

SOLAR ECG WITH LI-FI AND EDR TECHNOLOGY

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ABSTRACT

The cardiovascular (CV) crisis is glaringly evident in developed as well as in developing countries. Both the urban and rural areas are experiencing a mounting epidemic of cardiovascular disease, which was until recently considered a disease of the 'urban rich'. Based upon statistics by the World Health Organisation in 2008, approximately the total number of deaths due to cardiovascular disease read 17.3 million a year. An Electrocardiograph (ECG) is a device that diagnoses and detects heart abnormalities, which measures electrical potentials on the surface of the body and creates a record (electrocardiogram) of the electrical currents associated with heart muscle activity. To reduce dependence on electricity, solar powered ECG machines are introduced which has a microchip that records patients' details in it. Li-Fi is used to transmit the data obtained from the microchip through a light source (as Wi-Fi emits radio-waves which is harmful and is not permitted in health centres) and send it to any display device (tab, mobile, laptop etc.) through micro LED bulbs.

Keywords- Solar ECG, Application/Software, EDR, Li-Fi, LED, Li-ion battery, Cardiovascular Disease (CVD)

I. INTRODUCTION

This paper focuses the urgency currently faced by people in rural and disaster prone areas where electricity supply for 24 hours all the days in a year is a mighty challenge. The need to switch towards nonconventional forms of energy, especially solar is the need of the hour.

Heart related diseases is a major concern for people of 21st century as competition, pressure and irregular as well as unhealthy diets have become a trend for people with all economic backgrounds. The need to eliminate cardiovascular diseases is an alarming issue for doctors across the globe.

Another important aspect is to store the ECG data and to reduce dependency on doctors and health practitioners by developing an application which will be self-explanatory to tell a person if his/her heart is in a proper condition or not.

Keeping the above factors in mind it is crucial to prepare an ECG device which will run on solar power and also transmit data into application to inform the patient about his health condition and also make self-smart and efficient.

II. PROPOSED MODEL

System overview:

The model as proposed consists primarily of Solar Panel, Charge controller, Li-ion battery, ECG machine, Li-fi transmitting technology and application/software for a display device.

The solar panels when exposed to the solar light radiation generate electricity. This electricity is directed to a Li-ion battery through a charge controller which in turn powers the ECG machine. The ECG machine measures the electric potentials across the surface of the body and records the cardiovascular activities. The Electro Cardiogram so recorded by the ECG machine is then transferred to any display device (For eg., mobile phone, PC, tablets etc) using

Li-fi transmitting technology. An application/software present in these display devices displays the patient's relevant information regarding the functioning of the heart.

Fig.1 describes the set up of the system.

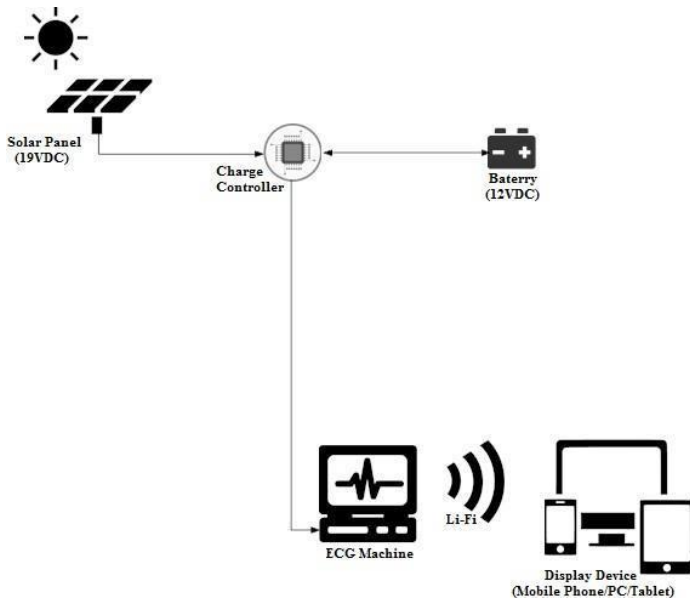


Fig.1

(i) Solar Panel

The solar panels form the input source of electricity. 40W, 19V panels are recommended to be used. These power the ECG machine. The panels also charge the Li-ion batteries which act as a backup for power generation at night or at times when the solar panels cannot produce electricity. The reason why the input power is being derived from the solar panels instead from the grid is that this project is focussed mainly on rural areas. In India, 70% of the population live in the rural areas out of which 49% have no access to electricity. Sun is a free source of electricity and it is available in all corners of the country. On an average, every village/town/city in India receives 300 days of bright sunlight in a year. Also, this project focuses on times when disaster strikes. Most of the time after any disaster, power services are disrupted. This device would be portable enough to be easily carried in a mobile van and since it is powered by the sun, disruption of power supply after the disaster won't affect it. Also solar power is a clean source of electricity and doesn't cause any carbon footprint. With the rapid depletion of fossil fuels, renewable energy resources such as solar energy would be powering our daily life activities.

(ii) Charge Controller

For overall safety mechanism of the battery (Liion) the charge controller sets limit at which electric current is either added or squeezed from electric batteries. Not only this helps to check overvoltage, but also overcharging as it might pose safety risk. The charge controller device also checks battery draining as all these factors give better life span to the Li-ion battery and overall performance of the device to execute maximum possible efficient results.

