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Wearable Smart Band for Heart Rate Monitoring and Charging Electronic Pacemaker

Besia Baby
B. Tech Bio Medical Engineering
Bharath Institute of Higher Education and Research (BIHER)
Chennai, Tamil Nadu, India

Abstract :- Wearable smart band is a wrist watch modeled device that can be used in determining the heart beat as well as for charging the electronic pacemaker. Wireless devices are a common trend in today's world, where mini to macro devices has got cordless charging facilities. When coming to pacemakers placed inside the human body, it becomes more difficult to recharge the device once its battery percent goes down. Moreover, it is highly hazardous to life if the working of the pacemaker is not checked at regular intervals. In order to overcome these obstacles, a monitoring device for pacemaker is needed for health safety. This system can achieve an end to end power efficiency of about 82.2% with 15W power supply to the heart. The wearable smart band is a device that is worn around the wrist and it determines the heart beat of a person as well as it can be used in charging the pacemaker by means of mutual induction through Transcutaneous Energy Transfer. It also notifies the patient when there is any error in the working of the pacemaker on its LCD display.

***Keywords:-** Pacemaker; Cordless Charging; Mutual Induction; Transcutaneous Energy Transfer; LCD*

I. INTRODUCTION

Electronic Pacemakers are devices used in normal functioning of the heart when the sinoatrial node fails to transmit electric signals for the proper heart rhythm for blood circulation. According to FDA reports from United States of America on 26th September 2016, 0.46% of pacemaker failures are reported and 1.3 malfunctions per 1000 persons per year are registered in which the lead failures are not included. These are caused due to lack of periodic monitoring.

Electronic pacemakers are mechanical pumps that work under the principle of Inductive Power Transfer. This system consists of two components: an external wearable device and an internal mechanical heart valve. For charging a pacemaker, an external cordless battery is used that transmits the power by mutual induction through Transcutaneous Energy Transfer. The wearable wrist band determines the working conditions of the pacemaker and its battery level. When there is a drop in battery percent, a notification is received by the patient on the LCD screen of the band so that he could charge the pacemaker by bringing the band close to the area where the pacemaker is implanted.

II. METHODOLOGY

A. Heart Beat Sensor

A heart beat sensor works under the principle of light phlethysmography. Heart beat is monitored in seconds with respect to the amount of blood flowing through any organ of the body that changes the light intensity of the organ. The normal heart rate of a person is 60-80 beats per minute. Here, the heart beat sensor is placed in the external wrist band of the device. The outputs are displayed on the LCD screen of the wrist band.

B. Mechanical Pump

A mechanical pump is a device used to give failing heart a boost, which is placed in patients waiting for heart transplant. These pumps functions as ventricular assisting devices and can function effectively for years. It is awarded the most promising research in the field of artificial pacemakers.

C. Transcutaneous Energy Transfer System

A Transcutaneous Energy Transfer system is a standalone device used for powering high power implantable devices such as artificial pacemakers. It uses a half-bridge energy injection resonant converter that powers the implanted mechanical pump. The efficiency of this will depend on the thickness of the surgical implant position.

D. Primary And Secondary Power Transfer Coils

There are two types of coils used for the purpose of transferring power. Here, the primary coil is placed in the wrist band whereas the secondary coil is placed inside the artificial pacemaker that is placed inside the body. It has a diameter of 55 mm and 65 mm respectively. The weights of these coils should be of minimum 60 grams for the primary coil and 45 grams for the secondary coil.

E. Field Effect Transistor

This transistor is used to control the electrical behavior of a device with the help of electric field. A Field Effect Transistor performs single carrier type operation. The conductivity between the two objects is regulated by the

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electric field of the device produced by voltage difference between the body and gate of the device.

III. PROJECT OVERVIEW

A. Block Diagram

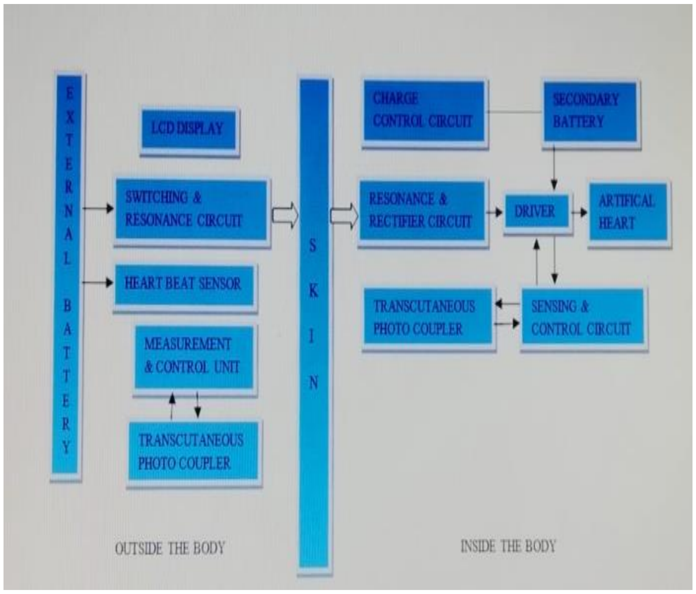

Fig 1

B. Working

The given block diagram is developed to monitor and supply power for the implanted artificial pacemaker. Here, the proposed device is composed of an external power converter with a delivery coil and an internal power receiving coil with its power conditioning circuit. A current limit controller is used to limit the overcharging of the device. The feedback of the implanted device is obtained through radio link of frequency 2.4GHz. A threshold value is set for the heart beat sensor. When it declines below 40 bpm, the wrist band gives a notification that the heart is functioning poorly due to low battery level or device malfunction. Therefore, the patient can charge the device using the wrist band charger. If the notification comes further, the patient can determine that the device is damaged and seek medical assistance before further complications.

IV. CONCLUSION

The operating conditions for the stand alone system is highly demanding in terms of power level, degree rise in temperature of the surrounding tissues,coupling variations and heat. Despite of some coupling variations, the proposed system has a capability of giving 15W power to the implanted pacemaker and helps in monitoring its function in periodic intervals of time. The system can achieve a power efficency of 78.7% to 82.2%.

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