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Emotional Stress Relief Vest – Research on Heat Dissipation

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關鍵詞：Pressure vest、Active airflow cooling system、Sandwich fabric

Abstract

Due to having Asperger's syndrome, I want to make a pressure vest suitable for hot and humid climates like Asia to help reduce the daily anxiety of children and adults with autism, ADHD, sensory disorders, etc.

To solve this problem, I first tried using a porous material. But after seeing a pressure vest in person, I found it to be useless. Therefore, I came up with the idea of creating an active airflow cooling system between the body and the pressure vest. To experiment, I wanted to make pressure vests. However, I found that a high-frequency TPU welding machine is required. Thus, I made models of pressure vests using airbags, water-resistant nylon, and quick-drying fabric. I also made models, which came from sandwich fabric.

Through this research, I discovered that the sandwich fabric design has the best passive heat dissipation, and the combination of the sandwich fabric and the active airflow cooling system has the best active heat dissipation.

I. Introduction

A. Motivation

An emotional stress relief vest, also known as a pressure vest, compresses the body to form a wrapping feeling. This device is proven by much research to provide comfort for most patients (children and adults alike) with autism, ADHD, sensory disorder, etc. When they are exhibiting the anxious symptoms associated with their particular disorder. The stable, womb-like comfort provided by the pressure vest can relax and ease their emotional stresses, thus helping them in their daily lives.

Fig. 1. Squease vest

This device is of particular personal interest because I have Asperger's syndrome and my anxiety had previously led to me to several possibly harmful reactions in the hope of gaining relief. To carry out normal daily activities I had to take medicine to lower my anxiety levels, but the dosage necessary to obtain a non-anxious mindset was not enough to carry me through a normal school day. I found however that wearing a pressure vest is a better way to reduce anxiety that does not need large doses of anti-stress medication. With this intimate personal experience, I firmly believe that pressure vests can help other people with the same difficulties.

Nevertheless, the problem is pressure vests currently developed by companies in temperate, sub-polar, and polar countries cannot be worn for a long time by people living in tropical or subtropical regions as they live in hot and humid weather. Thus, I wanted to study whether an active airflow cooling system could be used to give a heat dissipation function between the pressure vest and the human body. Logically, a pressure vest with improved, controllable heat dissipation would provide a better quality of life for patients with autism, ADHD, sensory disorder, etc., living in hot and humid climates.

B. Purposes

(I). Design a pressure vest with better ventilation and heat dissipation.

C. Literature Review

(I). Heat Dissipation

Heat dissipation occurs because of temperature difference between objects. When an object has a higher temperature than the ambient environment, it dissipates heat to the ambient environment.

There are three main ways for heat to dissipate: conduction, convection, and radiation.

(A). Conduction is the transfer of thermal energy by the microscopic collision of particles.

(B). Convection is the process by which heat is transferred via the movement of molecules within a fluid.

(C). Radiation is the transfer of thermal energy by electromagnetic radiation when two objects are not in physical contact, where the heat of an object of higher temperature transfers to an object of lower temperature.

Two other types of heat transfer are less well-known: diffusion and advection, where diffusion is the net movement of particles from high concentration to low concentration. Advection is the motion of particles along with a bulk flow.

(II). Thermal Conductivity

Thermal conductivity refers to the ability of an object to conduct heat. The rate at which an object with an intrinsically higher thermal conductivity transfers heat is higher than an object of lower thermal conductivity, and can be calculated using the following formula:

$$K = \frac{Qd}{A\Delta T},$$

where K is thermal conductivity, Q is the amount of heat transferred, d is the distance between the two planes, A is the area of the surface, and ΔT is the temperature difference.

(III). From Solar Water Heating to the Heat Transfer of the Pressure Vest

An active solar water heating system with a flat plat water collector has a pump which controls the volume of the water flowing through parallel pipes in a collector. In a direct system, the water passing through the tubes in the collector is heated directly by the sunlight through Infra-red rays.

In our heat transfer system, I plan to transfer body heat by adding tubes under the vest to warm the water. In the vest I have designed, the parallel tubes in the collector have a similar arrangement to the original heat transfer system, while the fan in our system serves as the pump. In the same way used in an active solar water heating system, the human body becomes the heat source. Therefore, after understanding the theory and using a mathematical analysis of a solar water heating system, I was able to formulate a theory to calculate the heat transfer efficiency of our system.

(A). Solar water heating formula:

For a solar water heating system, the energy balance can be described as:

$$Q_u = Q_s - Q_l,$$

where Q_u is the energy flux that can be used, Q_s is the energy flux emitted from sunlight, and Q_l is the ambient energy flux release. The optical properties of the collector are the most influential factors effecting energy absorption, thus Q_s can be expressed as:

$$Q_s = A_c I \tau \alpha.$$

With A_c representing the area of the collector, I is total solar radiation on the surface of the collector, τ is transmittance, and α is absorbance. For a flat-plate collector, the heat is released to the air through the top, back and sides of the collector which can be estimated as:

$$Q_l = \mathrm{A_c U_l} \left(\mathrm{T_c} - \mathrm{T_a}\right),$$

where Q_l is the heat loss coefficient, is the temperature of the collector whereas is the temperature of the ambient. Thus $\mathrm{Q_u} = \mathrm{Q_s} - \mathrm{Q_l} = \mathrm{A_c}[\mathrm{I}\tau\alpha - \mathrm{U_l}\left(\mathrm{T_c} - \mathrm{T_a}\right)]$.

Collector efficiency η the ratio of $\mathrm{Q_u}$ collected by the collector per unit time,

$$\eta = \frac{\int \mathrm{Q_u dt}}{\mathrm{A_c} \int \mathrm{I\,d\,t}}.$$

(B). The formula for an Active Airflow Cooling System

With the human body acting as the sun, the energy flux emitting from the body $\mathrm{Q_b}$ equals to $\mathrm{Q_s}$, and a very little $\mathrm{Q_l}$, the energy to be released $\mathrm{Q_r}$ can be estimated as

$$\mathrm{Q_r} = \mathrm{Q_b} - \mathrm{Q_l} \approx Q_b = A\mathrm{I}\tau\alpha.$$

Energy transfer efficiency η remains the same,

$$\eta = \frac{\int \mathrm{Q_u dt}}{\mathrm{A_c} \int \mathrm{I\,d\,t}}.$$

$$cm\frac{dT}{dt} = \mathrm{Q_u} \approx Q_b,$$

$$cm\int dT = Cm\left(T_f - T_i\right) = Q_u \int dt.$$

Where c is the specific heat capacity, m is the mass of the air flowing through the tubes in the vest, T_i is the temperature of the air entering the tube and T_f is the temperature of the air voided.

II. Equipment

A. Hardware

(I). BIDDEFORD Electric Blanket	(II). Sewing Mannequin
	
(III). Porous Material	(IV). Balloons
	
(V). Squease Vest	
	
(VI). Water – resistant Nylon	(VII). Quick-drying Fabric
	
(VIII). Airbags	(IX). Tubes and Connectors
	

Fig 4. Hardware

B. Electronics

(I). FLIR Thermographic Camera	(II). Seek Thermographic Camera
	
(III). FLEXTAILGEAR MAX Pump 2	
	

Fig. 2. Electronics

C. Software

(I). Python	(II). ImageJ
(III). MATLAB	(IV). Microsoft Excel

Fig. 3. Software

III. Methods

A. Porous Material

In the first pre-experiment, I hypothesized that putting a porous material between the inflation layer and the body could solve the heat problem because porous material is known to be an effective dissipation medium. This experiment uses an electric blanket to simulate the body and balloons to simulate the pressure vest when inflated.

(I). Experimental Procedure

(A). Select a porous material.

(B). Heat the electric blanket.

(C). Measure the temperature at 5, 10, 15, 20, 25, and 30 centimeters with the thermographic camera.

(D). Put balloons on the electric blanket.

(E). Repeat (C).

(F). Apply the porous material between the balloons.

(G). Repeat (C).

(H). Wrap the balloons in the porous material and place them on an electric blanket.

(I). Repeat (C).

(J). Record the temperatures with Microsoft Excel.

B. Squease Vest

After the arrival of the Squease vest, I found that the passive porous material theorem won't work (see V. A.). For the second pre-experiment, I test the thermal conductivity of the Squease vest, inflated and uninflated. This experiment also uses an electric blanket to simulate body heat while the Squease vest is mounted realistically on a sewing mannequin.

(I). Experimental Procedure

(A). Mount the electric blanket to the sewing mannequin.

(B). Heat the electric blanket, to a specific temperature, turn the power off, and start recording with the thermographic camera.

(C). Mount the Squease vest over the electric blanket on the mannequin.

(D). Repeat (B).

(E). Inflate the Squease vest.

(F). Repeat (B).

(II). Data Analysis

(A). Convert Video to Frames

I wrote a program in Python to convert video to frames.

(B). Calculate the RGB values

RGB separation of the frames using ImageJ, then save it as a text file to record the RGB values.

(C). Measure the temperature of each frame

Compare the RGB values of each frame to the RGB values of the color bar in MATLAB. Export the matrix into Microsoft Excel to obtain the temperature of each pixel.

(D). Graph the Temperature

After analyzing in MATLAB, import the average temperature of each frame to a new Excel form, then graph it.

C. Pressure Vest

To produce a pressure vest with better ventilation and heat dissipation, I made a new hypothesis by creating an active airflow cooling system between the pressure vest and the body, the heat problem could possibly be solved. I also tested other methods in comparison with the active airflow cooling system.

High-frequency welding of TPU films, which is a method to seal the fabrics is needed to produce pressure vests. Thus, I made models of pressure vests, using airbags, water-resistant nylon, and quick-drying fabric.

(I). Models

(A). Nomenclature

1. Material

AB = Airbags

WN = Water-resistant Nylon

QF = Quick-drying Fabric

2. Designs of the models

PV = WN + AB + WN

R11 = The ratio between the airbags and the interval between the airbags are 1 to 1.

R12 = The ratio between the airbags and the interval between the airbags are 1 to 2.

H2.5 = The diameter of the holes punched through the interval between the airbags are 2.5mm.

H7.0 = The diameter of the holes punched through the interval between the airbags are 7.0mm.

AF150 = The airflow rate of the active airflow cooling system is 150LPM.

AF300 = The airflow rate of the active airflow cooling system is 300LPM.

