RENEWABLE ENERGY SOURCES FOR BIOMEDICAL APPLICATIONS

Abstract

In this chapter the brief discussion about different types of medical devices which uses renewable resources has been discussed. In our current scenario medical devices plays an very important role in a variety of medical aspects such as diagnosis and treatment. But the main challenge the hospital industry faces the power consumption because in order to maintain specific environmental conditions for safe handling end equipment's and delicate lab equipment require uninterrupted energy flow and hence Pharma Industry are now looking for renewable energy resources. In this article the brief discussion about different ways of extracting energy resources and the various design and circuitry for developing such model and the successful implementation of those products in medical field.

Keywords: Renewable Resource; Medical Devices; Uninterrupted Energy Flow.

Authors

S. Shobha Christila
Assistant Professor
Department of Biomedical Engineering
Hindusthan College of Engineering and Technology
Coimbatore, India
christilashobha@gmail.com

Dr. S Saravana Sundaram
Professor and Head
Department of Biomedical Engineering
Hindusthan College of Engineering and Technology
Coimbatore, India
bmehod@hicet.ac.in

I. INTRODUCTION

Environmental bio-energy harvesting (EEH) is a means of powering biomedical devices by scavenging many low grade ambient energy sources such as infrared, solar and wireless energy transmission, and their conversion into useable electrical energy to power the implanted devices. EEH devices are therefore potentially attractive as replacements for implanted batteries. They also hold the promise of one day enabling the powering of a range of implantable and wearable medical devices.

In the current world scenario renewable energy resources based medical equipment's plays an very important role to provide clean energy. For example solar based technologies can be applied in healthcare facilities. But the main advantage of using these kinds of systems provide low carbon di oxide emission. the various forms of renewable energy sources includes solar, geothermal and wind

II. METHODS

1. **Solar based autoclave:** Autoclave is used to sterilize medical instruments and equipment's .in the autoclave process the medium is exposed to saturated steam at higher temperature. But the main disadvantage lies in the fact that the autoclave needs high power and hence high energy consumption for continuously running the autoclave.

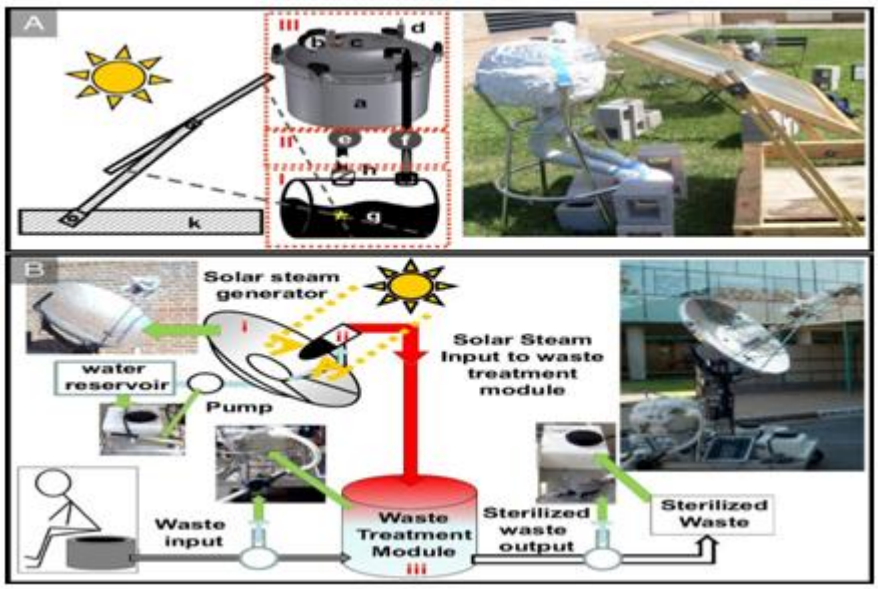

Figure 1: Solar Autoclave

In this method we uses light absorbing particle as the source of heat generated for example., carbon, nanoshell, metallic nano shell converts solar energy to steam. But the main advantage of using nano based material they have the tendency to be in a neutral state such that neither it will not get evaporated nor get destroyed by steam process .In one method strong localized photo thermal process creates a nucleation sites with increase in temperature, in another method sustained illumination bulk fluid heating

occur because of prolonged exposure to sunlight the two principle production techniques are interlinked in such a way that steam energy will be generated.

