2015

The Jubilee School

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THERMO BLASTER

[MAINTAINING HUMAN THERMAL COMFORT]

Dedication

this project is dedicated to people whom are suffering from the lack of thermal comfort, feeling uncomfortable leading to inefficiency in their daily works, it's dedicated to whoever wishes to feel comfortable without consuming too much power and reach the optimum thermal comfort despite how does the people around him feel .

Declaration

I hold a copy of this research / project that we can produce if the original is lost or damaged. I declare that no part of this research / project has been copied from any other student's or another's work except where such collaboration has been authorized by the supervisor.

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Acknowledgement

This research / project would not be very useful if supervision did not exist. Therefore, I would like to thank My supervisor T. HazemHamdan for the vision to believe in and support such a new field project , as well as his valuable discussions and cooperation, Huge thanks to the head of the research unit of Jubilee school for the follow-up supervision of the report writing. I also would like to thank Mr. AbdelkhaleqShboul for his great help in electronics and circuits designs.

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ThermoBlast

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Abstract

ThermoBlast is a wearable technology which is mainly based on the perception of thermal comfort, the condition of mind that expresses satisfaction with the thermal environment, ThermoBlast is a wearable item which based on a scientifically proven fact that heating or cooling a certain region in the body will affect the whole body by several degrees, this study was done by students at MIT university, ThermoBlast is a wearable tech which cools or heats your body by using the peltier, 5*5cm piece works on thermoelectricity, it converts electricity to heat, The Peltier effect is a temperature difference created by applying a voltage between two electrodes connected to a sample of semiconductor material. , so we need to make all needed modifications to achieve the goal which is affecting a single body's temperature despite the environment or people around, and achieving thermal comfort.

Introduction:

Thermal comfort is perceived as the comfort of human beings under given room conditions, Because of individual differences of the perception or sensation of humans.

After brainstorming to find ideas on how we can maintain the optimum conditions for a person's thermal comfort, it is best if we developed a wearable device that could alter user's temperature without consuming too much power, feasible and easy to use.

After coming up with the problem which involves the necessity of maintaining thermal comfort, we thought it was better to develop a thermoelectric device effecting human's temperature and keep the user comfortable.

The device is equipped with technology that delivers warm or cool thermal pulses to slightly raise or lower your body temperature, The current prototype cools or warms the body at a rate of about 0.4 degrees Celsius per second depending on peltier, the thermoelectric unit.

ThermoBlast might not be a full heating and cooling solution -- most people will still need a furnace and air conditioning for heating and cooling their homes--it might encourage people to set their thermostats differently to save energy.

Purpose:

The purpose of this project is to develop a low cost device which provides the perfect thermal comfort for the user without consuming too much energy.

Problem Identification and Justification:

It has long been recognized that the sensation of feeling hot or cold is not dependent on air temperature alone nevertheless, when it comes to home heating and cooling in the United States, there is a pervasive focus on the manipulation of air temperature to achieve comfort. This singular focus can lead to misconceptions of how to best achieve true thermal comfort and obscure your ability to make intelligent home heating decisions.

The purpose of any heating system is to raise the level of thermal comfort in the home. Thermal comfort can be expressed as the degree of satisfaction that you feel with your surrounding environment. It is affected by factors such air temperature, mean radiant temperature, conduction temperature, relative humidity and personal clothing. Thermal comfort is achieved when the heat generated by your metabolism is able to dissipate, while your thermal comfort level remains in equilibrium with the surrounding environment.

When air temperature is raised by a home heating system thermal transfer is achieved through the movement of air. This movement can be induced by mechanical means such as fans used in a forced air system or by natural thermal convection induced by a hot surface such as those found on a woodstove.

Research question:

can we develop a device that maintains human’s thermal comfort individually without affecting people or environment's thermal condition around and without consuming too much power ?

Hypothesis:

Using ThermoBlast maintain user's thermal comfort by regulating user's temperature rather than surrounding environment temperature.