3. List of Models

(1). PV + R11

(2). PV + R12

(3). PV + R11 + H2.5

(4). PV + R11 + H7.0

(5). PV + R12 + H2.5

(6). PV + R12 + H7.0

(7). QF + PV + R11 + H2.5

(8). QF + PV + R11 + H7.0

(9). QF + PV + R12 + H2.5

(10). QF + PV + R12 + H7.0

(11). QF + PV + R11 + H2.5 + QF

(12). QF + PV + R11 + H7.0 + QF

(13). QF + PV + R12 + H2.5 + QF

(14). QF + PV + R12 + H7.0 + QF

(15). QF + AF150 + PV + R11

(16). QF + AF300 + PV + R11

(17). QF + AF150 + PV + R12

(18). QF + AF300 + PV + R12

(19). QF + AF150 + PV + R11 + H2.5 + QF

(20). QF + AF150 + PV + R11 + H7.0 + QF

(21). QF + AF300 + PV + R11 + H2.5 + QF

(22). QF + AF300 + PV + R11 + H7.0 + QF

(23). QF + AF150 + PV + R12 + H2.5 + QF

(24). QF + AF150 + PV + R12 + H7.0 + QF

(25). QF + AF300 + PV + R12 + H2.5 + QF

(26). QF + AF300 + PV + R12 + H7.0 + QF

(B). Model Diagrams

Fig. 5 to Fig. 14 are the diagrams of the models, the yellow area is the airbags, the blue area is the water-resistant nylon, the green area is the quick-drying fabric, and the red area is the pathway for the active airflow cooling system.

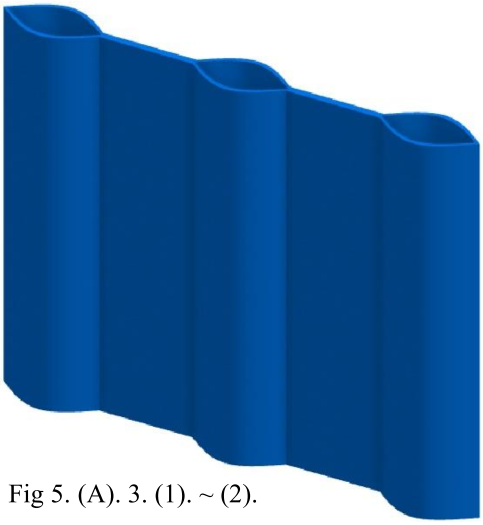

Fig 5. (A). 3. (1). ~ (2).

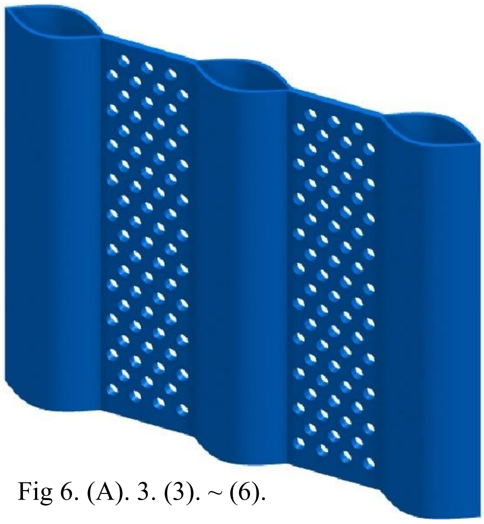

Fig 6. (A). 3. (3). ~ (6).

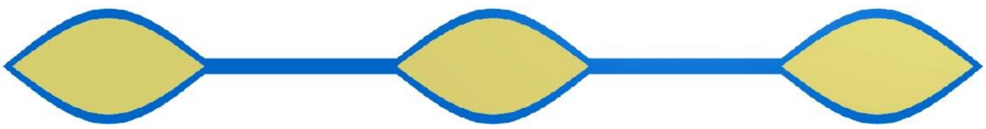

Fig 7. Cross Section view of (A). 3. (1). ~ (6).

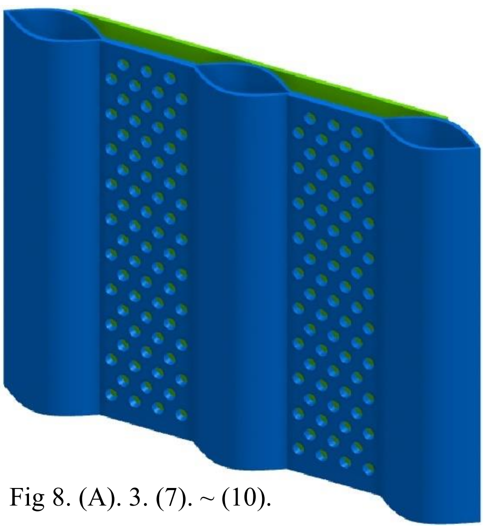

Fig 8. (A). 3. (7). ~ (10).

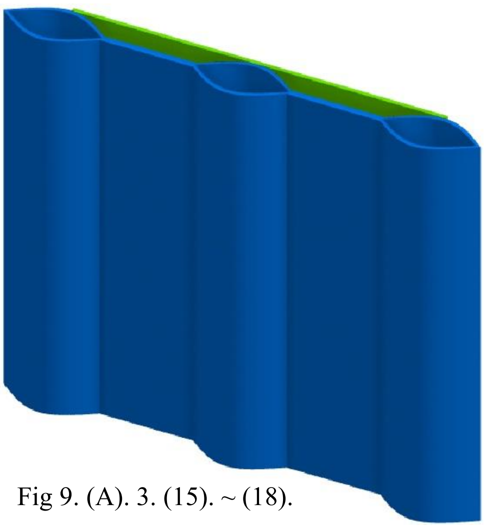

Fig 9. (A). 3. (15). ~ (18).

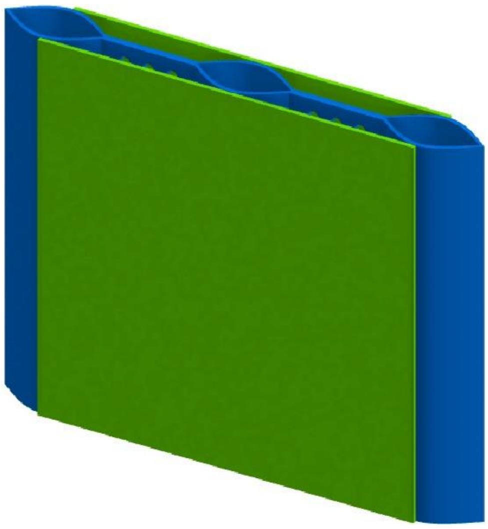

Fig 10. (A). 3. (11). ~ (14). and (19). ~ (26).

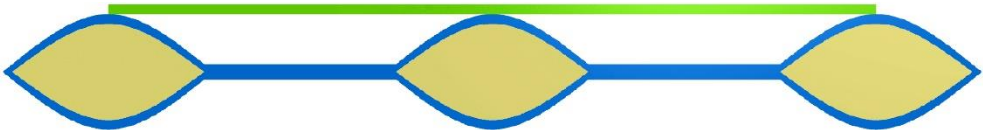

Fig 11. Cross Section view of (A). 3. (7). ~ (10).

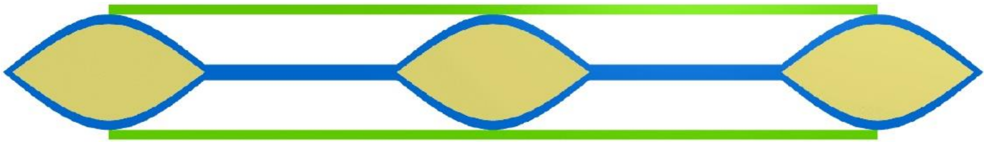

Fig 12. Cross Section view of (A). 3. (11). ~ (14).

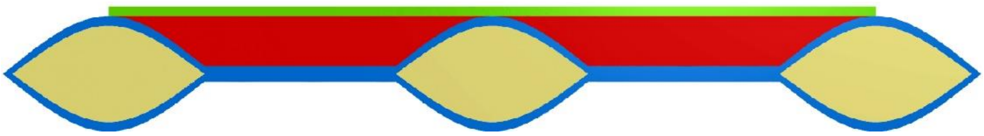

Fig 13. Cross Section view of (A). 3. (15). ~ (18).

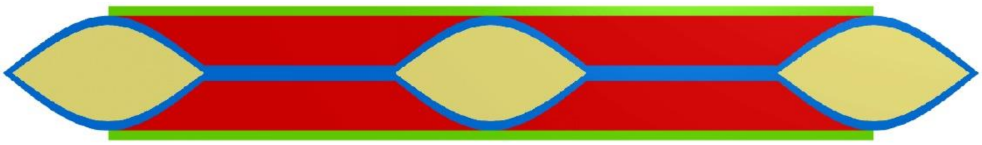

Fig 14. Cross Section view of (A). 3. (19). ~ (26).

(II). Experimental Procedure

(A). Mount the electric blanket to the sewing mannequin.

(B). Heat the electric blanket, to a specific temperature, turn the power off, and start recording with the thermographic camera.

(C). Heat the electric blanket, to a specific temperature.

(D). Wrap the water-resistant nylon over the electric blanket.

(E). Turn the power of the electric blanket off and start recording with the thermographic camera.

(F). Unwrap the water-resistant nylon.

(G). Repeat (C).

(H). Wrap the quick-drying fabric over the electric blanket.

(I). Repeat (E).

(J). Unwrap the quick-drying fabric.

(K). Repeat (C).

(L). Mount a model over the electric blanket on the mannequin.

(M). Repeat (E).

(N). Take the model off.

(O). Repeat (K). ~ (N). until all the models have been tested.

(III). Data Analysis

(A). Convert Video to Frames

I wrote a program in Python to convert video to frames.

(B). Measure the temperature of each frame

I wrote another program in Python, which extracts the RGB values of each frame and the RGB values of the color bar and then compares the two values and exports the two-dimensional array into Microsoft Excel to obtain the temperature of each pixel.

(C). Graph the Temperature

Import the average temperature of each frame to a new Microsoft Excel form to graph the chart.

IV. Results

A. Porous Material

Halfway through this experiment, I found that the passive porous material theorem won't work (see V. A.).

B. Squease Vest

The initial temperature of the electric blanket is set at 318.5 Kelvin.