Solar based blood pressure monitor: The renewable energy sources such as solar based methods are the need of our generation because in rural areas people cannot afford constantly for electricity and batteries. The main decision parameter for BP measurement is the systolic blood pressure measurement hence this solar based BP monitor measures the systolic pressure accurately. the main advantage of using this device is that it eliminates the use of mercury which is hazardous to the environment.it uses rechargeable sunlight powered batteries making it ideal for rural areas .the battery provides more than

2. **Solar based thermometer:** Temperature measurement with solar energy works completely without batteries and has small solar cells that take over the power supply of the thermometer once it has charged fully it can be used continuously for 3 days. the main component present inside the thermometer is the gold cap condenser which can take upto 25 readings with one energy transactions. The additional advantage of using this thermometer is that they can also be installed in any appliances and can able to sense the temperature of the equipment.

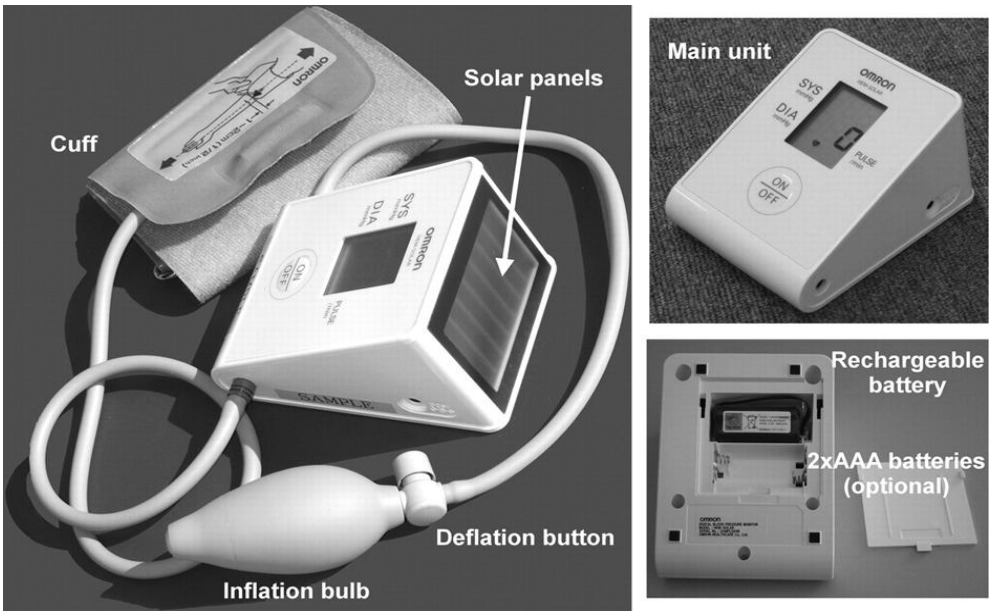

Figure 2: Solar Powered Blood Pressure Monitor

In the solar microscope a lightening device with a solar power supply is used. The solar power supply consists of a solar cell panel, a connecting bolt, a switch, and LED. The LED are arranged in outer shell, a battery, a boosting device, a switch, and LED. The LED are arranged in outer shell and they have connected with solar cell panel which is arranged at the bottom surface .The main objective of using the solar microscope that it replaces the use of reflector of a microscope so as to realize bright light source and two modes will be present like the daytime and light time so that the observation is clearer.

Two parameter have to be considered while designing power generation:

Module power conversion efficiency: It is the % of electrical energy converted from 1KW of light energy per/m2 (10.76 ft2) of solar module.

Module power conversion efficiency (%)=Maximum output of the module(W)X100/Area of the module (m2)x100(W/M2)

Cell power efficiency: It indicates the power conversion efficiency (%)=output of electrical energy/incident light energy

3. **Solar powered pacemaker:** A pacemaker is a device which uses electrical impulses to control abnormal heart rhythms .The pacemaker will have a battery with long life period and it should be replaceable when depleted .There are so many risk and complications involved that added stress for the patient .In this method near IR light is used because it aids good skin penetration .Thus in this method the implanted materials will be exposed to light energy which is preferably placed underneath the skin percutaneously and the light that protrudes through the skin layer falls on the solar cells which can act as the detector and converts the light energy into electrical energy.