Variables :

metabolic rate

clothing insulation

air temperature

mean radiant temperature

air speed and relative humidity

Psychological parameters such as individual expectations

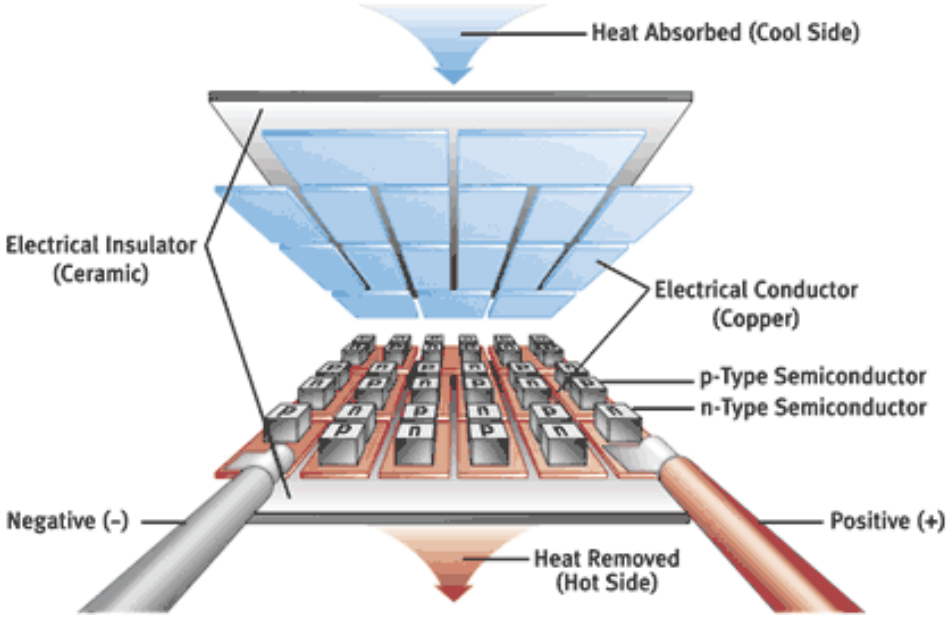
Previous Studies:

How does the peltier (thermoelectric unit) work?

Thermoelectric coolers are solid-state heat pumps that operate according to the Peltier effect: a theory that claims a heating or cooling effect occurs when electric current passes through two conductors. A voltage applied to the free ends of two dissimilar materials creates a temperature difference. With this temperature difference, Peltier .cooling will cause heat to move from one end to the other

A typical thermoelectric cooler will consist of an array of p- and n- type semiconductor elements that act as the two dissimilar conductors. The array of elements is soldered between two ceramic plates, electrically in series and thermally in parallel. As a DC current passes through one or more pairs of elements from n- to p-, there is a decrease in temperature at the junction ("cold side"), resulting in the absorption of heat from the environment. The heat is carried through the cooler by electron transport and released on the opposite ("hot") side as the electrons move from .a high- to low-energy state

The heat-pumping capacity of a cooler is proportional to the current and the number of pairs of n- and p- type elements (or couples).



N- and p-type semiconductors (usually Bismuth Telluride) are the preferred materials used to achieve the Peltier effect because they can be easily optimized for pumping heat. They can also control the type of charge carrier within the conductor.

