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DESIGN OF THERAPEUTIC PAD FOR MEDICAL APPLICATION

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Abstract: *As we all know, in our day-to-day life we are not getting proper nutrition, by this we are facing some problems in musculoskeletal system which includes the bones, joints, ligaments, tendons, and muscles that ae so essential to movement and everyday life. And by sitting for longer period at your working desk most of us had been experienced swelling problem in muscles, so to get rid of these problems we just cool down that body parts with the ice cubes or if we are facing muscle strain while playing a lot on ground due to this, we are facing muscle pain for treating that muscle pain we just put our body parts in hot water or after the surgery, for reducing the pain we mostly buy heating pads just to reduce that pain. In short, we are using different natural remedies for this different pain. So, to overcome these problems of using various remedies to cure the pain or swelling we have come up with an idea of therapeutic pad which can solve our both problems in just one pad so no need to do different remedies for different pains. Our therapeutic pad works on peltier module and this module works on peltier effect. This device is designed for cooling objects to below the ambient temperature or maintaining objects at a specific temperature by controlled heating or cooling. Peltier module contains two external ceramic plates separated by semiconductor pellets. One of this plate absorbs heat (Becomes Cooler) and the other plate dissipates heat (Becomes Hotter). Effect of heating and cooling is based on the direction of current amount of heat to be transferred through a peltier module for the cold side to the hot side is denoted Q and is specified in watts. It should be understood that peltier module do not possess the ability to absorb thermal energy. Peltier module only transfer thermal energy and the energy begin transferred will need to be dissipated on the hot side of the module. In our therapeutic pad, we have used step down transformer for getting required current, Bridge rectifier for converting AC to DC and Capacitor for reducing fluctuations from the current and relay we have used for controlling current through the circuit. Also, we have used total four peltier module and heat sinks for getting proper heat. The material we are using is glass fabric which is current suitable material for our therapeutic pad. Our pad is two in one pad for cooling as well as heating as per our requirements. System we have designed is very compact. It is very easy to use and its cost effective. Also, it works fast so we don't need to bare the pain for longer time. This is our therapeutic pad made by our group members under the guidance of project in charge.*

Keywords: *Muscle strain, Peltier module, Peltier effect, Swelling, Therapeutic pad.*

I. INTRODUCTION

In this therapeutic pad, we have shown the cooling as well as heating effect as per the requirements. This therapeutic pad works on peltier module and this module is works on peltier effect. This peltier effect is nothing but the changing surface temperature higher to lower and vice versa. The changing of temperature is depending on the direction of current flowing through it and it measures in watts.
The material we are using for making this pad is glass fabric. We have used Arduino so for taking care of Arduino we have used relay switch because Arduino can flow current upto 5V or else there is chances of burning Arduino.

The allover system we have made is the compact system and its cost effective and easy to use for everyone. The main advantage of this system is that we are getting cooling as well as heating effect in just one pad. No need to switch pad or system for different treatments.
Heating part of this pad can be used for fast recovery after a joint surgery. Cooling part of this pad can be used for reducing swelling in the muscle. This pad we can use to get a rid of muscle strain as well as muscle recovery after an intense workout.

II. LITERATURE REVIEW

Chidinma Okebalama, Masoud Salehi, Dec . 26 , 2017 presented a case study on "Self-Regulating Heating/Cooling Blanket" in order to maintain a particular body temperature. They manufactured the temperature automated blanket system (TABS) constantly monitors a patient's temperature, through a medical rectal probe (proven to be the most accurate way of reading a patient's core body temperature), and adjusts the heating/cooling blanket accordingly. The need for this product is evident by the fact that, currently, hospitals with non-automated systems designate a nurse to constantly monitor a patient, which is inconvenient for effective/efficient personnel use. Systems that automate the process of heating and cooling a patient do exist as complete packages, but these systems are large in size, require water, and are very expensive ($5,000 to $10,000). TABS is a cheap and smaller alternative to the large expensive packages that are available.

Marvin E. Jensen, Mundelein, Hollister Incorporated, Libertyville, Nov. 4, 1997 conducted a study on POST OPERATIVE THERMAL BLANKET and found out that The present invention relates generally to a method and apparatus for producing a repeatable series of temperature patterns on a human body or mammal by selectively and independently controlling the heating and cooling of a Peltier - effect thermoelectric device disposed within a portable carrier .They claimed that their blanket is very effective for treating pain in an area of a human 35 perature and a second LED that is activated in response body by creating a series of temperature patterns on a to the selection of the first predetermined time period of surface of the human body over a treatment area. E.g., the two common treatments for pain in elbow are One is to have a band on the forearm for compression 200 to dampen repetitive stress on the muscles and tendons. The other is to have alternating warm and cold therapy to reduce the inflammation but the thermal blank is very easy to use and safe.

III. METHODOLOGY

To process the need of having a therapeutic pad to treat both muscle strain and swelling in the body by the effect of cooling and heating in a single unit by using the application of Peltier effect.

3.1 Working process of therapeutic pad:

The working of our therapeutic pad is basically divided into two parts which are as follows: -
1. Supply part to our Peltier module

• Firstly a 240 V AC supply is given to the system

• Which is then transferred to a step-down transformer, which basically lowers the voltage which is suitable for our system.

• Then it is transferred to a bridge rectifier which basically converts the AC supply to DC supply.

• Which is then passed to a capacitor which helps to avoid any voltage drop in the circuit.

2. Controlling part of our system

• In this basically according to our requirement input is given to the Arduino.

