

Automatic Heat Finding Laptop Cooling Pad

Project Proposal for ECE 445, Senior
Design

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Introduction

1.1 Statement of purpose:

This project was chosen because sometimes the current laptop cooling pads are either too large in size or not effective enough. The heat is a great enemy against high performance computers and a highly efficient portable cooling pad can be a solution to this.

1.2 Goals:

Be able to find the heat source automatically. (automatic heat finding system can make help the cooling pad find hottest point on the laptop which can be improve the efficiency greatly.)

Be able to change and display the speed of the fan according to the temperature of the heat source.

Be able to develop a feed-forward system.(Develop a feed-forward system for cooling of laptop, especially for gaming laptops. Feed-forward system may be better than feed-back system because it could predict beforehand when to start cooling the laptop. Compared to feed-back system which only takes action after something has happen, a feed-forward system could prevent any disaster before it takes place.)

1.3 Functions:

- LED keyboard lamp
- Heat sensors keep trace on the heat source
- Visual indicator of fan speed
- Load monitor that can tell the fan to increase its speed
- Power hub

1.4 Benefits:

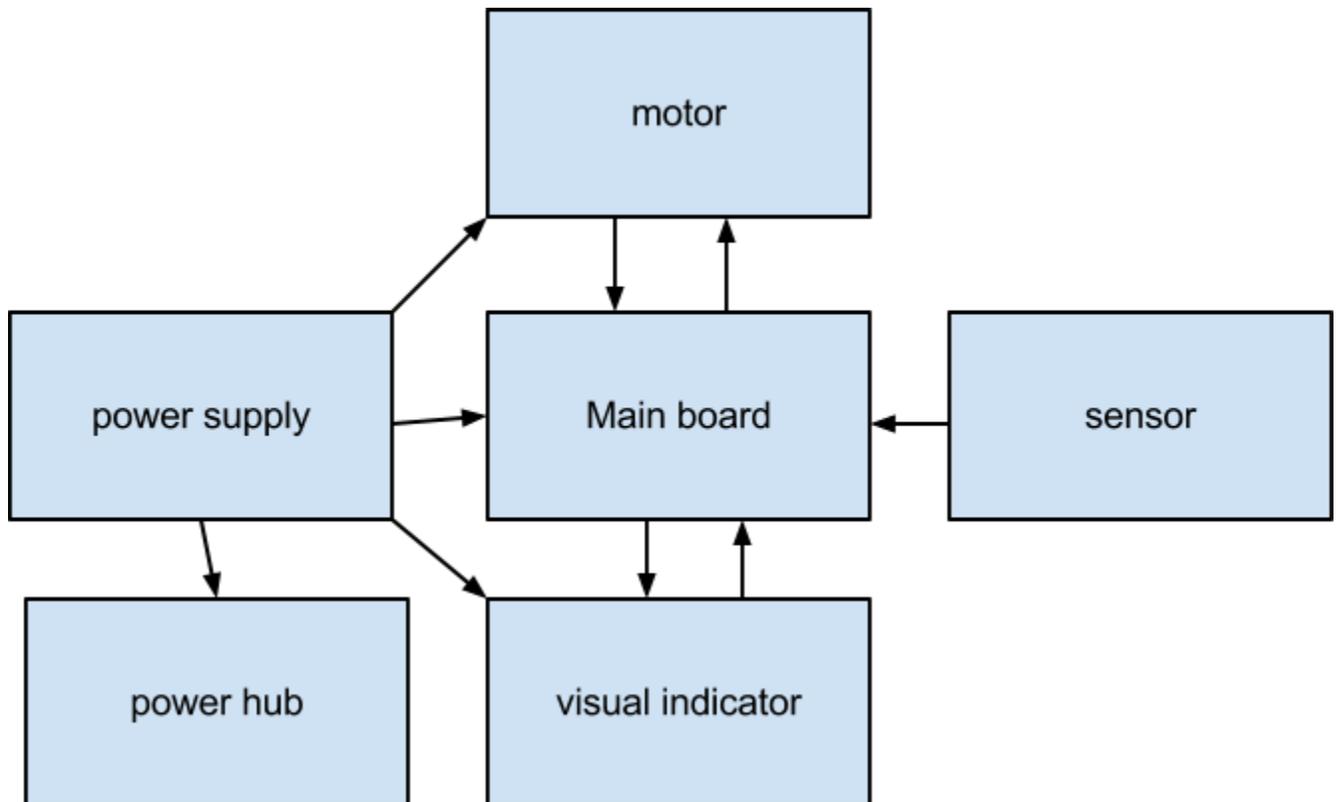
- This cooling pad is suitable for various model of laptops
- It saves more material by operating with only one small fan
- It has multi-functions such as power plugs and keyboard lamp

1.5 Features:

- Fan RPM range: 200~600
- Fan noise: 20 dBA
- USB ports: 2
- Consist of two track for the fan, one vertical, the other one horizontal
- Powered by USB

Design

2.1 block diagram



2.2 Block description

2.2.1 Power supply

The power will come from the USB port of laptop. We are also considering using battery for the power supply of the motors.