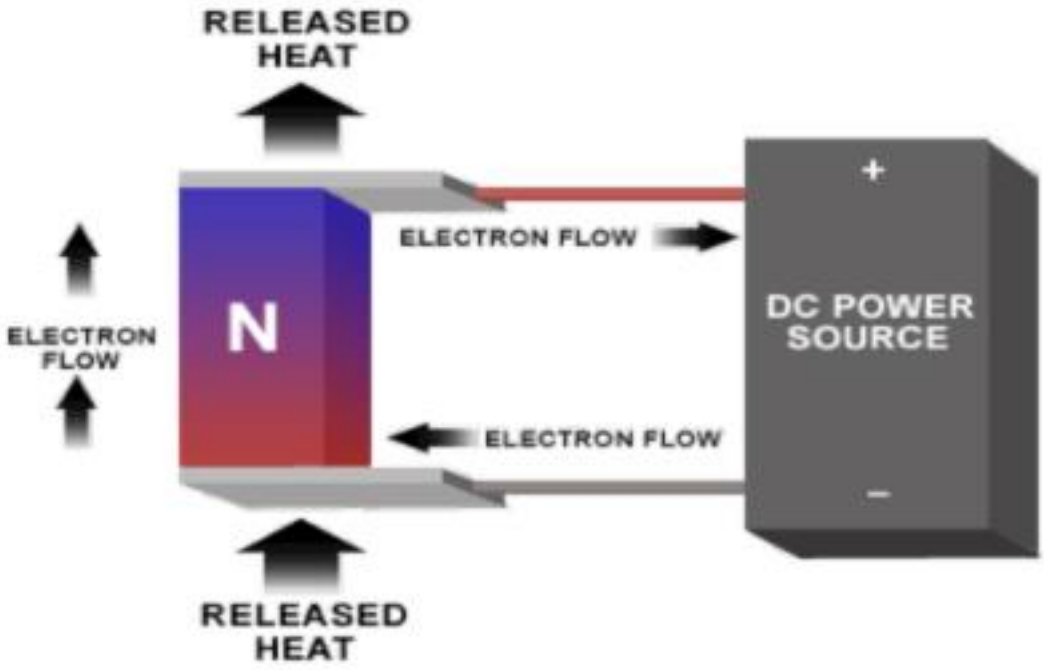


Figure 2 illustrates an "N-type" semiconductor element utilized to facilitate the Peltier effect. In this example, negatively charged electrons are repelled by the negative pole and attracted to the positive pole of the DC power source. This forces electron flow in a clockwise direction through the "N-type" material. Heat is absorbed at the bottom junction and actively transferred to the top junction by the electrons as they flow through the semiconductor element. This is known as electron transport.

Peltier's Data sheet :

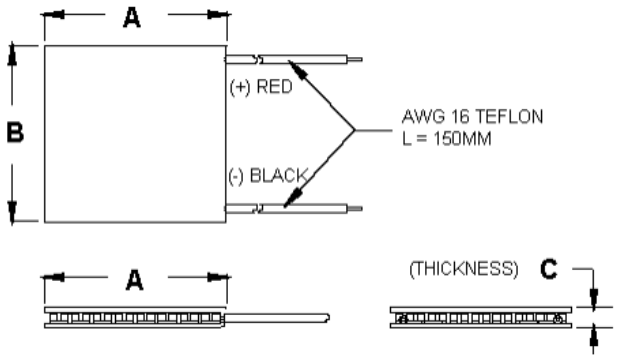
Thermoelectric Cooler

TEC1-12706

Performance Specifications

Hot Side Temperature (° C)	25° C	50° C
Qmax (Watts)	50	57
Delta Tmax (° C)	66	75
Imax (Amps)	6.4	6.4
Vmax (Volts)	14.4	16.4
Module Resistance (Ohms)	1.98	2.30

TEC1-12706



Ceramic Material: Alumina (Al_2O_3)
Solder Construction: 138° C, Bismuth Tin (BiSn)

Operating Tips

- Max. Operating Temperature: 138°C
- Do not exceed Imax or Vmax when operating module.
- Life expectancy: 200,000 hours
- Please consult HB for moisture protection options (seeling).
- Failure rate based on long time testings: 0.2%.

Air conditioners:

air conditioners are the most known technology to maintain an optimum thermal comfort, by altering the properties of air, to more comfortable conditions, typically with the aim of distributing the conditioned air to an occupied space to improve thermal comfort and indoor air quality.

Tools and materials:

- peltier
- arduino
- arduino motor shield
- lithium batteries
- appropriate wearable item

Procedure:

1. design an appropriate piece of clothes to fit the device in

2. place the batteries and peltiers in the desired position to achieve maximum efficiency

3. provide the device with a Bluetooth module to be able to communicate with the device

3. develop a mobile application to communicate with the device and enable the user to adjust peltiers temperatures to ensure full thermal comfort