• which basically operates the relay system in such a way that module gets the voltage supply which is been placed to provide that input requirement.

• For example, heating as our requirement we have to give an input as heating to the Arduino which than basically operates the relay in such a manner that the voltage supply is given to that module which basically is placed to provide heating as an output by keeping the another set of Peltier module disengaged which is placed to give cooling as an output.

• So, by this we can operate the system according to our requirement.

3.2 Block diagram of therapeutic pad:

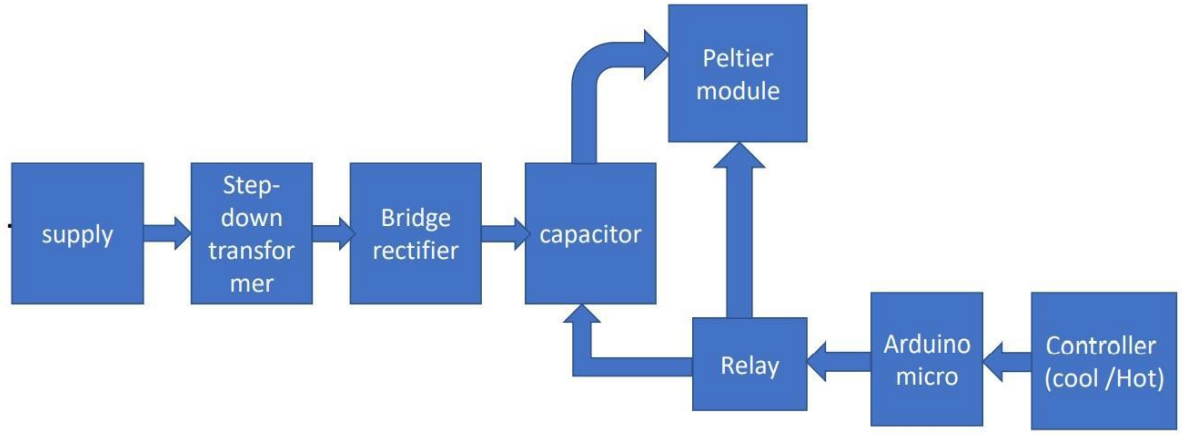

Fig 3.2.1: Block diagram

3.3 Component:

1**. Peltier module**:

Fig 3.3.1: Peltier Module

Thermoelectric cooling uses the Peltier effect to create a heat flux in the junction of two different types of materials. A Peltier cooler, heater and thermoelectric heat pump is a solid-state active heat pump which transfers heat from one side of the device to the other, with consumption of electrical energy, which is dependent on the direction of the current. Such an instrument is called a Peltier device.

2. Step down transformer:

Fig 3.3.2: Step Down Transformer

A Step-up Transformer is a device which converts low primary voltage to a high secondary voltage that, it steps up the input voltage. A Step-down Transformer on the other hand, steps down the input voltage that is the secondary voltage is less than the primary voltage.

3.Bridge Rectifier:

Fig 3.3.3: Bridge Rectifier

A Bridge rectifier is an Alternating Current to Direct Current converter that rectifies mains AC supply to DC output. Bridge Rectifiers are widely used in power supplies that provide DC voltage for the electronic components.

4. Relays:

Fig 3.3.4: Relay Switch

Relays are simple switches which can be operated both electrically and mechanically. Relays consist of an electromagnet and also set of contacts. The switching mechanism is carried out with the help of an electromagnet. The main operation of a relay comes in places where a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control lot of circuits.

5. Arduino Uno:

Fig 3.3.5: Arduino Uno

It is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC to DC adapter or battery to get started. You can experiment with your Uno without worrying too much about doing something wrong, In an worst scenario you can replace the chip for a few bucks and start over again.

3.4 PART LIST:

TABLE 3.4.1: Part list

COMPONENTS	QUANTITY
Arduino Uno	1
Peltier Module	4
Relay Module	2
Bridge rectifier module	1
Step down transformer	1
Switch	1
Heat Sink	2
Capacitor	1
Thermostat module	1
Aluminum plate	1
Glass Fabric	1

3.5 Circuit diagram:

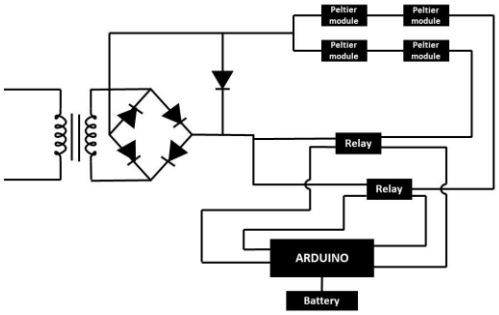

Fig 3.5.1: Circuit Diagram

So as we come to our circuit diagram, Our circuit diagrama basically comprises 2 way input to our system. Which goes from one end as (1) Supply is given to our system, Which is then transferred to step down transformer, then to a bridge rectifier and to the capacitor which then goes to an internal circuit. (2) Now the another end of the input comrisses the controller input given to the arduino which is then transferred to the relay system then to the internal circuit which comprisses the peltier module.

IV. CONCLUSION

To cure various muscle strain and soreness of body by using natural remedies it can take a while to get rid of it.so here comes our designed product which uses thermoelectric effect which Is comparatively faster and more reliable for use. We use Peltier effect to give both heating and cooling effect in a single system which is basically an application of thermoelectric effect. In this we have designed a circuit which allows us to use the system according to our requirement and to get rid from pain. So, by this we can conclude that by using this application we can

achieve a product which delivers both heating and cooling effect I a single unit more effectively and with cost efficiency.

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