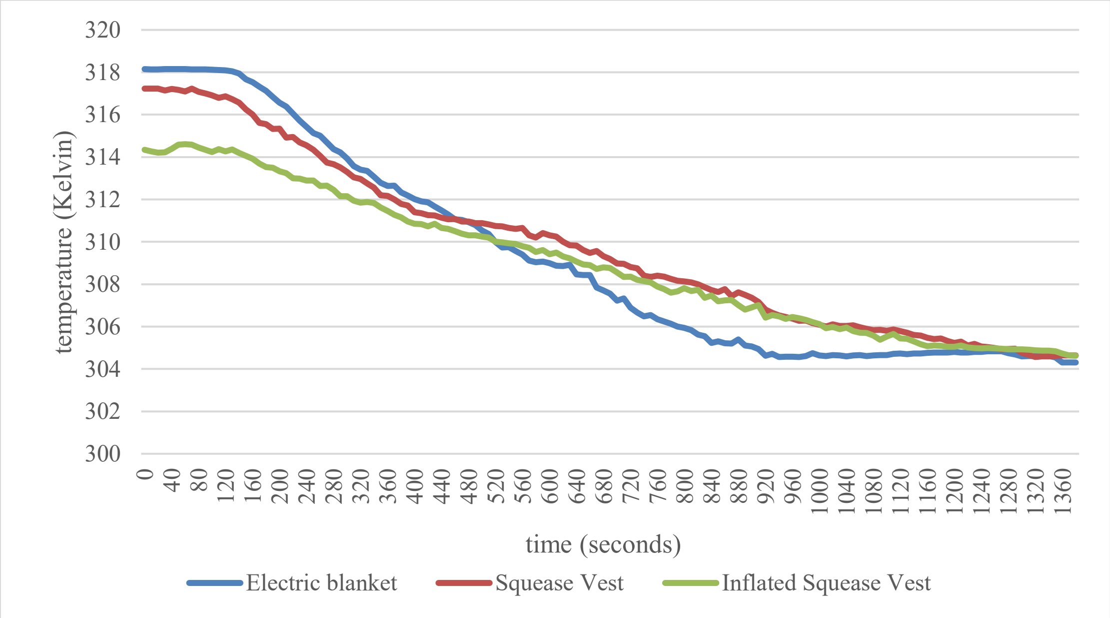

Fig 15. Results of the Squease Vest Experiment

(I). 0 to 450 seconds

From 0 to 450 seconds, the heat of the electric blanket is conducted to the Squease vest.

(A). Thermal Conductivity of Squease Vest

$$K = \frac{Qd}{A\Delta T}$$

Q is $75W$ according to the user manual, d is $1mm$, which equals $0.001m$, A is a constant value, ΔT is equal to the temperature of the electric blanket – the temperature of the Squease vest, which is $318.15 - 317.23 = 0.92$

$$K = \frac{75 \times 0.001}{0.92} = 0.082$$

(B). Thermal Conductivity of Inflate Squease Vest

$$K = \frac{Qd}{A\Delta T}$$

Q is $75W$ according to the user manual, d is $4mm$, which equals $0.004m$, A is a constant value, ΔT is equal to the temperature of the electric blanket – the temperature of the inflated Squease vest, which is 318.15 – 314.39=3.82

$$K = \frac{75 \times 0.004}{3.82} = 0.078$$

(II). 450 to 500 seconds

During this time the temperature of the electric blanket equals the temperature of the Squease vest.

(III). 500 to 1350 seconds

Between this time, the Squease vest retains the heat of the electric blanket inside, acting as thermal clothing.

C. Pressure Vest

In all charts, the initial temperature of the electric blanket is set at 318.15 Kelvin.

(I). Fabrics

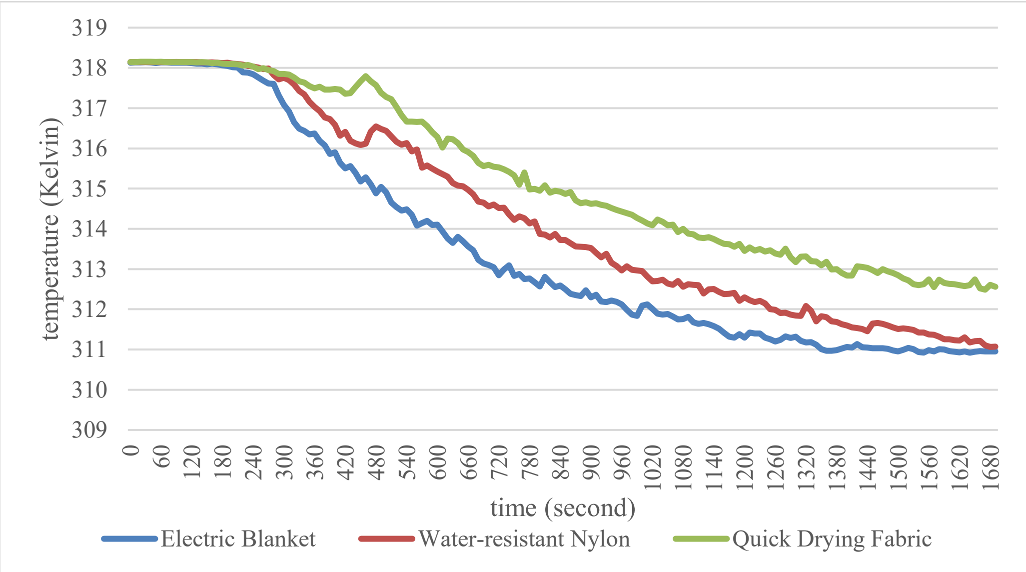

Fig 16. Fabrics

The quick-drying fabric used in this experiment came from Taiwan Textile Research Institute. Although it absorbs and drains moisture quickly, it does not perform well with heat dissipation.

(II). The ration between the airbags and the interval between the airbags

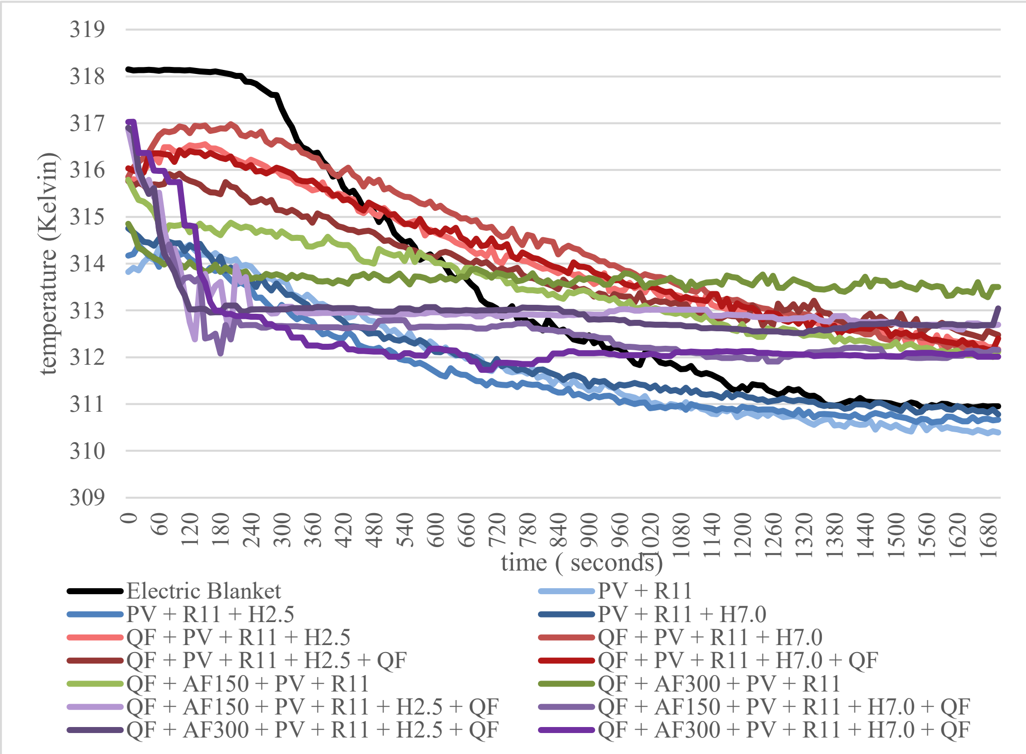

Fig 17. R11

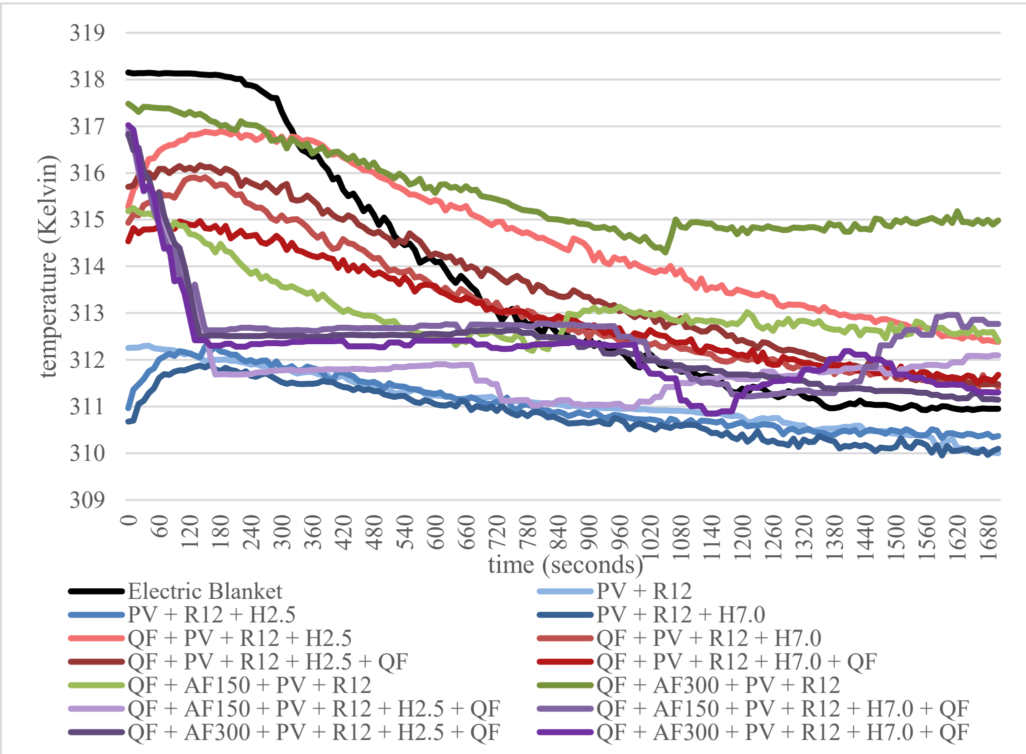

Fig 18. R12

In both charts, the incline of the red and blue lines is similar, but the blue lines' initial temperature is lower compared to the red lines', which implies the red lines have a higher thermal conductivity.

The green lines are the active airflow cooling system, in which temperature declines fast at first and then remains relatively steady. The purple lines are a combination of designs, resulting in an even faster decline in temperature than the green lines.

(III). The blue lines in Fig 17. and Fig 18.