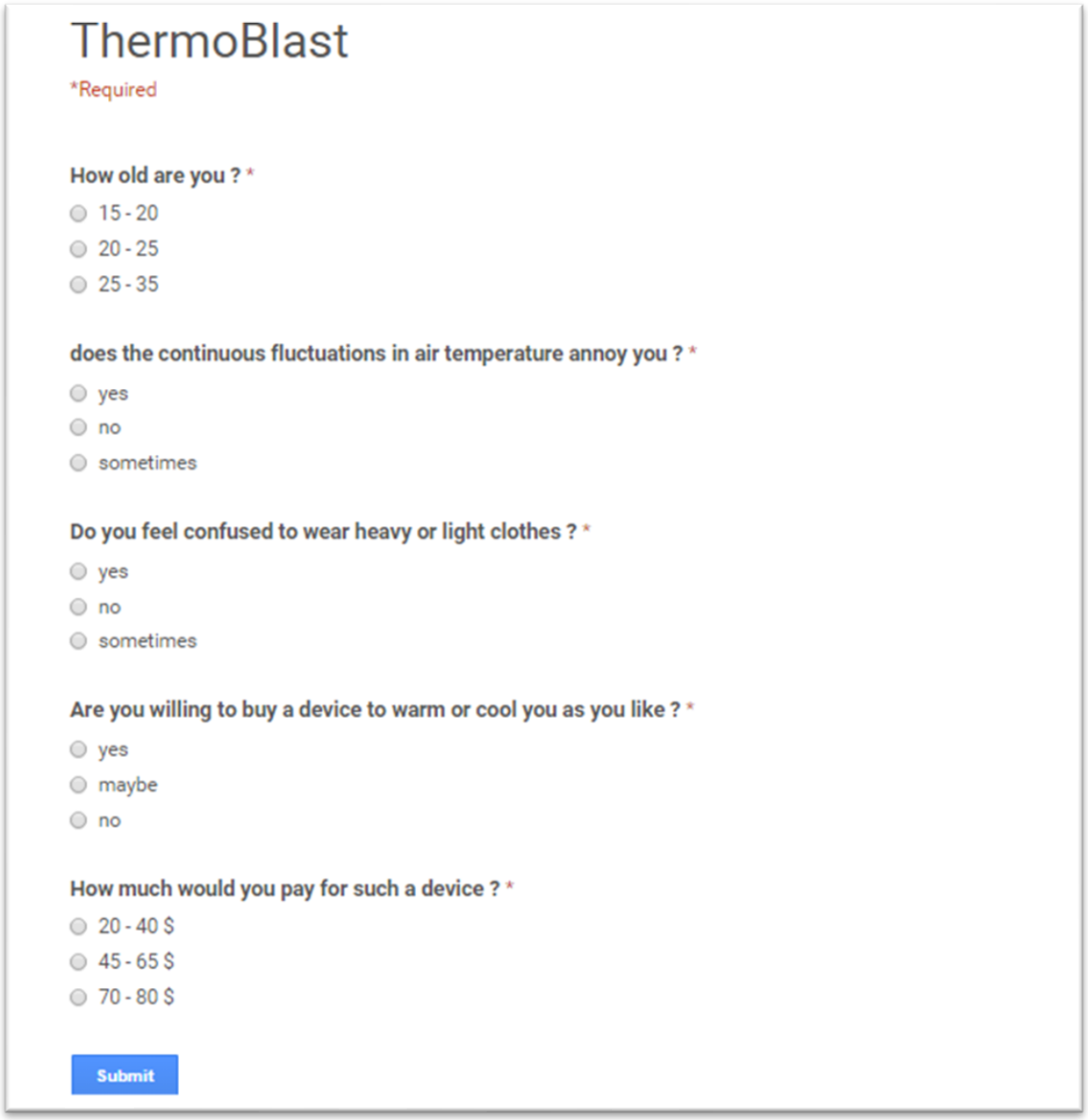
The Questionnaire :

Purpose of survey:

To get real results on how much would people would accept this device and whether it is applicable or not we conducted this questionnaire.

Where and when the survey would be held :

this questionnaire was distributed to high school students , university students and companies employees.



