Application Of Newton's Law Of Cooling for a System

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Abstract:

The temperature of the many *objects will be* modelled employing an equation. **Newtons law** of cooling states that the temperature of a body changes at a rate proportional to the distinction in temperature between the body and its surroundings, it is a fairly correct approximation in some circumstances.in this particular report student discovered and noticed distinction in temperature of the system example computers, portable computer with relevancy of time. Newtons Law of cooling is incontestable within the experiment.

KEYWORDS: Cooling, System, Heat, Time , Temperature.

Methodology

Formula for Newtons Law of Cooling

Newton's law of cooling describes the speed at which exposed body changes temperature through radiation that is roughly proportional to the distinction between the object's temperature and its surroundings, provided the distinction is little.

$$\frac{dT}{dt}\alpha(T_t - T_s)$$

The Newton's law of cooling is given by,

dT/dt = k(Tt – Ts)

Where

Tt = temperature at time t and

Ts = temperature of the surrounding,

k = constant.

The **Newton's Law of Cooling Formula** is expressed by

$T(t) = Ts + (T0 - Ts)\, e^{-Kt}$

Where,

t = time,

T(t) = temperature of the given body at time t,

Ts = surrounding temperature,

To = initial temperature of the body,

k = constant.

The time duration ranges for time duration from 1 to 2 hours on 12 cases and within 2—3 hours on 14 cases , the duration of measurements ranged from to initial state to end state most, were less than 24 hours.

Sources of heat in a system

While all electronics give off some amount of heat, for many of them it is a negligible amount and doesn't require any special attention. However, there are a few components that give off a significant amount of heat. These are usually:

- Processor
- GPU
- Voltage regulator modules (VRM), these are located around the CPU socket
- Chipset
- High-performance RAM

The effects of heat

Over time, high heat accelerates wear and reduces dependableness of the elements.

The dependableness loss but affects .However stable the half is at a given performance level. If dependableness problem begins cropping up (due to, e.g., overclocking a processor awfully high and perpetually running significantly loads), running the half at a lower performance level might eke out a touch additional life before the system is not any longer reliable. Another impact that heat has on elements is thermal stress. Once things get hot, they expand, once they cool off, they contract.

Repeated heating/cooling cycles cause mechanical stress which will fatigue the fabric.

At some purpose the fabric cracks and breaks. Thermal stress is far additional outstanding if the temperature variation area unit wide. Air and body part temperatures were measured with thermocouples and a recording potentiometer.

Solutions:

There are 2 methods to keep a system cool as follows

1. The case cooling.
2. The C.P.U (central processing unit) cooling.

Case cooling refers to the method of air cooling. Air cooling is one of the most common method of system cooling in which different fans are used to pull out the hot air and intake the cold air inside a C.P.U. This is one of the cheapest method of cooling a system.

Most PCs have a combination of these fans for cooling:

A. Front Intake Fan: This fan is used to bring fresh, cool air into the computer for cooling purposes. It is attached in the front of the case.

B. Rear and Top Exhaust Fans: These fans are used to evacuate hot air out of the case. Rear fan is attached at the back and top fan is attached at the top of the case.

C. Power Supply Exhaust Fan: This fan is usually found at the rear of the power supply unit and is used to cool the power supply and take the hot air out of the case and power supply unit.