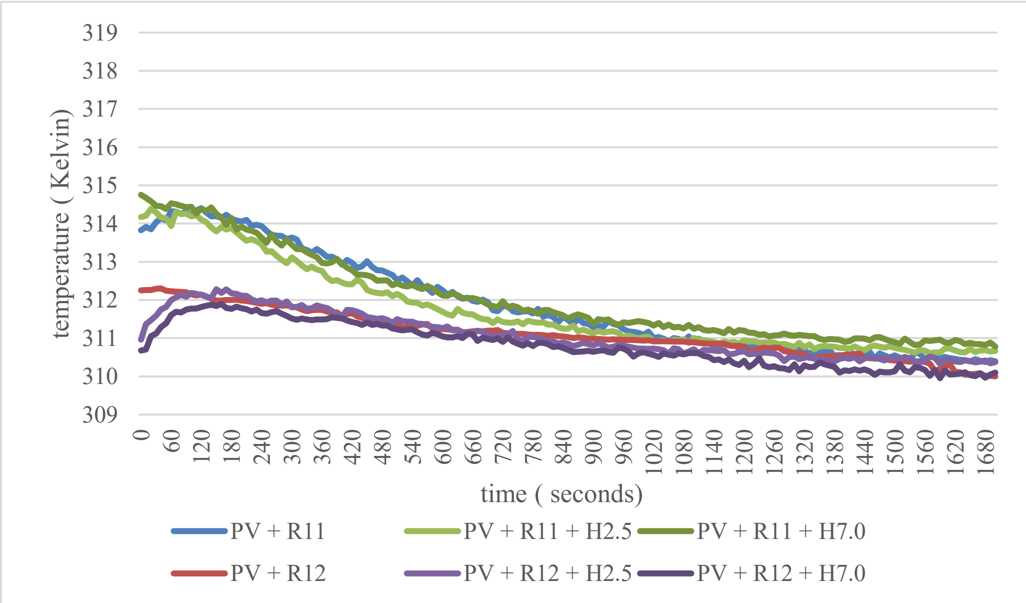

Fig 19. Blue Lines

This chart is the comparison of the blue lines in Fig 17. and Fig 18. The blue and red lines in this chart are models with no design, and the green and purple lines are models with holes punched through the interval between the airbags.

This chart shows that models with holes punched through the interval between the airbags have little to no effect on the dissipation of heat.

The green lines are models with a 1 to 1 ratio between the airbags and the interval between the airbags, and the purple lines are the 1 to 2 ratio models. The green lines' initial temperature is higher than the purple lines', which means that the green lines have better thermal conductivity.

(IV). The red lines in Fig 17. and Fig 18.

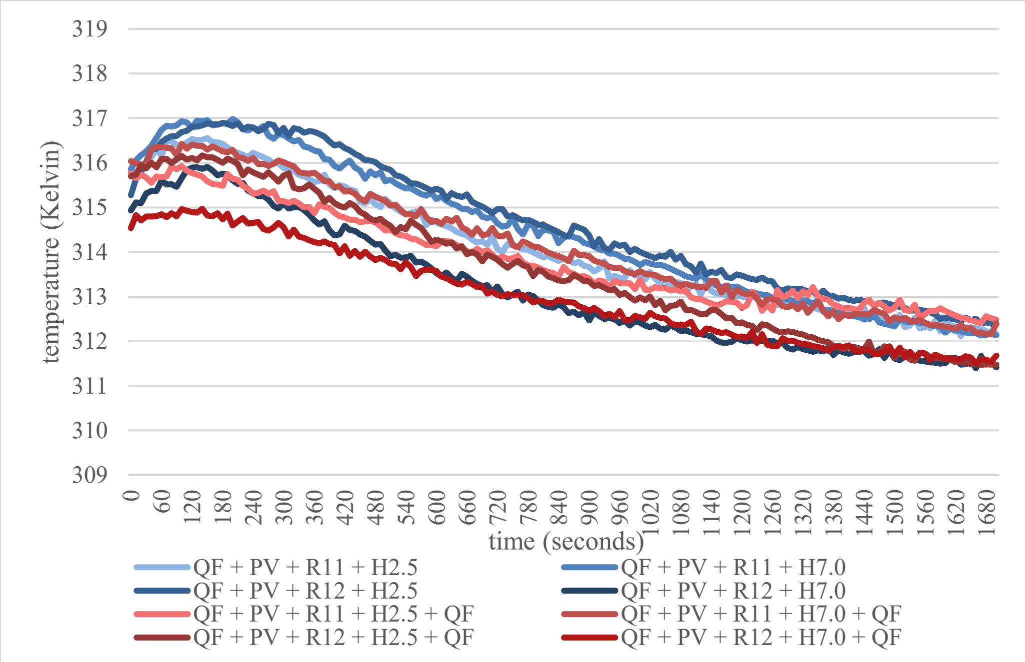

Fig 20. Red Lines - Design

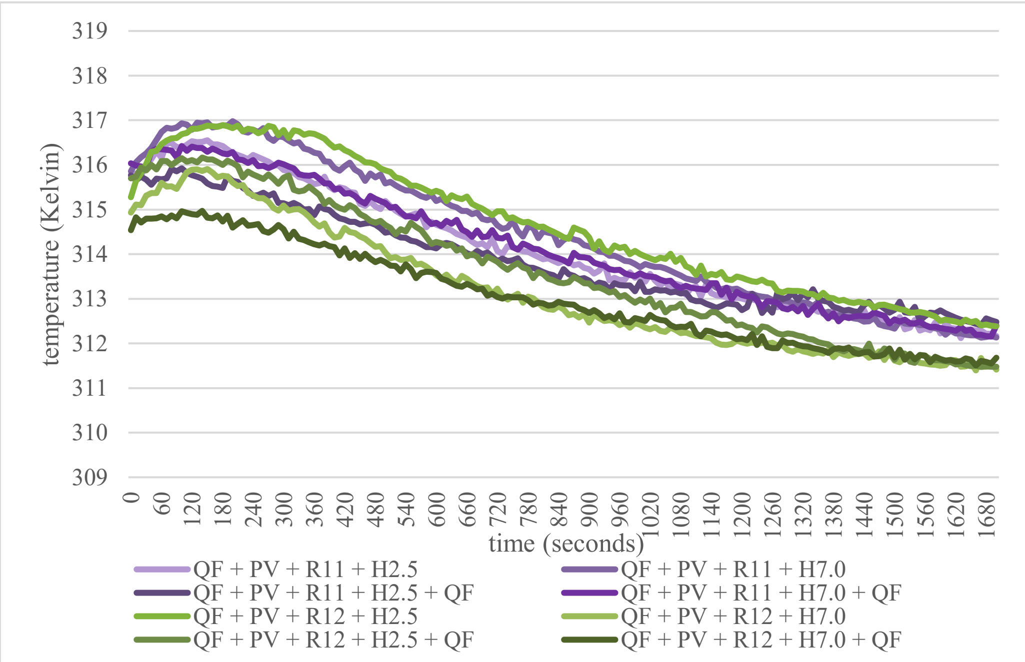

Fig 21. Red Lines – R11 & R12

Both charts are the comparison of the red lines in Fig 17. and Fig 18.

In Fig 20. the blue lines are models with holes punched through the interval between the airbags with a quick-drying fabric between the model and the electric blanket, and the red lines are the same models as the blue lines but with another layer of quick-drying fabric covering the model.

Fig 20. shows that the blue lines climb up to a higher temperature before declining, and more red lines drop to a lower temperature at the end, which entails that the red lines have better heat dissipation.

The purple lines in Fig 21. have a ratio of 1 to 1 between the airbags and the interval between the airbags, and the green lines are a ratio of 1 to 2, and the purple lines have a much more similar performance than the green lines.

(V). The green lines in Fig 17. and Fig 18.

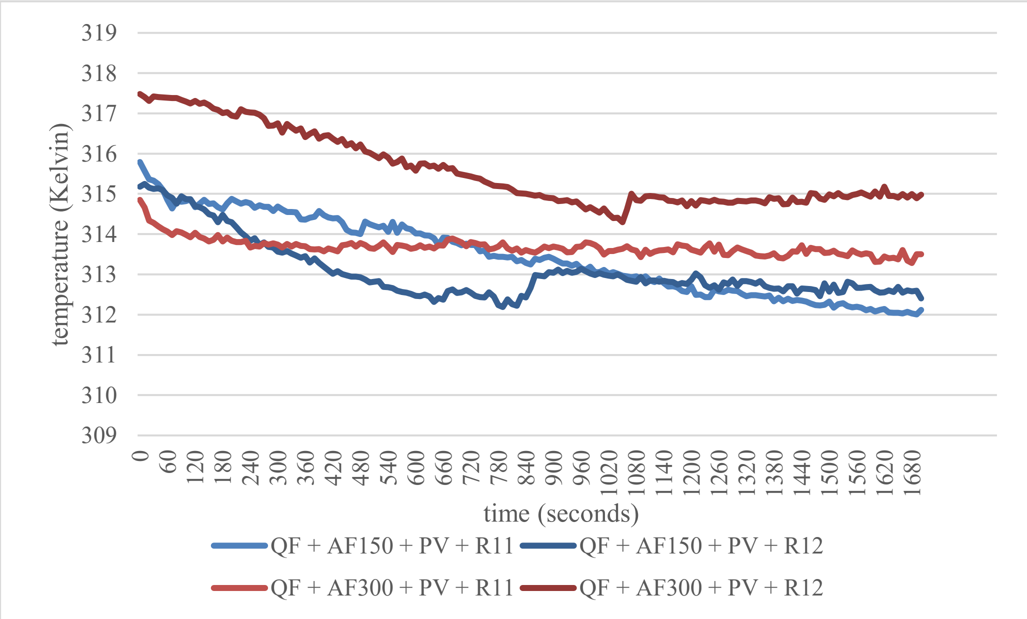

Fig 22. Green Lines – Airflow

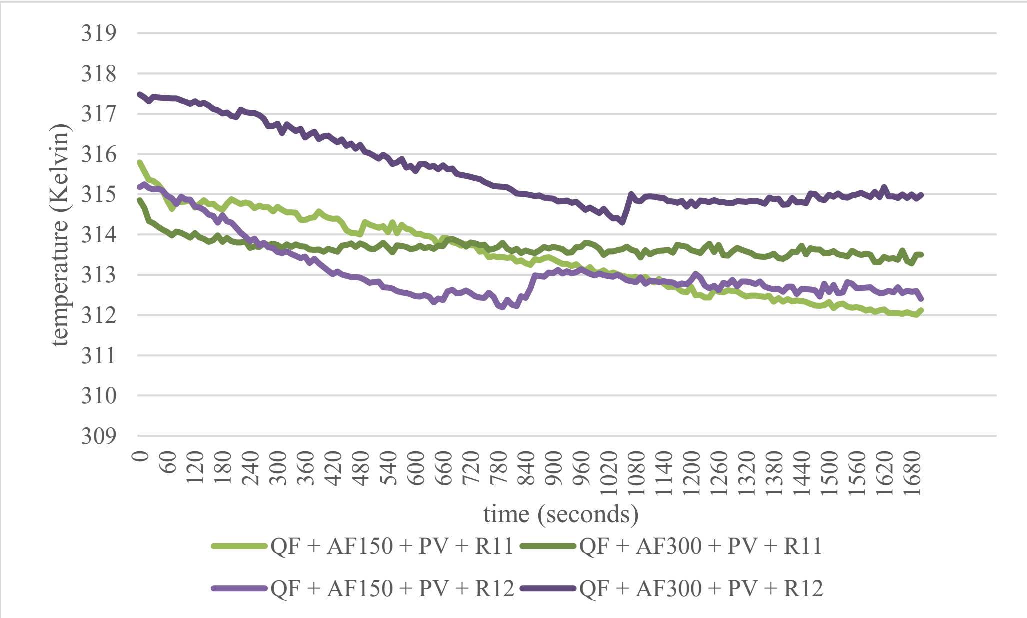

Fig 23. Green Lines – R11 & R12

Both charts are the comparison of the green lines in Fig 17. and Fig 18.