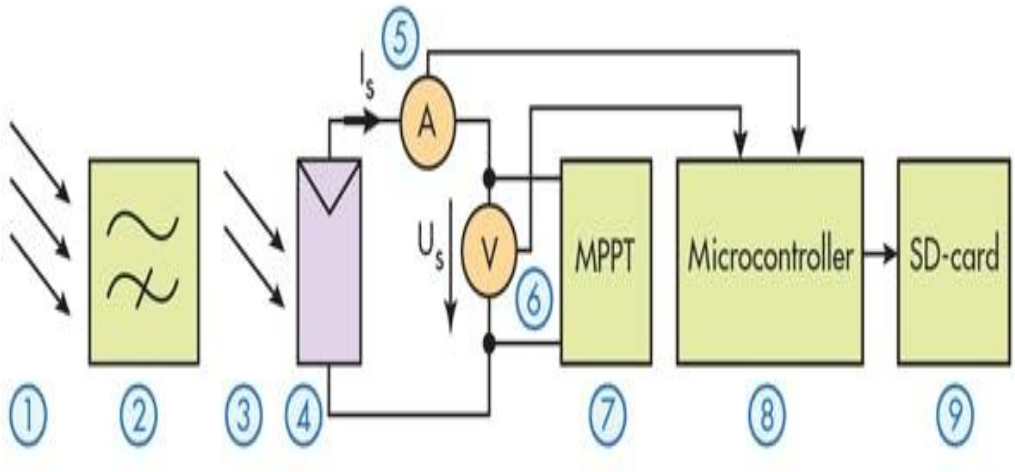

Figure 3: Solar powered pacemaker

- it is the ambient light
- optical fibre attenuated by light
- solar cells gets radiated
- grid arrays
- voltage and current circuit for monitoring purpose

Another method of solar pacemaker uses the tiny solar cells and the laser light principles. In this it has a flexible mesh out of silicon that when activated by flash less of light creates a tiny electrochemical effect that encourages the heat to beat.

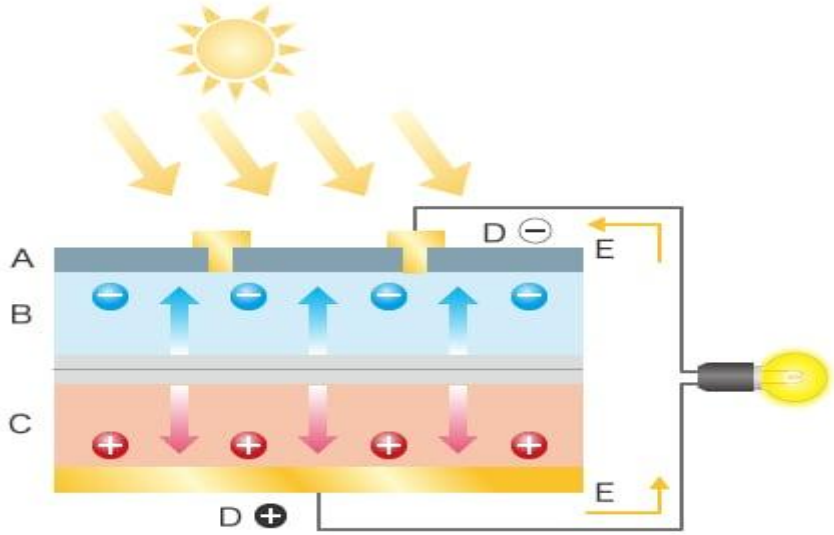

Figure 4: Solar Powered Pacemaker Using Laser Principle

4. **Alternative energy resources for inseminate medical equipment's:** Inseminate medical devices produces electrical energy generates power by extracting energy from surroundings. In usual practice inseminate medical devices are powered by external method where external wires are used but the disadvantage of using this method they causes skin infections ,discomfort and other dangerous hazards to the patient .So the next alternative for wires is batteries which provides power to the inseminate medical devices. But the batteries suffer several setbacks such as limited lifetime, power and chemical hazards .Thus the problem solving methodology for those setbacks are closely analysed by the researchers and they came up with alternative energy resources as the good solution for all these setbacks. So the alternative energy resources have greater lifetime and it is very safe for the patients. The best technique which can trap alternative energy is using wireless sensor which can trap energy from the surroundings.