ThermoBlast

*Required

How old are you ? *

- 15 - 20
- 20 - 25
- 25 - 35

does the continuous fluctuations in air temperature annoy you ? *

- yes
- no
- sometimes

Do you feel confused to wear heavy or light clothes ? *

- yes
- no
- sometimes

Are you willing to buy a device to warm or cool you as you like ? *

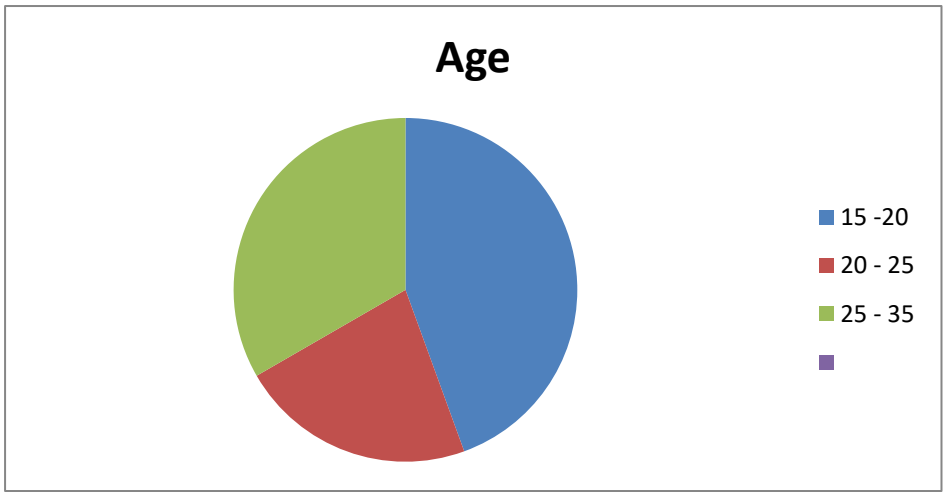
- yes
- maybe
- no

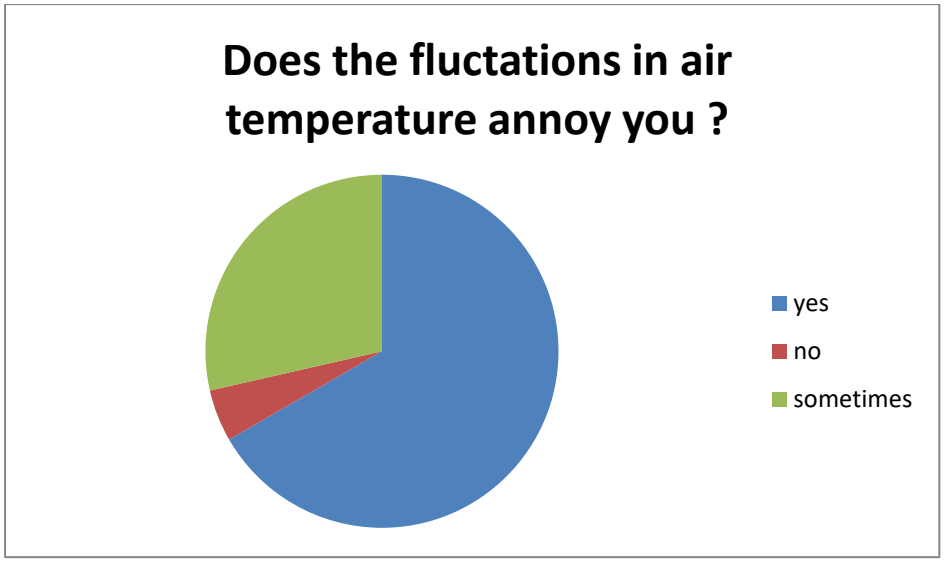
How much would you pay for such a device ? *

