

Design and Analysis of Rechargeable Pacemaker

Ankita Barapatre¹ Sachin Dhasal² Dnyanesh Lohar³

^{1,2,3}Department of Biomedical Engineering

^{1,2,3}Yadavrao Tasgoankar Institute of Engineering & Technology, Bhivpuri Road, Karjat India

Abstract— life saving medical device like pacemaker being used to implant in the patient suffering from heart problem, but after some years of implantation their batteries get discharge and patient had to undergo frequent surgeries to replace battery. To overcome these surgeries, we have designed rechargeable pacemaker in which MAX756 is used to charge and monitor voltage level in battery. A very important feature of this project is that it can charge the battery of pacemaker using sensor like PIEZOELECTRIC PLATE which is used to convert body's mechanical energy into electrical energy which can avoid life risk and money.

Key words: Pacemaker, Max756, Atmeg328, Piezoelectric Plate, Vibrating Motor, Li Ion Battery

I. INTRODUCTION

Pacemaker can be implanted in two ways external and internal. External pacemaker is temporary and in this technique a belt is worn around chest, while internal pacemaker is also called as permanent pacemaker. It is implanted internally inside the body just below the collar bone. Internal pacemaker consists of electrodes, pacing system, power supply, and sensing circuit. The life span of battery is generally 5-10 years. [7]

II. RELATED WORK

Implanted pacemaker along with electrodes, are designed to be entirely implanted beneath the skin. Different types of implanted pacemaker according to the need of patient is implanted. Patient with complete heart block is implanted with fixed rate pacemaker. Alternative source of charging these devices with low power requirement are

- 1) Power generation using thermocouple
- 2) Power generation using piezoelectric elements

In piezoelectric technique a piezoelectric crystal is used for sensing body energy. The basic principle is to employ a piezoelectric and a semiconducting coupled nanowires is used such as zinc oxide nanowire that has ability to convert mechanical energy into electrical energy. In thermocouple technique thermocouple is used to sense body heat and convert it into electrical energy.

It is studied that when a person walks 67watt of power is generated and by a finger movement 0.1watt of power is generated and while breathing 1watt of power is generated. If only one third of the body heat is used it is sufficient to charge the battery of pacemaker. [1][2]

There are many research regarding wireless power supply to pacemaker in recent year.

III. METHODOLOGY

A. Working

In this project Arduino works as pacemaker and missing pulse detector while heart is replaced by vibrating motor of 3volt. Pacemaker pulses is generated using Arduino. piezoelectric plate is placed on heart, While heart beats it

will sensed by piezoelectric plate and mechanical vibrations of motor are converted into electrical pulses, and these pulses voltage are given to charging circuit of lithium ion battery.

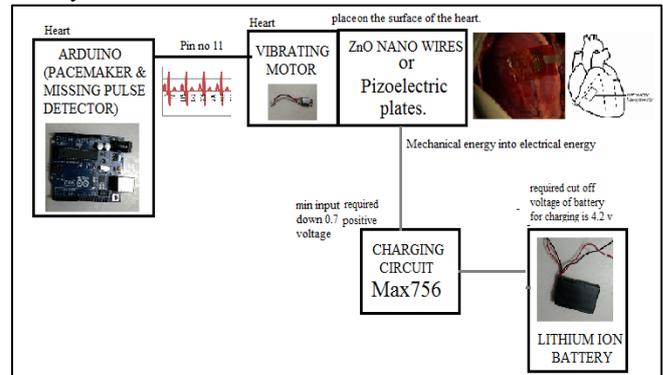


Fig. 1: block diagram

B. Hardware Specifications

Vibrating motor of compact size and light weight is used having diameter of about 6mm current used to operate is around 140mA. These motor are widely used in mobile phones, handset, pagers etc.