As shown in Fig 22., the blue lines, airflow 150LPM dissipates heat better than the red lines, 300LPM.

In Fig 23. the green lines, models with a 1 to 1 ratio between the airbags and the interval between the airbags have a more identical performance than the purple lines, 1 to 2 ratio. I suspect that the pathways with the purple lines are too big, which causes it to have turbulence.

(VI). The purple lines in Fig 17. and Fig 18.

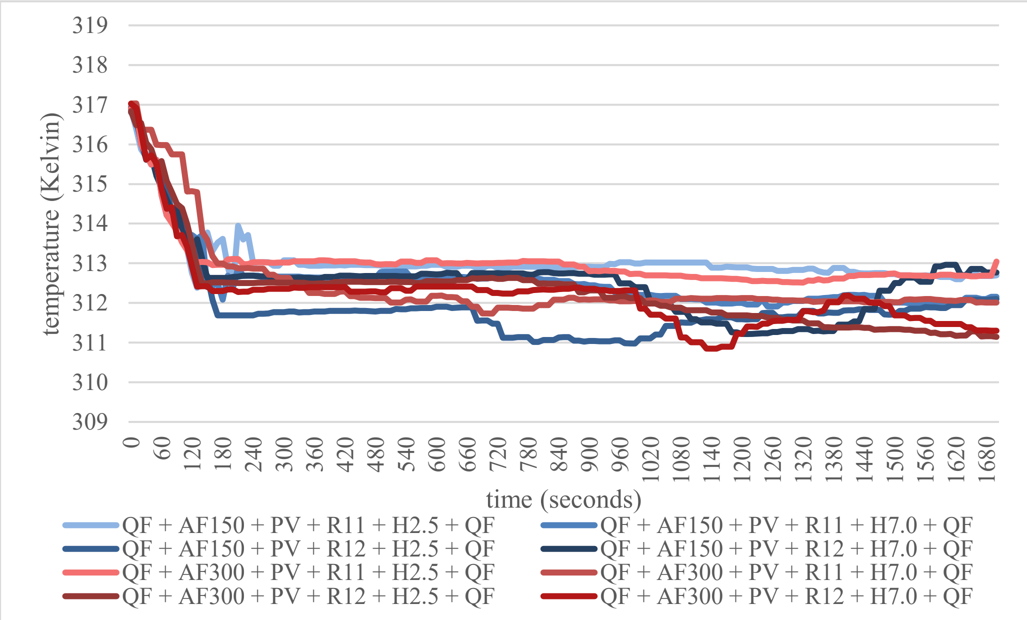

Fig 24. Purple Lines – Airflow

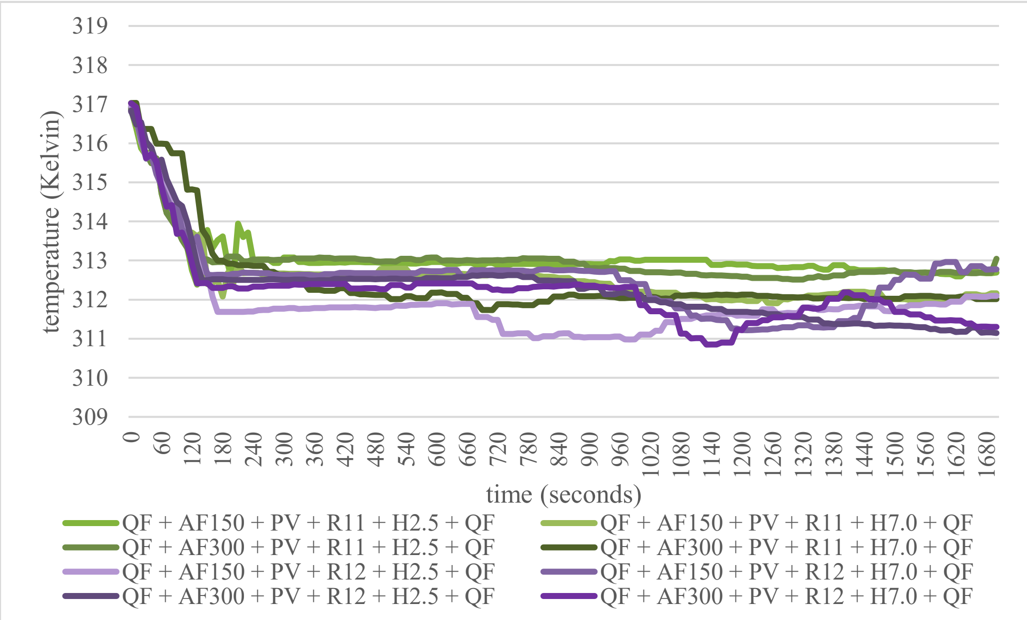

Fig 25. Purple Lines – R11 & R12

Both charts are the comparison of the purple lines in Fig 17. and Fig 18.

Fig 24. shows the blue lines, airflow 150LPM, and the red lines, airflow 300LPM having similar performance.

As shown in Fig 25., the green lines, which have a ratio of 1 to 1 between the airbags and the interval between the airbags, dissipate heat better than the purple lines, which are of 1 to 2 ratio.

V. Discussion

A. Porous Material

I bought a "Squease" vest (the most common inflatable pressure vest on the market) for this research. Before the Squease vest arrived, I used balloons to simulate the inflated parts. After the arrival of the Squease vest, I found that when the Squease vest inflates, it puts pressure on the porous material, expelling the air and rendering it useless.

B. Squease Vest

Through this experiment, I found that the thermal conductivity of the Squease vest is 0.082W/m·K, and the thermal conductivity of the inflated Squease vest is 0.078 W/m·K.

C. Pressure Vest

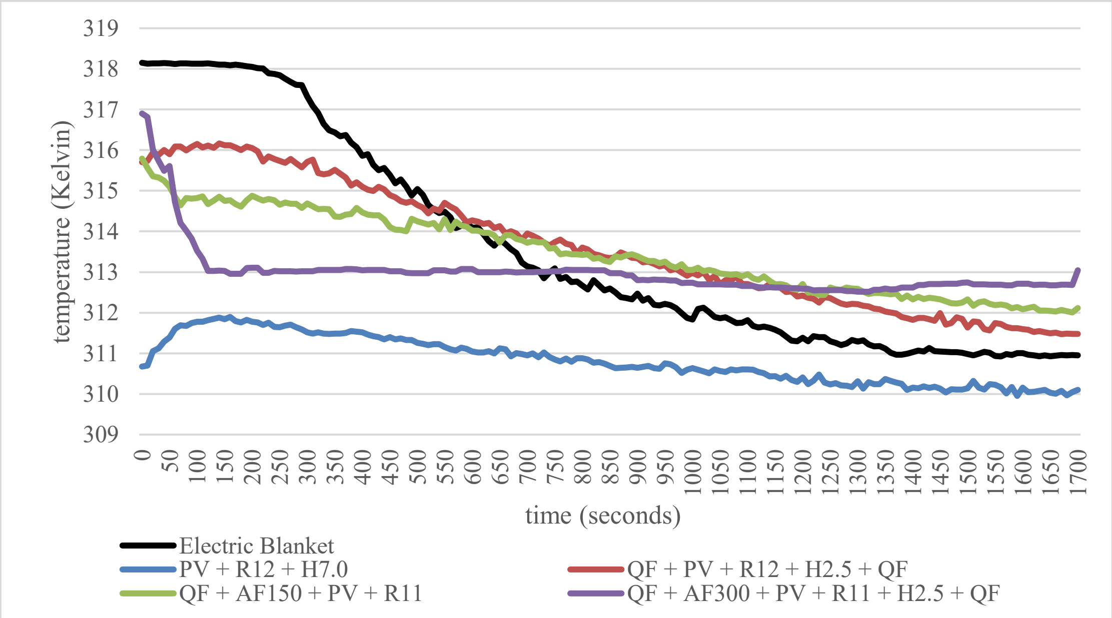

Fig 26. Discussion – Pressure Vest

The blue line, models with holes punched through the interval between the airbags, have the worst heat dissipation.

The red line's design came from the idea of sandwich fabric, which is a weaving technique often used when combining two different textiles into one fabric. It has the best passive heat dissipation.

The green line is the active airflow cooling system, the temperature first declines at a fast rate and then slows down. I infer that the ambient air is not cool enough to dissipate heat, and the pump of the active airflow cooling system overheats, causing the air pumped in to get hotter.

The purple line, which combines the design of the red and green lines, dissipates heat at the fastest rate in the beginning, but the same as the purple line, the temperature slows down. If I were to add a cooling device to the active airflow cooling system, the problem could be solved.

VI. Conclusion

The purpose of this research is to design a pressure vest with better heat dissipation Via this research, I found that for a passive approach, sandwich fabric, which is a weaving technique often used when combining two different textiles into one fabric is a feasible method. For an active approach, combining the sandwich fabric with the active airflow cooling crime system is the proposed solution.

For the sandwich fabric design, I am currently using a quick-drying fabric, whereas using a material that has high thermal conductivity and a high heat dissipation rate should lead to better results. As for the design of the active airflow cooling system, it should be equipped with a thermoelectric cooling module to control the temperature of the airflow.

