-7].

VIII. COST ANALYSIS

As far as we concern about the cost of one nano leaf, it is around 105 paisa. So if a tree is having 10,000 leaves then it can be constructed within Rs.15, 000 including stem and twigs. Thus for the renewable energy sources it is a very cheaper solution[4-6].

IX. PRODUCTION ANALYSIS: As we go for the production its one leaf can produce 1.25 V with a current of 100mA [7-8]. So the total power produced by the one leaf Power = 1.25*100 =0.125W as shown in table 1.

Table1. Quantity Produced from the tree

Sr.No	Quantity	Current	Voltage	Power
1.	One leaf	100mA	1.25V	0.125W
2.	One tree	……..	……..	12500W

X. CONCLUSION

The Energy Harvesting Trees are multifunctional, efficient, renewable energy system [4-5]. These super eco-friendly synthetic trees will make use of renewable energy from the sun along with wind power, which are an effective clean and environmentally sound medium of gathering solar radiation and wind energy [4-7]. Using such technology, power producing solar products could be applied to just about any surface downtown or anywhere. This is a new technology to harness the renewable energy [8]. With the progress in nanotechnology, the photovoltaic, thermo-voltaic and piezoelectric materials are becoming more efficient and combined in one system which will lead to implementation of Energy Harvesting Trees sooner.

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