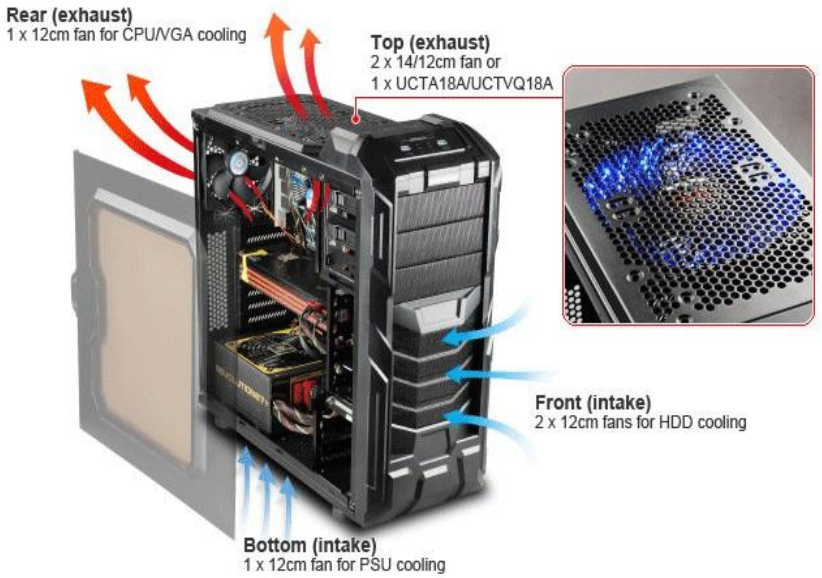


Figure 1: Fan A,B,C used for cooling the system

CPU Cooling: The CPU produces the heat most as compared to the other components and there should be a proper measure for cooling the CPU in order to prevent it from damage. The two most common way of application for CPU Cooling are: air cooling.

Air Cooling

The parts inside most computers are cooled by air moving through the case. Similarly for the CPU cooling, the heat sink with a fan fixed to it is attached to the flat area of the CPU in order to cover maximum surface area. The heat sink basically consists of the Aluminum fins spread in the rows and a fan is attached at the top or side of the metal fins. The fan push the air to the heat sink and the hot air in the sink expands and comes out of the sink and then it is pushed to outside of the case through case cooling system. As a result, the temperature of the CPU doesn't exceed.

The following figure shows the CPU Air cooling system.

Figure 2: **Air Cooling system of the CPU**

Temperature data were analysed as in the reports: the successive hourly differences between rectal. Tr = rectal temperature and air temperature, To, were divided by the initial difference and the ratios were plotted on semi-log paper.

Curves were fitted to the linear trends by the method of least squares to obtain the cooling constant k.