I hope that by developing a sandwich fabric, which combines polyethylene-coated nylon and a textile with high thermal conductivity and a high heat dissipation rate can reduce the cost of the pressure vest, with the Squease vest, which is the cheapest inflatable pressure vest on the market, costing £245.00, reducing the price of the pressure vest can allow it to benifit more people.

The ideal pressure vest ought to be constructed of a sandwich fabric developed for this intended use, with a dual pumping system, one to inflate and deflate the vest, and another is the active airflow cooling system with a thermoelectric cooling module to pump air into the pathway created by the sandwich fabric. The dual pumping system can include a temperature sensor to detect the ambient temperature, and a processor can be used to adjust the thermoelectric cooling module accordingly, the processor can also send the data to software, and a controller to control when to inflate and deflate the pressure vest, and when to activate and deactivate the active airflow system or the frequency it starts, and the temperature of the thermoelectric cooling module.

Fig 27. shows the ideal pressure vest's design. The black areas are buckle straps to adjust the width of the vest, the red areas are the shoulder straps with Velcro to join with the front of the vest, the blue and green areas are the sandwich fabric, and the orange areas are the double pumping system with the thermoelectric cooling module, the temperature sensor, the processor, and the controller.

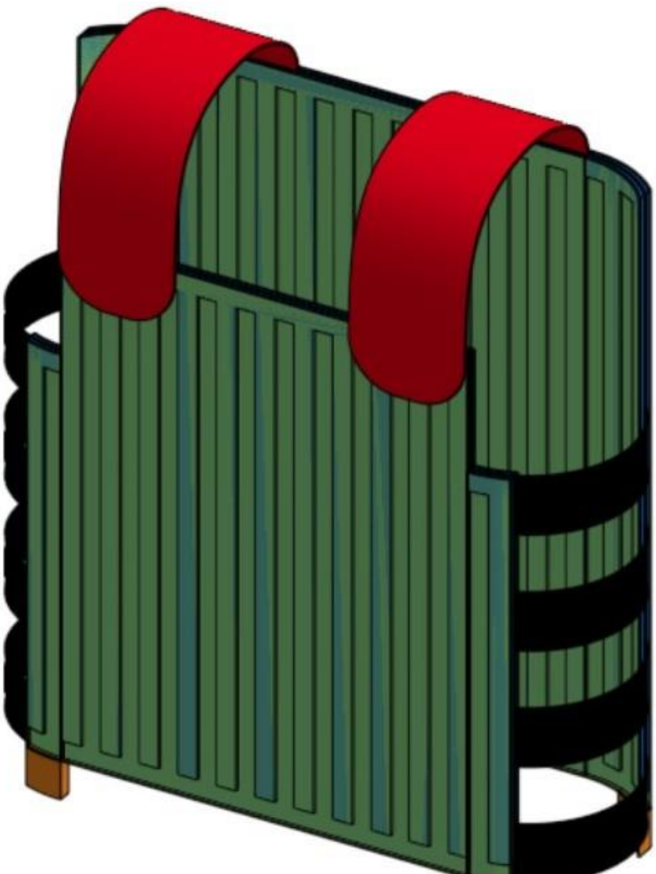

Fig. 27. Pressure Vest

VII. Reference

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【評語】052411

本研究研發一具有改良壓力背心通風與散熱效果之壓力釋放背心，使此背心適用於亞熱帶地區，讓患者能以較低價格購入與長時間穿戴，選用防水尼龍、氣囊、多孔材料、主動性氣流冷卻系統等以製作壓力背心，針對所建議二十六種背心模型進行實驗，最終獲得三明治纖維與促進氣流降溫設計之散熱紓壓效果最佳，立意甚佳，可提供亞斯伯格症等患者適用之背心。研究方法謹慎且具有條理，但研究內容缺乏實際作品照片，同時，缺乏估算自製背心之熱傳導係數，此外，壓力背心中多種操作變因對散熱效果之影響，宜依據試驗量測所得數據結果，提供統整性說明分析。

作品簡報

Project ID: 052411

Emotional Stress Relief Vest – Research on Heat Dissipation

01 Introduction

- Motives:
  - For those with Autism, ADHD, sensory disorder, etc.
  - Provides comfort, better focus, and lowers anxiety by a hugging feeling.
  - I suffer from Asperger’s Syndrome.
  - Need to a wear pressure vest in daily life.
  - Developed by temperate countries.
  - Too hot for those living in hot and humid climates.
- Objective:
  - Design a pressure vest with better heat dissipation.

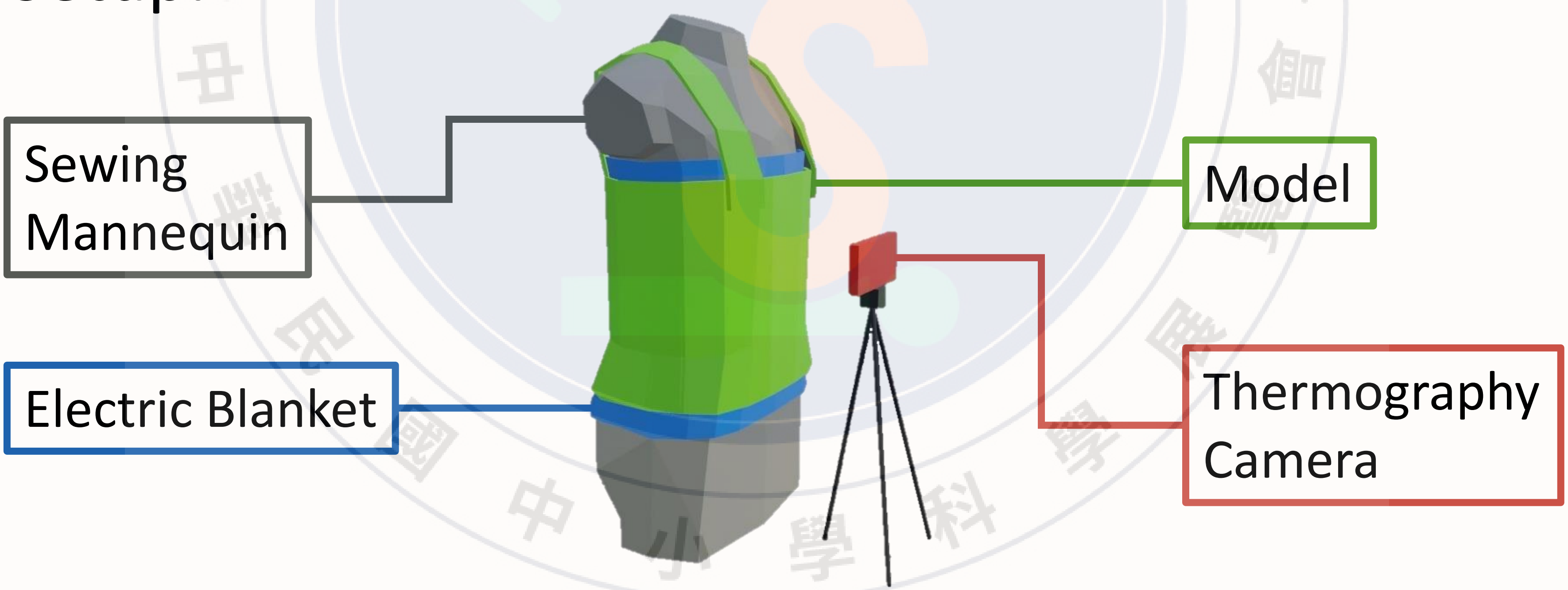
Pressure Vest

02 Method

- Experiments:

Porous Material → Squease Vest → Pressure Vest

- Setup:



02 Method

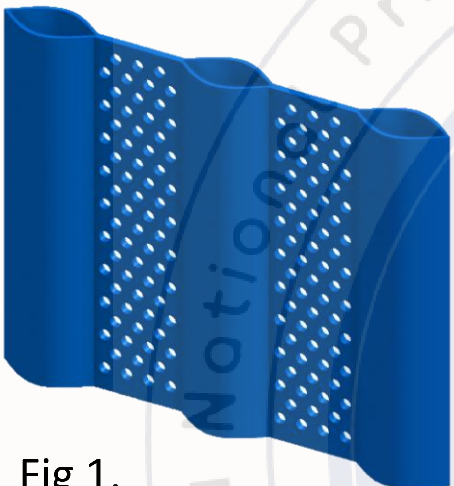


Fig 1.

Fig 2.

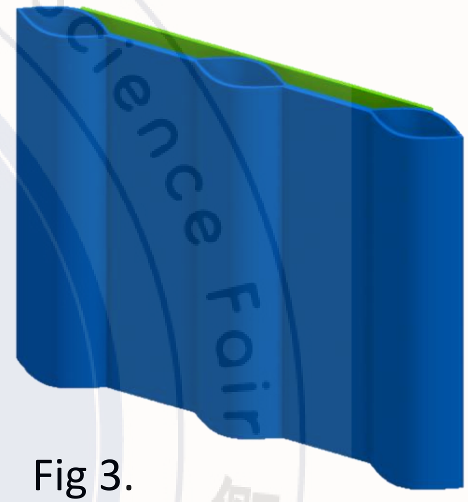


Fig 3.

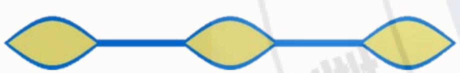


Fig 4.

Fig 5.

Fig 6.

Fig 7.