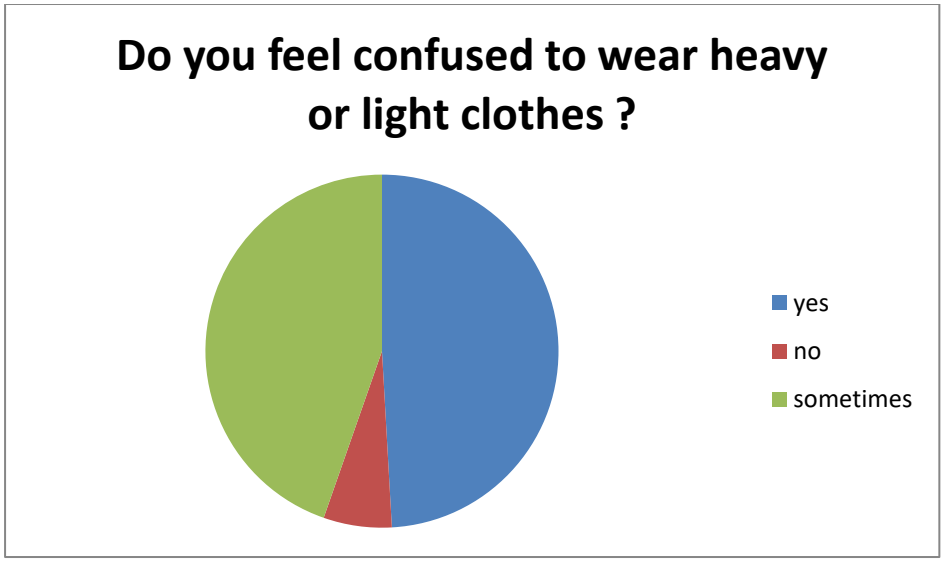
- 20 - 40 $
- 45 - 65 $
- 70 - 80 $

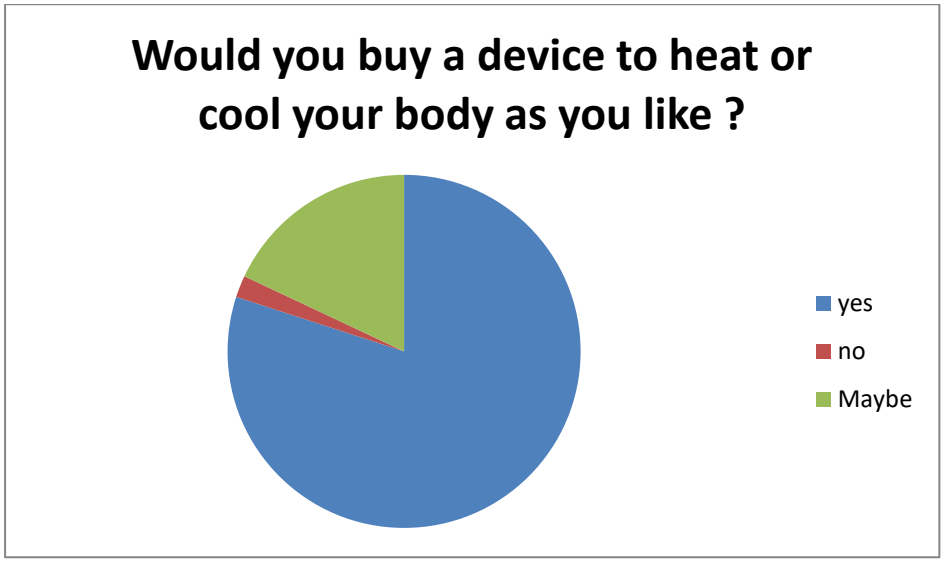
Submit

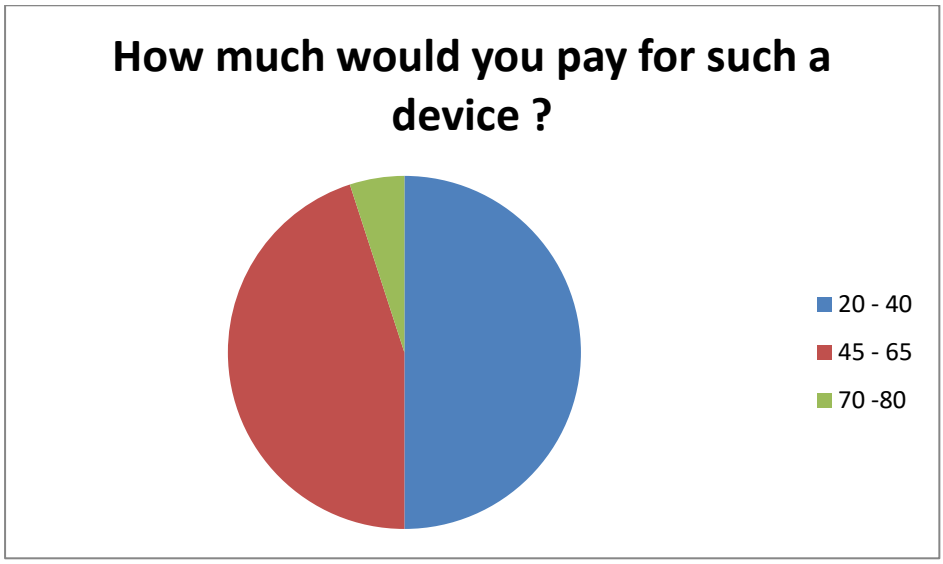
Questionnaire results and analysis :











as we see, too much people want to maintain their thermal comfort, with these features in this project, as they suffer from air fluctuations and the need of having individually thermal device despite the surrounding environment.

Objective and aims:

Overall objective:

developing a device to maintain user's thermal comfort without consuming too much power.

Specific aims:

- enhance Human's life quality.
- The production of a device that is affordable by different communities.
- reduce the power consumed in using air conditioners.
- Engage people with technology.

Expected budget for ThermoBlast:

Peltier	$2.19
Arduino	$2.20
Arduino motor shield	$5.85
Lithium batteries	$6.99
Piece of cloth	$1.99

Future Plans:

1. link the application to database so that every user has his own data and history when using the device

2. adjust the circuit to be smaller and more effective

3.enahnce the application to better communicate with the device and adjust the perfect amount of heat that best suits him

4. reform the finishing of the device to be much more attractive

5. develop the application's user interface

6. enable the charging feature

7. build other types of this project to target specific people such as medical ThermoBlast or ThermoBlast for babies etc..

Reference:

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Health and safety excusive

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http://www.marlow.com/resources/general-faq/6-how-do-thermoelectric-coolers-tecs-work.html

Peltier's Data sheet

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