

## Functional implantable devices designed using bio-potential thermoelectric generator

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### ABSTRACT

Thermo Electric Generator is a device which Converts warmth immediately into electric electricity the usage of a phenomenon known as the "Seebeck effect". Unlike traditional dynamic warmness engines, thermoelectric generators contain no shifting components and are absolutely silent. But for small packages, thermoelectrics can end up competitive due to the fact they are compact, easy (inexpensive) and scalable. Thermoelectric systems may be without problems designed to perform with small heat resources and small temperature difference. The main aim of this project is to use BIO-POTENTIAL as a driving source of power for the implant devices such as Pacemakers. Pacemakers usually use batteries as their power source, and when the battery's period is over, the patient has to undergo surgery to replace the batteries. By using TEG, rapidly undergoing surgery of those pacemakers's patient can be avoided. The main objective of our project is to power implantable devices using Thermoelectric Generator and avoid further surgeries for the patient.



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## INTRODUCTION

Implantable devices such as pacemaker not only save patients from life-threatening situations but also help people who want to adapt them to expand their biological limits. The biggest drawback with these lifesaving implants is their power source, i.e. the batteries which eventually runs out and the patient has to undergo surgery again to get the battery recharged or replaced. Advanced medical technology has given the medical society Thermoelectric Generators which recharges these implants using

biopotential using various energy harvesting techniques. In the early 1960's an obligation for independent long time source of electrical power arose from the advancement in medical physics and mistreatment of earth's capitals in progressively hostile and unreachable locations. The first thermoelectric generator employed a radioactive isotope providing a required electrical power. Later in 1990's thermoelectric generators with two units were invented. The first unit was embeddable, and the other unit was wearable; hence it can be implanted under the skin [1].

## Hardware Description

### LM-35 Sensors

The LM35 assortment is precisionmerged circuit temperature sensor, whose yield voltage is sprightly relative to the Celsius (Centigrade) temperature. The LM35 in like manner has a bit of leeway over direct temperature sensors accustomed in ° Kelvin because the client isn't constantly needed to take away a gigantic steady voltage from its yield to secure helpful Centigrade scaling. The LM35 does no longer necessitate any external arrangement or tending to offer standard exactness's of  $\pm 1/4^{\circ}\text{C}$  at

room temperature and  $\pm 3/4^{\circ}\text{C}$  over a total  $-55$  to  $150^{\circ}\text{C}$  temperature assortment. Low worth is definite by the method of tending to and modification at the wafer stage. The LM35's low yield impedance, direct yield, and specific inborn modification makes interfacing to readout or oversees hardware precisely simple. It very well may be exploited with single quality assets, or within calculation to and short parts. As it draws in the easiest  $60\ \mu\text{A}$  from its convey, it has low self-warming, significantly less than zero.  $1^{\circ}\text{C}$  in any case air [2].

### Features

- Calibrated directly in  $^{\circ}\text{C}$  Celsius (Centigrade)
- Linear  $+ 10.0\ \text{mV}/^{\circ}\text{C}$  scale factor
- $0.5^{\circ}\text{C}$  accuracy guaranteeable (at  $+25^{\circ}\text{C}$ )
- Rated for full  $-55^{\circ}$  to  $+150^{\circ}\text{C}$  range

### Display

Liquid crystals are a segment of a count whose instruction is intermediary among that of a liquid and that of a crystal. The particles are commonly rod-formed natural moieties about 25 Angstroms in length, and their organization is a characteristic of temperature. The Nematic segment, for example, is characterized by the aid of the orientation order of the constituent molecules [3]. The molecular orientation (and consequently the material's optical homes) may be controlled with applied electric powered fields. Nematics are (nonetheless) the most typically used segment in liquid crystal presentations (LCDs). The maximum not unusual utility of Liquid Crystal Technology is in Liquid Crystal Displays (LCDs). With the benefits of skinny construction, ultra-low power consumption, and with the improving viewing attitude and resolutions, LCD era has emerged as vital in modern-day programs.

LAMPEX Offers LCDs & LCMs in numerous Types as beneath: TN Display: TN Fluid is the least luxurious type. The viewing perspective is ready 40-45 and must be distinctive "top" or "bottom" view preference. The bottom view is used whilst the person could be underneath the plane perpendicular to the display, consisting of on a desk calculator. Top view is used whilst the show is set up on a vertical floor under eye stage. TN (Twisted Nematic) LCD show bureaucracy most people and also the most fundamental show mode for the liquid crystal. The Liquid crystal bureaucracy a ninety-diploma twist cellular. TN has the gain of low tooling value and unit value. It is economical and has affordable viewing cone. It is broadly in use for low multiplex software (up to one/16 MUX with  $\frac{1}{4}$  applicable to most people). The display has top impartial heritage shade with black on section colouration.

### Power Supply

A centre tap step down the transfer of 9V is used along with 7805 and 7812 voltage regulator [4]. These voltage regulators fix the 5V and 12V output, respectively. They produce a voltage that is positive relative to the common ground.

The general purpose 1N4001 series rectifier diodes are also used in the power supply unit having a blocking voltage of 50-1000 volts [5].