- Airbags
- Water-resistant Nylon
- Quick-drying Fabric
- Airflow

- Fig 1. + Fig 4. Models with holes
- Fig 2. + Fig 5. Sandwich Fabric
- Fig 3. + Fig 7. Active Airflow Cooling System
- Fig 2. + Fig 6. Sandwich Fabric with Active Airflow Cooling System

03 Analysis

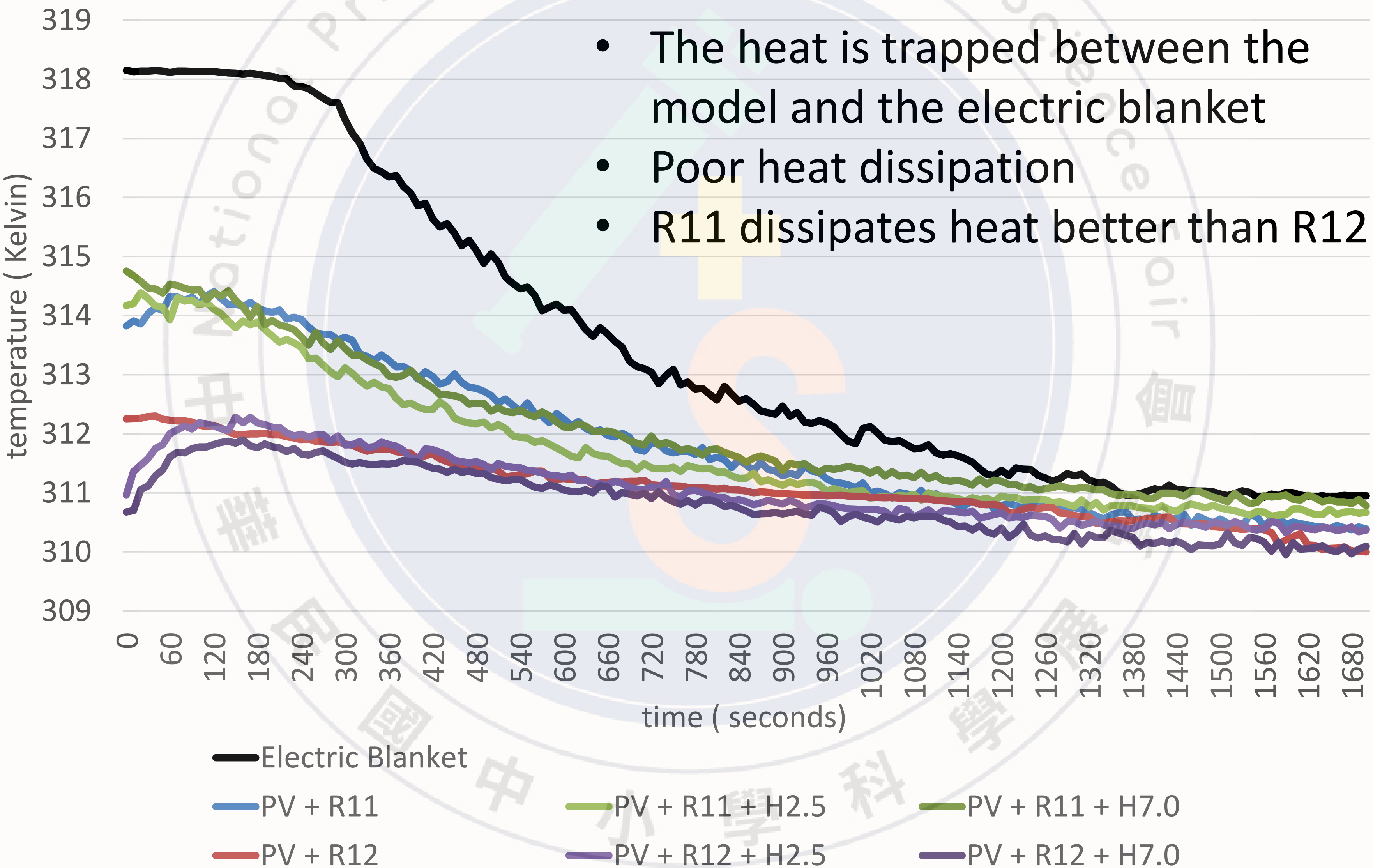
Extract and
Compare the RGB
values with Python

Convert Video to
Frames using
Python

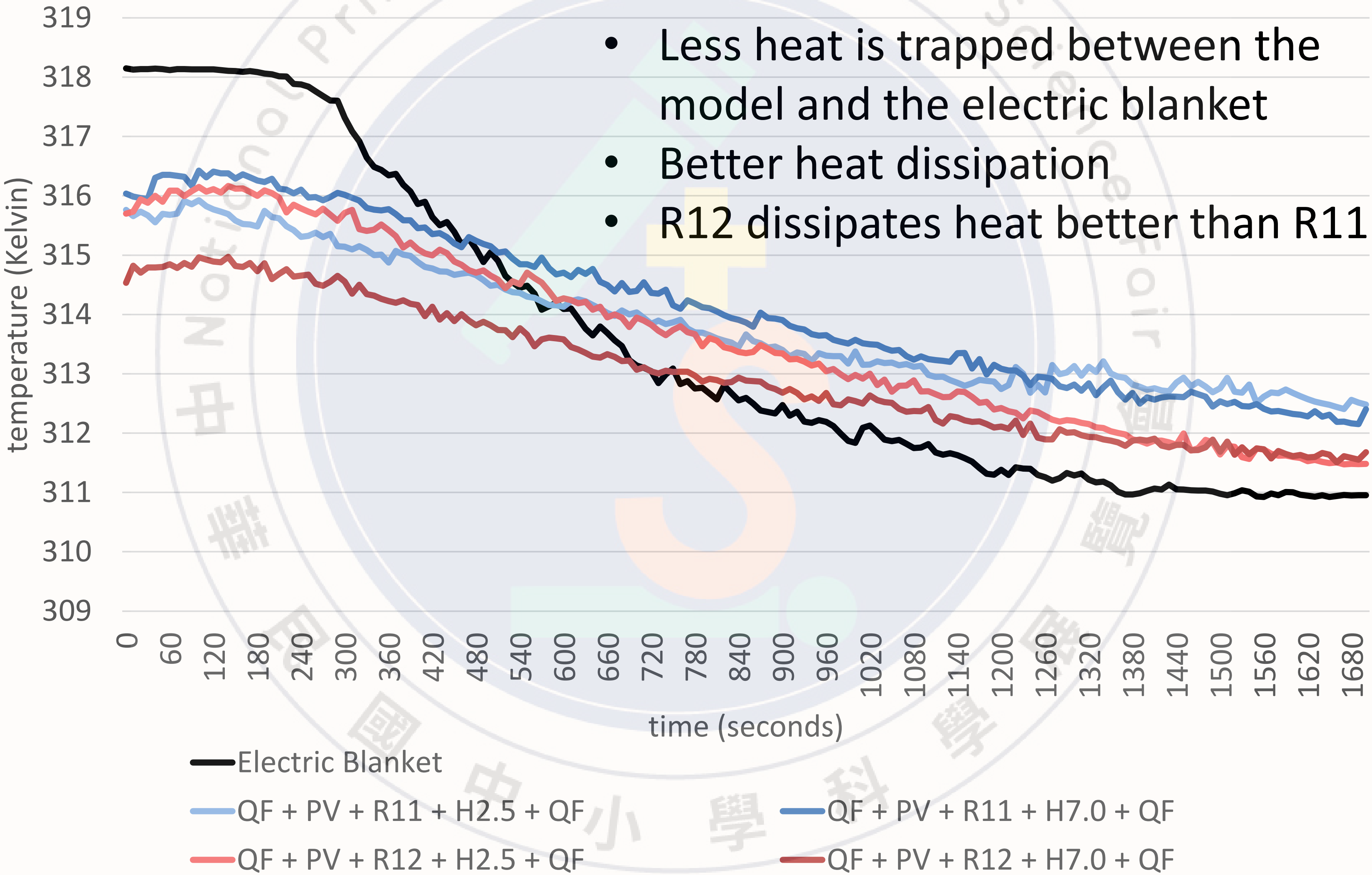
Graph the average
temperature in
Microsoft Excel

04 Results

- The heat is trapped between the model and the electric blanket
- Poor heat dissipation
- R11 dissipates heat better than R12