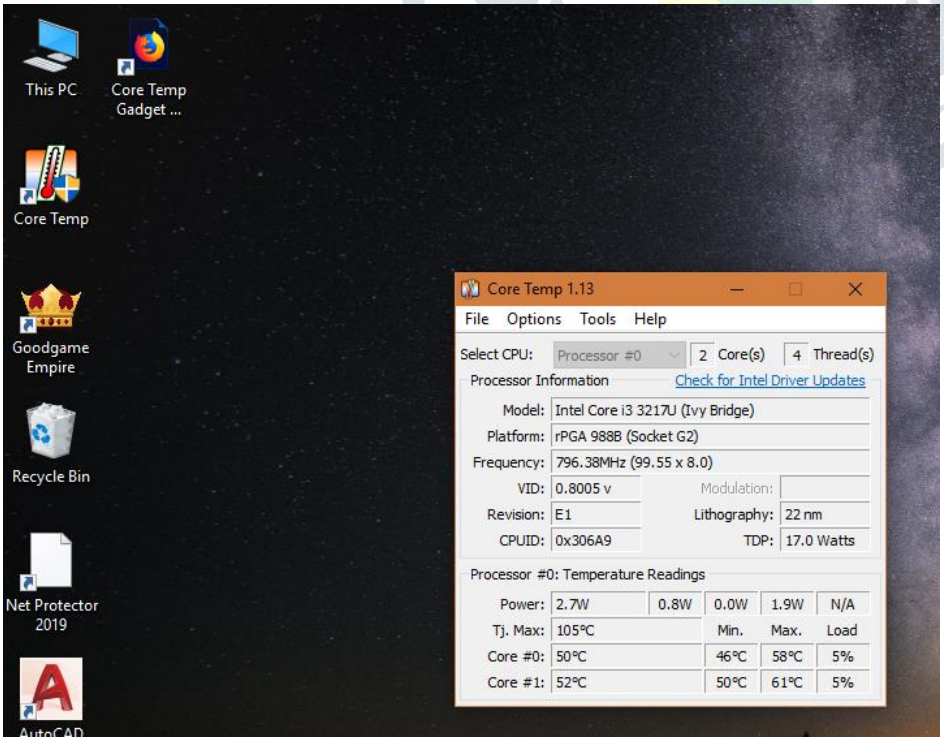


Figure 3. The initial temperature reading for a regular computer system.

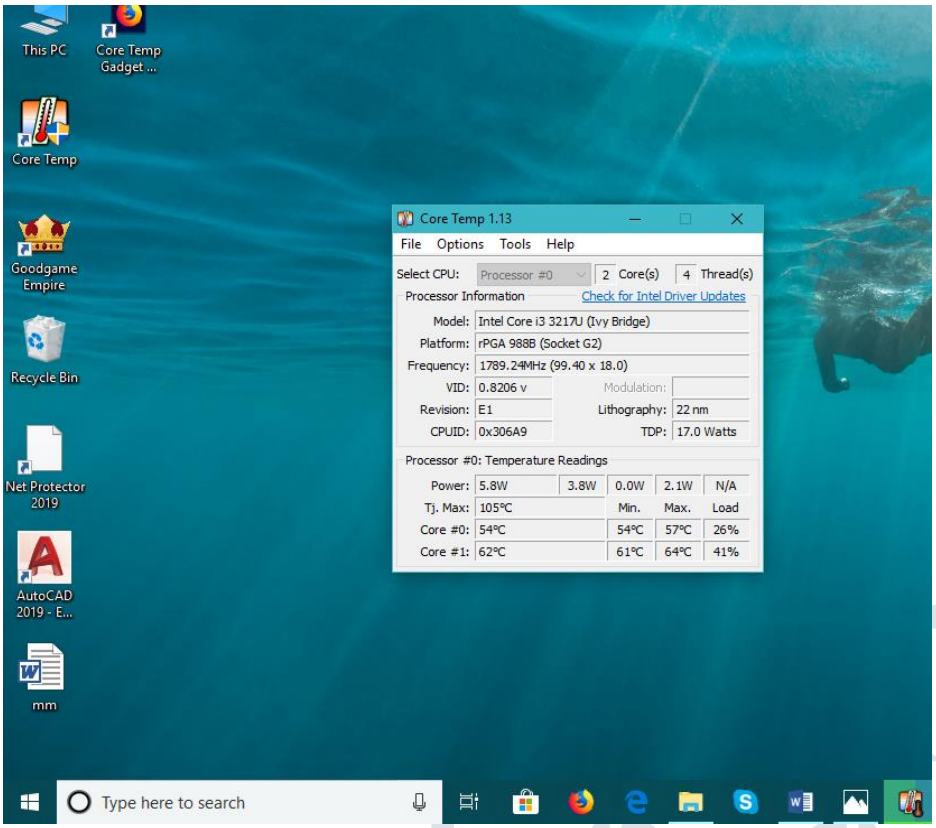


Figure 4. The temperature reading for a regular computer system after some time.

Observation table for time and temperature when the system is in use:

SR.No	Temperature	Time
1	65.8	0.00.02
2	65.2	0.00.07
3	63.1	0.00.19
4	61.5	0.00.25
5	59.7	0.00.36
6	57.3	0.02.13
7	55.9	0.03.17
8	53.2	0.04.21
9	52.6	00.04.36
10	51.4	00.05.48
11	50	00.05.57
12	49.8	00.06.14
13	49.1	00.07.41
14	48.5	00.08.13
15	48.2	00.08.51
16	47.7	00.09.48
17	46.3	00.10.55
18	45.8	00.11.28
19	41.6	00.18.49
20	38.8	00.23.57