Zno nanowires is used as it has unique characteristic of converting biological, mechanical, vibrating energy and bio fluid hydraulic energy into electricity. These nanowires of 1micrometer thickness can be combined together to form Nano generator that can generate voltage of approximately 1mv in amplitude. But in these project piezoelectric plates are used in place of nanowires

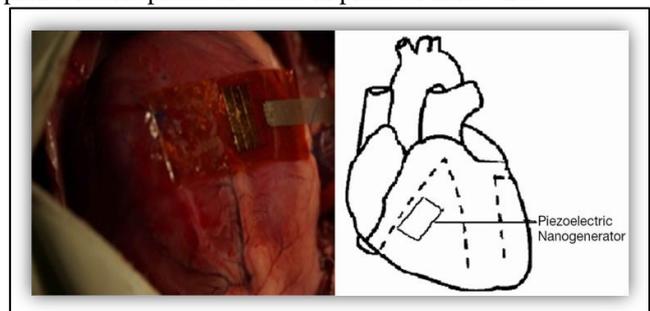


Fig. 2: placement of sensor

Lithium ion rechargeable battery of 3.6volt is used in these a Nan crystalline cathode component is used to extend battery life of lithium.

1) ARDUINO (ATmega328)

The ATmega328 provide following features: 32kbytes of in-system programmable flash with read, write capabilities, 1kbytes EEPROM, 2kbytes SRAM, 23 general purpose input /output lines, 32 general purpose working registers, Real Time Counter (RTC), three flexible Timer/Counters with compare modes and PWM, 1 serial programmable USARTs, 1 byte-oriented 2-wire Serial interface (I2C), an SPI serial port, and six software selectable power saving modes. The idle mode stops the CPU while allowing the Timer/Counters, SPI port, and interrupt system to continue

functioning. The device is manufactured using Atmel's high density non-volatile memory technology. The ATmega328 is supported with full suite of program and system development tools including: c compilers, macro assemblers, program debugger/ simulators, in circuit Emulators, and Evaluation kits. [4]

2) MAX756

MAX756 is CMOS step up DC switching regulators for small, low input voltage or battery powered system. It accepts positive input voltage less than 0.7 volt and convert into higher voltage of 3.3v to 5v. Efficiency is greater than 87%. Used in many medical equipments like Glucose meter. Also it has low battery detector (LBI/LBO). [3]

The MAX756 combine a switch mode regulator with an N channel MOSFET, precision voltage reference, and power fall detector in a single monolithic device. MOSFET is a sense FET and has a very low gate threshold voltage to ensure start up under low battery voltage condition (1.1v).

3) LI-ION BATTERY

The Li-ion cell can be safely charged at low temperature between 0-45 degree centigrade. Li-ion battery is superior to Ni-Cd/Ni-MH in performance over temperature. It has high energy density and low self discharge. There is a progressive loss of capacity at low temperature, at 0degree energy delivered is about 90% of 20degree amount and at the cell deliver around 70% of the capacity that delivered at -20degree. It has limited power density which makes it suitable for today's requirement such as long telemetry. Formulations of new cell achieve many benefits of the lithium iodide and provide better power delivery to system. [6]



Fig. 3: lithium ion battery

IV. CONCLUSIONS

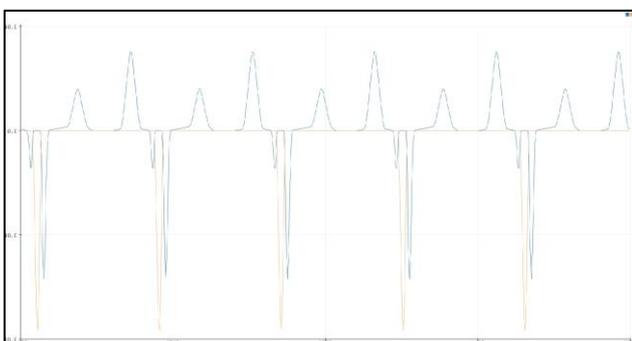


Fig. 4:

A working representation of rechargeable pacemaker is based on microcontroller MAX756, piezoelectric plate. During this project various issues were also discussed like

patient need to be aware while dealing with electronic devices such as cell phones, ovens etc also the patient cannot undergo MRI scan. There is still much development had to be done in future so that patient do not have any limitations.

REFERENCES

- [1] Wong, George SK, body heat power generator available from: <http://www.freepatentsonline.com/6075199.html> [last cited in 2010 Jan [5].
- [2] Snyder GJ, Ursell TS. Thermoelectric efficiency and compatibility. *Phys Rev Lett* 2003; 91:148301
- [3] <https://www.maximintegrated.com>
- [4] www.alldatasheet.com/Atmega328
- [5] www.alldatasheet.com/maxima756
- [6] www.microchip.com
- [7] Handbook of Biomedical Instrumentation 2nd edition KHANDPUR.