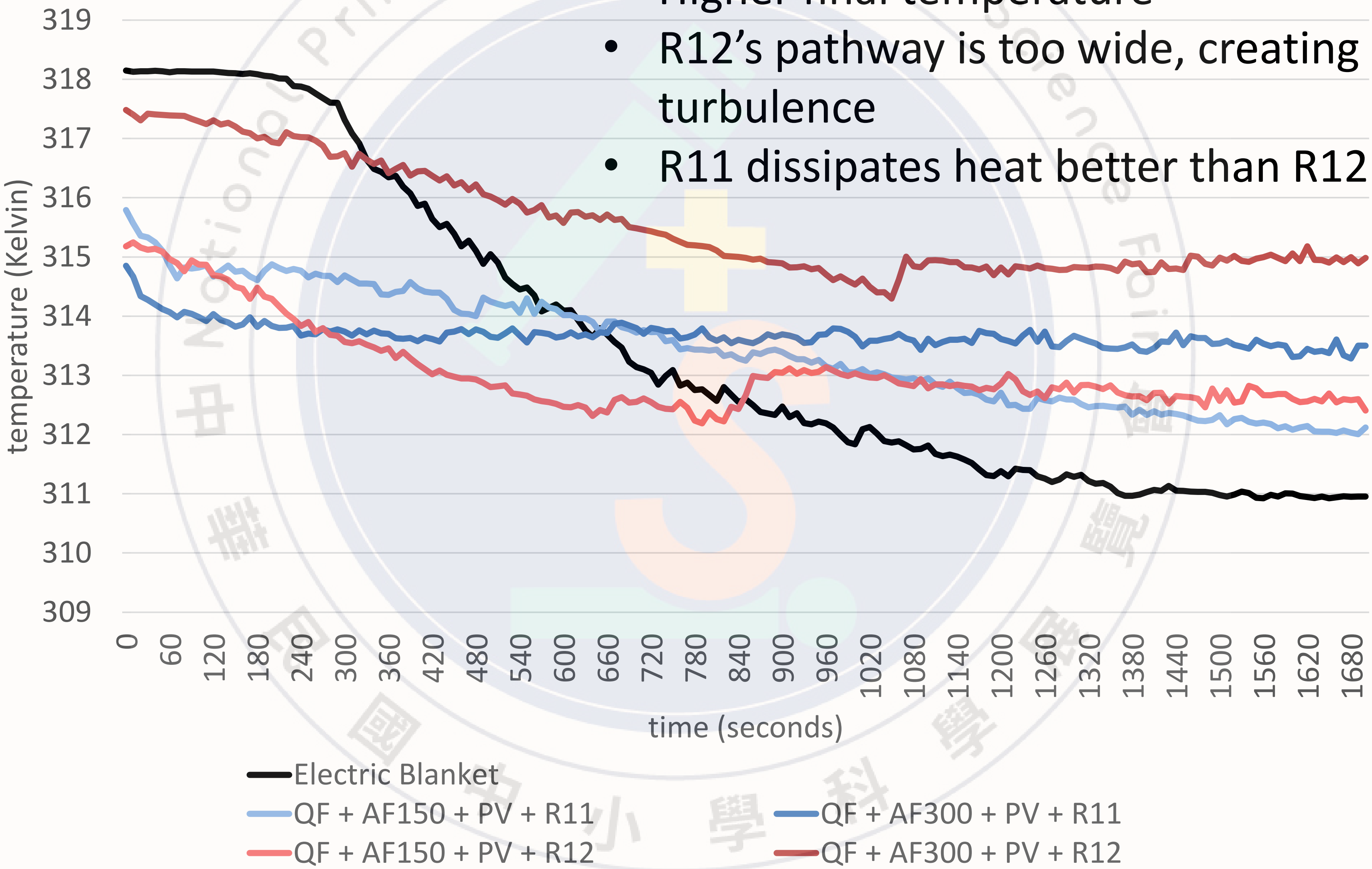
04 Results



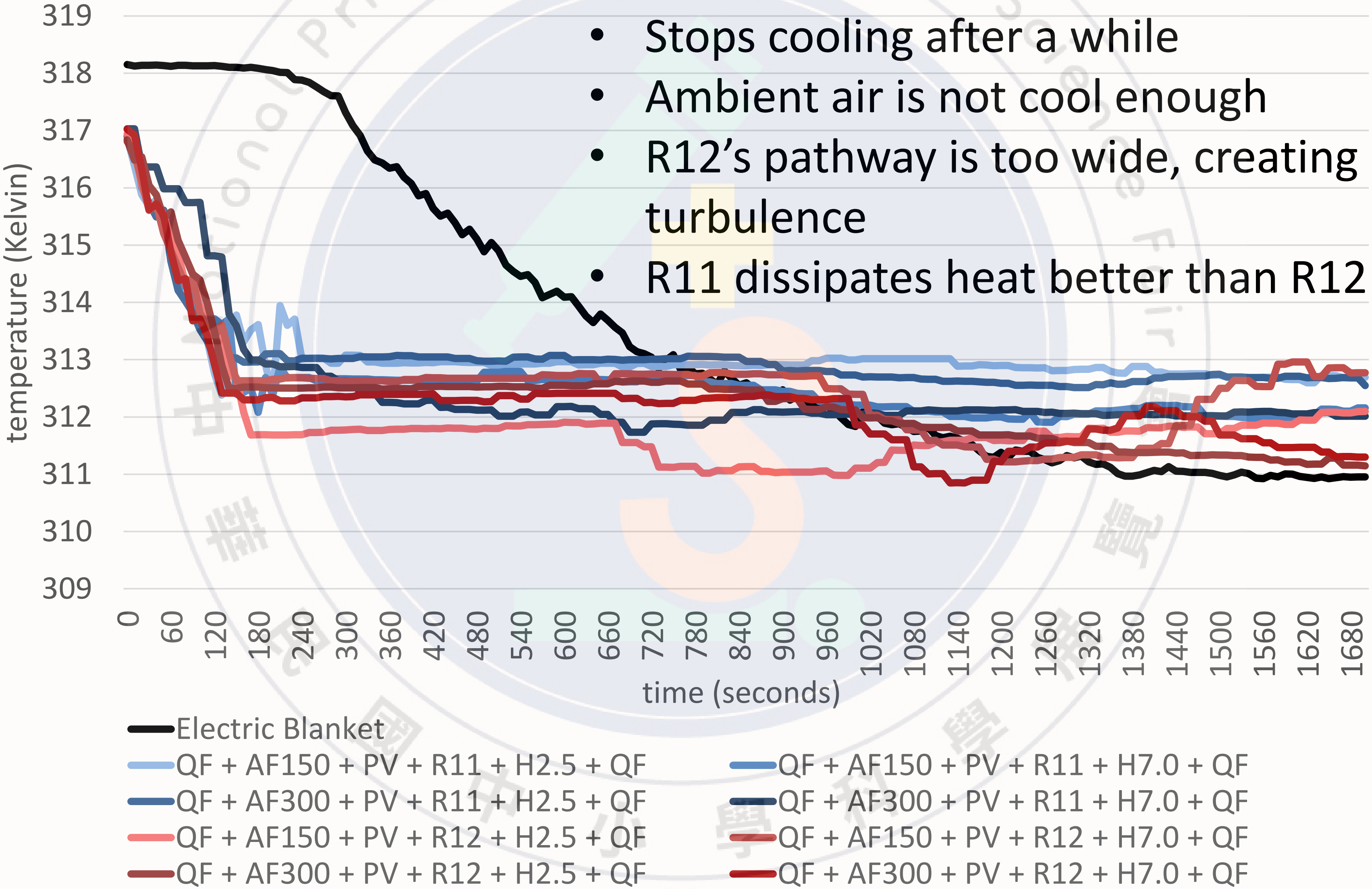
- Less heat is trapped between the model and the electric blanket
- Better heat dissipation
- R12 dissipates heat better than R11

04 Results

- Higher final temperature
- R12's pathway is too wide, creating turbulence
- R11 dissipates heat better than R12



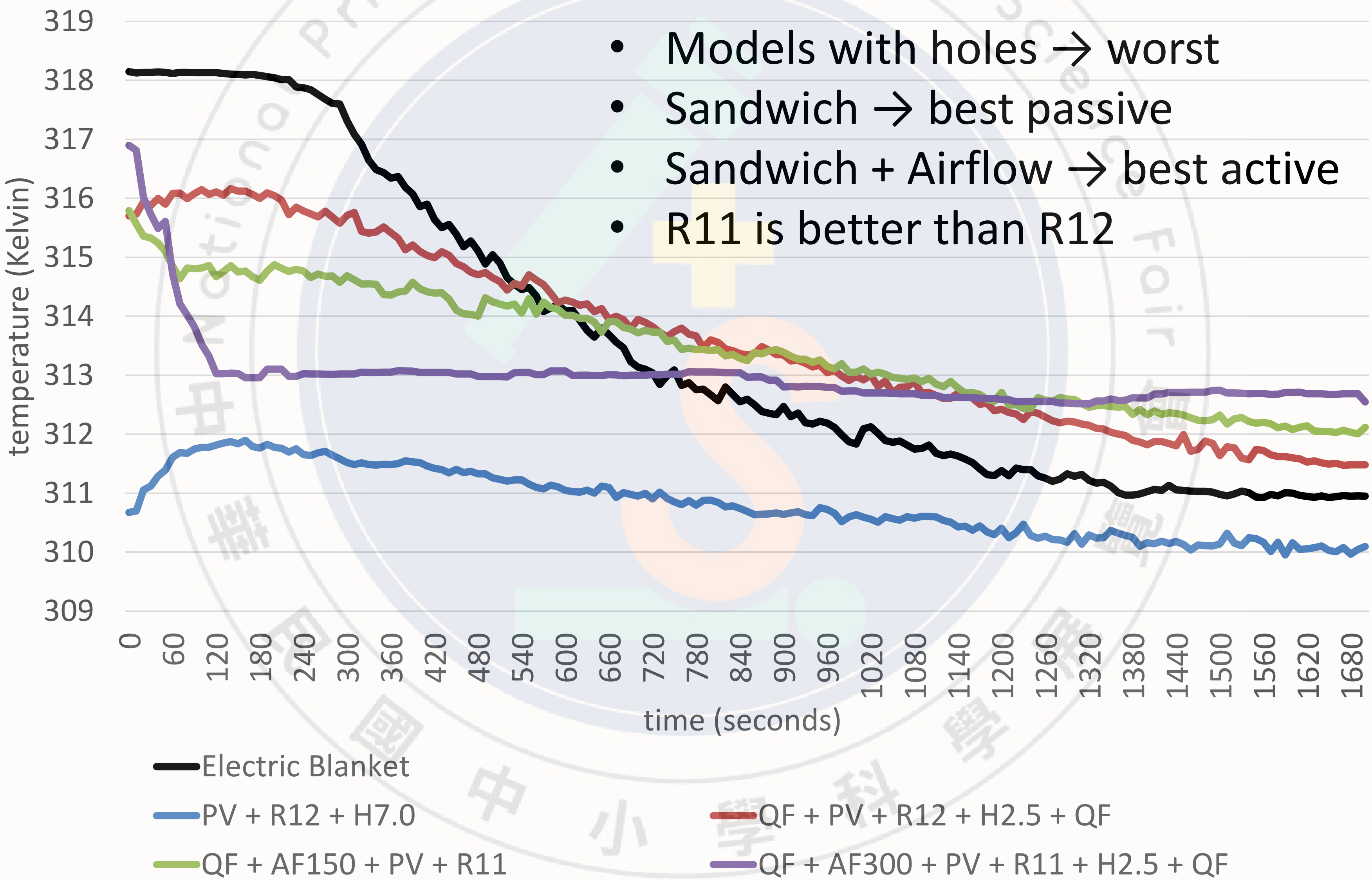
04 Results



- Stops cooling after a while
- Ambient air is not cool enough
- R12's pathway is too wide, creating turbulence
- R11 dissipates heat better than R12

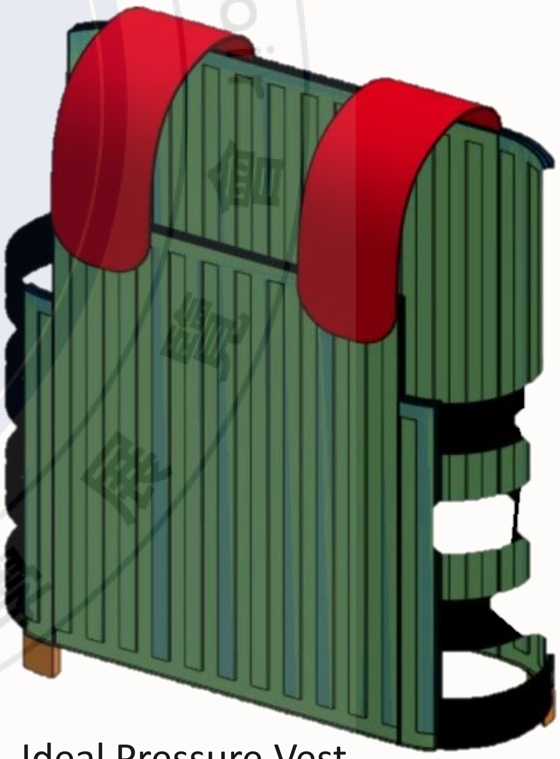
05 Discussion

- Models with holes → worst
- Sandwich → best passive
- Sandwich + Airflow → best active
- R11 is better than R12



06 Conclusion

- Proposed solution
  - Passive approach → Sandwich fabric: a weaving technique often used when combining two different textiles into one fabric
    - Squease vest costs £245.00, I hope to reduce the cost by developing a sandwich fabric
  - Active approach → Sandwich fabric with the active airflow cooling system
    - Sandwich fabric with a dual pumping system, one to inflate and deflate the vest, and another is the active airflow cooling system with a thermoelectric cooling module, temperature sensor, processor, and controller



Ideal Pressure Vest

07 Reference

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