   Inseminate devices are divided into two main systems, the first method involves the energy that can be obtained from the human anatomical systems and the second method involves the energy getting trapped from the surroundings.

   Implantable battery has lots of side effects having stable energy with no alternations, easily depleted, chemical hazards and bulky size. So researchers are working on energy efficient, longer lifetime, comfort and safety conventional devices .The sources from which we can trap or harvest energy such as heat sources, movable motion sources,non wired sources and electromagnetic energy resources.

   Electrical energy can be trapped from kinetic method including ultrasonic method, magnetic induction generator and electrostatic methods. The piezoelectric effect make use of the mechanical strain which produces an electrical polarization.in Massachusetts institute of technology they have illustrated a concept in which human motion into energy which can be used to operate wearable electronic applications. This kind of prototypes will have an piezeoelectric elements on toes and shoes and they will generate electricity of about 8.3MmW and 1.3mW and in another method the sensor is

compressed and placed on the heel of a boot. Sieko kinetic approach, in this method the heart beat of the patient is used to power the inseminate pacemaker battery

Figure 5: Magnetic Generator Adapted in a Shoe

5. **Thermal energy based devices:** Using See back Effect (i.e) temperature difference minimal power generations can be done. The various applications such as implanted nerve and stimulators, cochlear hearing replacements and for wireless patient diagnostics. This concept implies the fact that hot and cold junctions when created causes the voltage generation across the thermocouple.

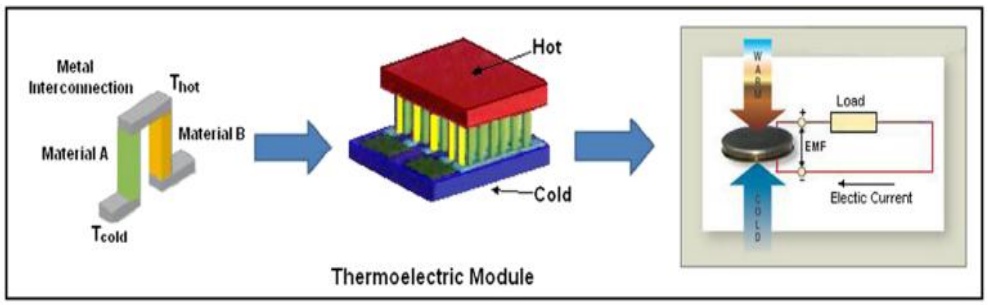

Figure 6: Thermoelectric Module

REFERENCES

[1] Mahammad A Hannan, Saad Mutashar, Salina A Samad and Aini Hussain," Energy harvesting for the implantable biomedical devices: issues and challenges", Hannan et al. BioMedical Engineering On Line 2014.

[2] M. R. Zulfikar Fajar, S. Hadiyoso and A. Rizal, "An interfacing digital blood pressure meter with arduino-GSM module for real-time monitoring," *2017 International Conference on Control, Electronics, Renewable Energy and Communications (ICCREC)*, 2017, pp. 98-102, doi: 10.1109/ICCEREC.2017.8226669.

[3] Ituna-Yudonago, Jean-Fulbert, et al. "Review of solar-thermal collectors powered autoclave for the sterilization of medical equipment." *Alexandria Engineering Journal* 60.6 (2021): 5401-5417.

[4] Haeberlin, A., Zurbuchen, A., Walpen, S., Schaerer, J., Niederhauser, T., Huber, C., & Vogel, R. (2015). The first batteryless, solar-powered cardiac pacemaker. *Heart rhythm*, *12*(6), 1317-1323.

[5] Koutroulis, Eftichios, and Kostas Kalaitzakis. "Development of an integrated data-acquisition system for renewable energy sources systems monitoring." *Renewable Energy* 28.1 (2003): 139-152.