2.2.2 sensor

The sensors measure the temperature and convert the heat into electronic signal for the main board to process

2.2.3 Mainboard

The main board's power will come from USB port of the laptop. It would control how fast the fan will spin and control the position of the fan. It gathers data from the sensor then analyze it before sending any signal to the motor. The signals send to the motor would be amplified. The main board will also tell the user how fast the fan is actually spinning by using a visual indicator which is composed of LEDs.

2.2.4 motor

There are 3 motors in our design, two of them used to control the movement of the fan and the third is used to control the speed of the fan. The main board will control the speed of the motors so that to control both the location and the speed of the fan.

2.2.5 power hub

It will provide 2 USB ports for multiple use and will provide energy for the LED keyboard lamp

2.2.6 Visual indicator

It is an LED indicator which tells the user about the speed of the fan and when the speed will rise. The signal come from the mainboard will control the indicator and it is powered by the supply.

Requirement and Verification

3.1 Feature Requirement

3.1.1 Power Supply

Power supply is a standard USB port which have a maximum $5(+/- 0.25)V$

3.1.2 Motors

1. Motor to control the speed of the fan: Driving Voltage around 5V Driving current around 1A. The speed of the motor can be controlled by changing the supply voltage and small enough to be portable.

2. Motor to control the location of the fan: 5V driving voltage and 1A driving current. Low rpm can be stopped immediately when the supply current is low.

3.1.3 Mainboard

1. PCB: be able to amplify the signal to drive the motors

2. Controller 1: be able to analysis the data from the sensor and output the right signal to drive the speed of the fan and the LED indicator

3. Controller 2: be able to analysis the data from the sensors and send right signal to change the location of the fan to the hottest spot.

4. Controller 3: the controller needs to predict when to accelerate the fan (feed-forward system)

3.1.4 Grove- Infrared Temperature sensor

Grove compatible interface

Supply voltage range: 3V- 5V

Power consumption: less than 0.06 mW

Temperature measure range:-10~100°C

Accuracy: $\pm 2^\circ$

3.2 LED indicator:

LEDs; supply voltage below 5 voltage and supply current around 1 A

(LEDs with different colors have different supply voltage which can be used to indicate the speed of the fan)

3.2 Verification:

- Motors: Connect to 5V 1A supply and test the RPM; change the supply current to see if the RPM is changing
- Mainboard:
 1. Controller:
 2. PCB: Connect it to the output of the controller and test the output current and voltage of the PCB. (the PCB is an amplifier)
- Sensor:
- LED: Given different voltage supply to see if LED of different color work well.
- Visual indicator:

Cost and Schedule

4.1 Labor Cost

| Name | Hourly rate | hours per week | total weeks | total |
|-------------|-------------|----------------|-------------|-----------|
| Yuan Yao | \$30.00 | 12 | 12 | \$4320.00 |
| Xuandong Xu | \$30.00 | 12 | 12 | \$4320.00 |
| Jifei Xu | \$30.00 | 12 | 12 | \$4320.00 |

The total labor cost is \$12960.00

4.2 Parts Cost

| Item | quantity | cost | total cost |
|---------|------------------|--------|------------|
| LEDs | 1bag(pack of 60) | \$7.89 | \$7.89 |
| motors | 3 | \$0.45 | \$1.35 |
| fan | 1 | \$7.97 | \$7.97 |
| sensors | 5 | 9 | 45 |

| | | | |
|---|---|--------------------|--------------------|
| controller(arduino Uno board & wire and a breadboard) | 1 | \$26.10 | \$26.10 |
| PCB(with circuit fabricated) | 2 | \$10.00(estimated) | \$20.00(estimated) |
| LED lamp | 1 | \$3.71 | \$3.71 |
| usb mini hub | 1 | \$7.29 | \$7.29 |
| frame | 1 | \$15.00 | \$15.00 |
| Total | | | 134.31 |

4.3 Schedule

| week | Task |
|------|---|
| 2/4 | Proposal Research necessary paper Find and buy parts |
| 2/11 | Prepare for design review Look up items in ECE store motor testing Learn more about Arduino |
| 2/18 | Research on analog design for motor speed modulation Research on Control Signals Research on robotics for automated rotor motion |
| 2/25 | Initial design of the analog part Initial design of the Arduino program Initial design of the robotics |
| 3/4 | Testing and analysis of the analog design part on breadboard Testing and analysis of the Arduino system Testing and analysis of the robotics system |
| 3/11 | Testing and analysis of the analog design part on breadboard Testing and analysis of the Arduino system Testing and analysis of the robotics system |
| 3/18 | Testing and analysis of the analog design part on breadboard Testing and analysis of the Arduino system Testing and analysis of the robotics system |

| | |
|------|--|
| 3/25 | Finalizing the analog design Finalizing the Arduino system Finalizing the robotics system Put all system together for testing and revising. |
| 4/1 | PCB fabrication Cooling pad assembly Final testing and analysis |
| 4/8 | Sign-up for Demo and Presentation |
| 4/15 | Prepare presentation Final modulation |
| 4/22 | Final paper |
| 4/29 | Final paper |