(iii) Battery

The battery that is being proposed to be used here is Li-ion battery. The Li-ion battery possesses high energy density and is also rechargeable in nature. When compared with Lead-Acid batteries, Li-ion have lower selfdischarge rate and also lesser in weight. The ease of use makes it more approachable. Li-ion batteries are less costly than Lithium Polymer batteries; as a result it does not increase the cost of the overall project. Fig.2 shows a cell voltage to battery percentage comparison graph between various types of batteries.

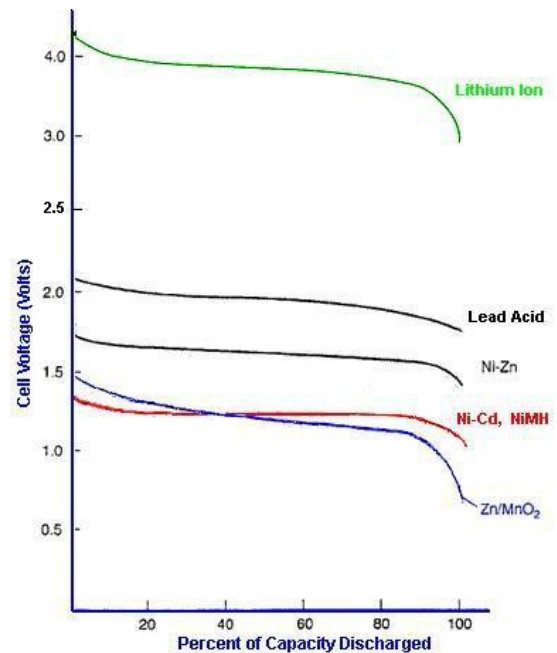


Fig.2

(iv) ECG Machine

ECG machines form the crux of the model as it measures cardiovascular activities. The ECG machine derives its input power from solar panels and would work on DC supply thus eliminating dependence on electricity from the grid. Since the ECG machine can work on DC supply, the need of converting it into AC is eliminated and thus making the device less bulky and hence light weight which is ideally portable. The proposed ECG machine will have Enhanced Data Recording (EDR) technology which would allow it to record the ECG of various persons and keep it in storage for accessing it later, Also it shall send the same to a display device such as mobile phones, PC, laptop, tablet etc through Li- Fi transmitting technology. The electrocardiogram so generated will be displayed on the display device with the help of a supporting application/software.

(v) *Li-Fi Transmitting Technology*

Light Fidelity (Li-Fi) is similar to Wi-Fi, except it uses light source for transmission of data. The data can be pictures, videos or any other document or files. Here the data would be the Electro Cardiogram recorded by the ECG machine. The reason for usage of Li-Fi over other modes of data transmission is: -

- Faster than Wi-Fi or Bluetooth®
- Radio waves(which is a mode of transmission in Wi-Fi or Bluetooth® technology) can cause radiation problems to patients and hence are banned in many hospitals. Li-Fi uses light to transfer data. Light causes no harm and doesn't possess any radiation exposure concerns and hence Li-Fi can be seamlessly used in hospitals and particularly for this project.

The best form of light transmission can be made via micro-LED source of light.

The data through Li-Fi is transmitted to the cellular or any other display device. For the present scenario as of April 2017, since no regular mobile device, PC, laptop, tablet houses inbuilt Li-Fi receiver, use of a separate Li-Fi receiver is suggested which would in turn send the data to these devices.

(vi) *Application/software*

The display device which would display the ECG data needs to have a supporting

Application/software to work with the Li-Fi as well as displaying the data. The application/software upon receiving the patients ECG diagnosis shall show the report. It will also be self-explanatory to inform the patient whether or not his/her heart is in a proper condition or not. This helps in rural areas where doctors might not be available at all times to detect the faults in a person's ECG.

III. ADVANTAGES

1. Since the input power of the project is Solar powered it reduces the stress on electricity generated from grid. Also sun is a nonconventional form of energy thereby it is everlasting and the fear of depletion is not there.
2. The ECG machines are better equipped with SD cards; as a result recording of the person's ECG shall be done and can be preserved for longer span of time.
Also, data storage and recording would be a much faster process.

3. The application/software described in this paper focuses the increasing reduced dependency on health practitioners and doctors as the App. is user friendly and needs minimum knowledge to decipher the person's cardiovascular condition.
4. Recording facility is a new trend as the chance of losing any patients data significantly reduces when a new patients ECG is taken,
5. As the data is transmitted by means of light source, transmission is fastest, and cheaper as well.
6. The Application/software is user friendly thereby people with less technical knowledge shall not hinder in understanding the diagnosis of the cardiovascular problem.

IV. CHALLENGES

1. Even though the initial cost of the device might be higher, however the running cost shall be very low as solar power is free to harvest and light source will of minimal charge. Also, The cost of solar power has fallen drastically such that in many countries, it is less expensive than electricity generated by traditional fossil fuels from grid.
2. Solar power device will not work to its fullest potential during clouds, night time or when sun light is not available. To avoid such problems Li-ion batteries are proposed for utilisation. These powerful batteries support the system when such difficulty arises.

V. CONCLUSION

The proposed device shall set a new benchmark in the field of medical science as it tries to overcome the challenges faced by the present ECG devices. People from all sectors, all aspects of life, and all economic background are facing heart related issues, this machine will be a boom in rural as well as disaster prone areas. The device shall be portable and can be carried by mobile medical vans which can diagnose in remote areas. This Solar ECG along with EDR technology reduces paper work of patients as it makes more people rely and dependant on technology. This

machine will serve the needs of doctors and also reduces their stress as the application/software for display devices will act as an interface between the patient and the doctor. Especially in third world countries this ECG device will be of immense help to people.

VI. REFERENCES

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