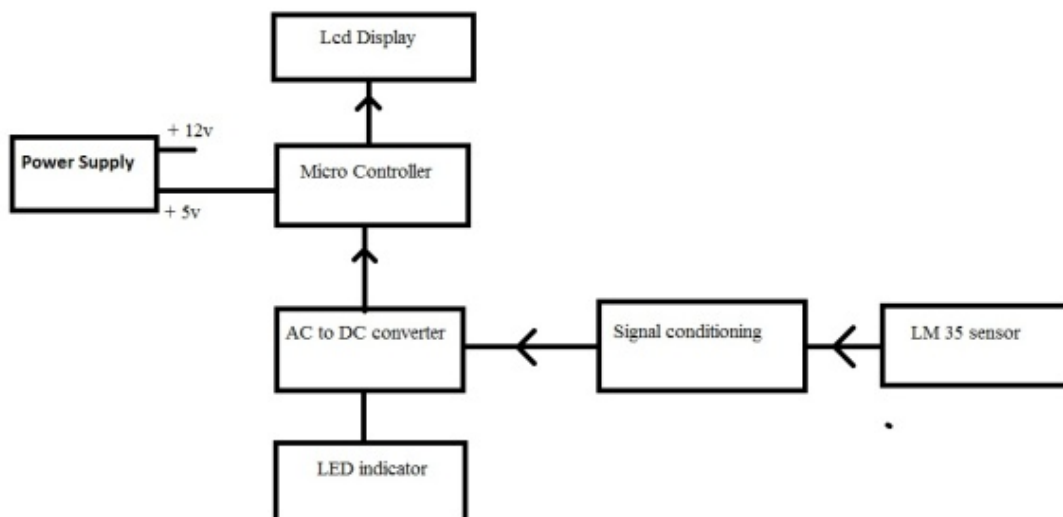
A filter capacitor of  $1000\ \mu\text{F}$  is installed after the voltage regulator to smooth the dc supplies [6].

### Microcontroller

The microcontroller consolidates all the highlights which are situated in a microchip. A microcontroller is an entire PC fabricated on a solitary chip. Microcontrollers are typically committed devices inserted inside a product. For instance, microcontrollers are utilized as motor regulators in engines and as exposure and insight regulators in cameras. To serve those bundles, they have a high consciousness of on-chip focuses which incorporate sequential ports, equal information yield ports, clocks, counters, interfere with control, simple to-virtual converters, irregular get admission to memory, perused the best memory, etc. The I/O, memory, and on-chip peripherals of a microcontroller are settled on depending at the particulars of the objective programming. Since microcontrollers are successful virtual processors, the level of overseeing and programmability, they give significantly supplements the viability of the application. The 8051 is the essential microcontroller of the MCS-51 family conveyed by utilizing Intel Corporation toward the finish of the Nineteen Seventies. The 8051 family, with its a lot more favourable individuals, appreciates the most significant market extent, imagined being about 40%, some of the different microcontroller structures. The microcontroller has on-chip fringe devices. Microcontroller (MC) can be known as pc on-chip since it has essential capacities of a microchip with internal ROM, RAM, Parallel and sequential ports inside a single chip. Or on the other hand, it might be said as a chip with memory and ports is alluded to as microcontroller. This is broadly used in clothes washers, VCD player, microwave, and mechanical technology or ventures [7]. Figure 1

### METHODOLOGY

From above fig 1, the first unit is the power supply unit which consists of a centre tap step down transformer, filter capacitor ( $1000\ \mu\text{F}$ ), voltage regulator (7805 and 7812) and a rectifier diode (1N4001). It



**Figure 1: Block Diagram**

is connected to the ADC unit having 74LS245 buffer. LM35 is connected to channel 0 of ADC. Buffer is connected between ADC and port 2 of microcontroller. LM35 senses the biopotential, convert and amplifies it which is displayed in the LCD through the microcontroller.

## RESULT AND DISCUSSION

The tapping of the biopotential from the human body is achieved.

For each  $1^{\circ}\text{C}$ ,  $10\ \mu\text{V}$  is amplified.

The main drawback of this project is that it can sense the biopotential only when the temperature difference is in the range from  $2\text{-}50^{\circ}\text{C}$ . If the temperature difference is below the mentioned range, it will not sense the biopotential.

Since the charging of the implants is continuous, the thermoelectric generator will continuously charge the implants. So further work can be done to store this amplified potential. Embedded systems can be a viable future scope of this project as it is proposed to limit the continuous charging of the implants.

As the range of LM35 sensor is  $-55^{\circ}\text{C}$  to  $150^{\circ}\text{C}$ , so some other sensor can also be used in place of it.

In creating, the materials utilized must be lawfully affirmed naturally to guarantee their wellbeing. In Indonesia, the natural cultivating framework has been directed in SNI 6729: 2016. The respectability of the material created is ensured by outsiders through the issuance of natural declarations in the wake of experiencing a progression of review measures on archives and creation measures in the field

and capacity region known as natural confirmation. The use of natural development so far doesn't strife with different guidelines that control the creation of crude materials and the utilization of items in well-being services. [8–10].

Use of arbuscular mycorrhizae parasites (AMF) and biofertilizer are proposed to be utilized to improve the viable development and yield of a few medicinal plants, for example, *Hemigraphis col-orata*, *Tinospora cordifolia*, *Ocimum basilicum*, *Gymnema sylvestre*, *Coleus amboinicus*, *Bacopa moninierii*, and *Artemisia vulgaris*. [11, 12] All things considered, the yield of biomass, spice, rhizomes from medicinal plants can increment without the utilization of concoction composts [13–15].

## CONCLUSION

This device will not only recharge the batteries of the implantable devices but will also prevent the possibility of life risk during repeated surgery. Due to the high cost associated with the purchasing of the precise nanotechnological devices applications are limited by economic feasibility. But the use of this device will improve effectiveness and reduce capital cost. Hence it would be possible to place these safe charging devices in the body which will recharge the batteries of the implants, thereby enhancing the patient safety by minimizing the risk involved due to frequent surgical procedures.

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## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest for this study.

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