The Newton's Law of Cooling Formula is expressed by

Formula:- $T(t) = Ts + (T_0 - Ts)\, e^{-kt}$

Solution:-

$50=45+(65-45)\, e^{-k9}$

$5=20e^{-9k}$

$5/20 = e^{-9k}$

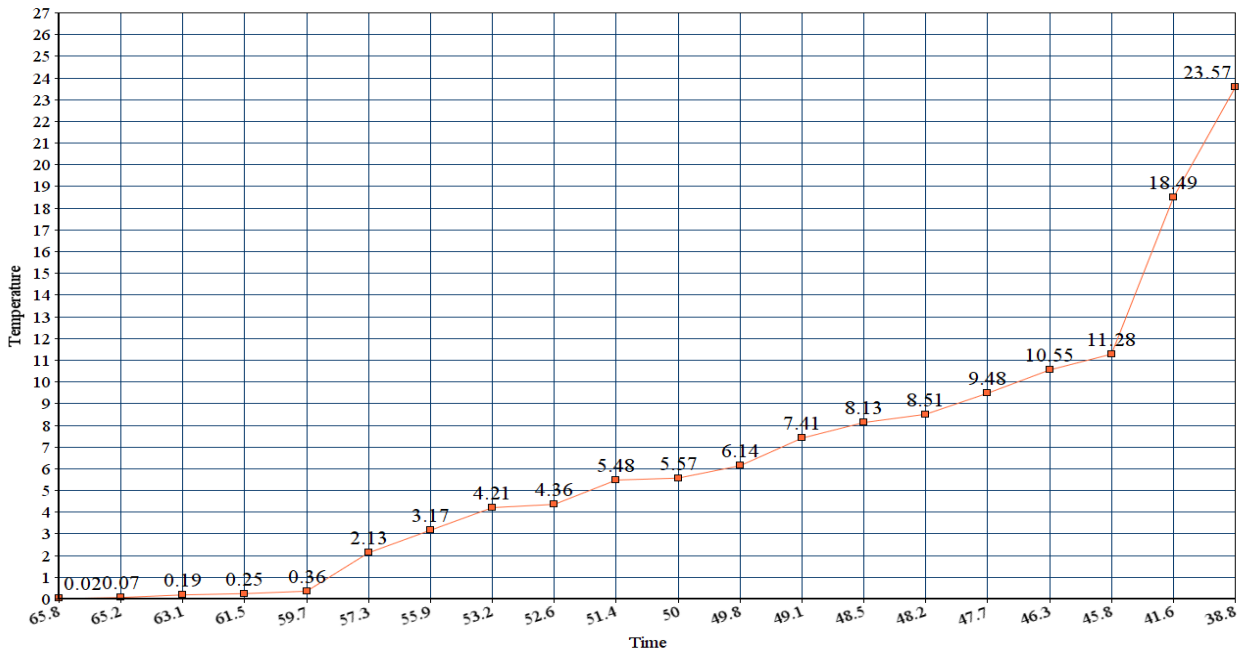
$1/4 = e^{-9k}$

$\text{Ln } 1/4 = \ln e^{-9k}$

$\ln 1/4 = -9k \ln e$ (Since ln=1)

$\ln=0.25/-9 = \ln$

K= 0.15



Graph: observation table of temperature VS time

The graph describes temperature with respect to time for a given computer system, these readings have been taken by the observations from the observation table. The graph shows the result that the temperature of the system doesn't exceeds more than the limit because of the fans present in the C.P.U with increase in time.

Conclusion:

This project depends on the principles of Newton's Law of cooling and is hygienic and innovative than different comes of identica as a result of it being addressed in a very unique manner containing all the parameters of system heating and is simple and good tha learn and implement thereon. This technique covers largely all of the content in to pick your required possibility and collect your value with no complications. This helps the user to help's to stay the track of system heating and also the heating method

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