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CATCHING DEHUMIDIFIER OUT OF PELTIER MODULE AND DC FANS

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ABSTRACT

The objective of this study is to create an improvised air dehumidifier out of Peltier modules and DC Fans to reduce indoor humidity levels by utilizing environmental friendly and cost-effective resources. A dehumidifier is used to reduce and regulate the humidity levels in the air, condenses air into liquid water, and collects dust, hence having three functions. The condensation of air into water is done with the help of the Peltier module. It is a heating and cooling thermal control module while Direct Current or DC fans contribute to the flow of the entrance and exit of the air in the dehumidifier. Furthermore, the effectiveness of the made Catching Dehumidifier was proved through the humidity level, amount of water and dust collected. This was done through the help of the Galaxy Sensors app, teaspoon measuring spoon, and dust paper collector. The results of the study shows that the dehumidifier helps in reducing the amount of humidity in the air, as it effectively lowered the humidity level in under 1 hour, collected water and dust in 2 different time intervals, as tested in the study. Finally, it allows the use of cost-effective materials that are also environmentally beneficial. The Catching Dehumidifier is capable of reducing high humidity levels in short-term time intervals, but not in long-term. However, its effectiveness was still proved by the amount of condensed water and dust collected; which is a vital role of a dehumidifier. Current and future researchers are welcome to change materials, which may produce a more efficient, cost-effective dehumidifier, and make better results. The Philippine School Doha (PSD), Qatar, and Philippine Community are urged to place dehumidifiers in their facilities to reduce molds, and allergies. This is especially helpful during summer.

KEYWORDS: air dehumidifier; Peltier module; heating; cooling; thermal control module; condensation; DC fans; humidity level

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1. INTRODUCTION

The humidity in Qatar ranges from average to high, reaching the humidity level of 20% to 50% (Reid, 2022). According to Aquino (2020), the Philippines has an average humidity level which reaches from 64% to 83%. Research conducted by the Building Science Corporation discovered that a percentage of 70% or higher can cause serious harm (Bannister, 2020). From seeing this, it can be inferred that the range of Philippines' humidity level is too high that it can damage and affect one's health. The Health and Safety Executive recommended a 40% - 70% humidity level, however most people find the humidity level of 30% - 60% the most comfortable (Bannister, 2020).

According to Watson (2020), dehumidifiers are electrical devices that extract moisture from the air. In an extremely humid home, a dehumidifier can assist reduce humidity levels. They can also help to prevent fungus and dust mite issues by reducing the leftover moisture from the air. Breathing in too much humidity can trigger asthma and cause respiratory distress. As proclaimed by Koncius (2018), dehumidifiers are machines that remove excess moisture from the air. During the summer, a rainy spell, or any time a temperature of more than 60 degrees, the air is combined with high humidity that can have a significant impact on the climate in your home, dehumidifier's purpose is to maintain a reduced relative humidity to prevent mold, mildew, and dust mites. However, leaving it on 24 hours a day, seven days a week can add up to a large energy bill. As a result, dehumidifiers should run for at least 12 hours every day (Tyler, 2021).

As stated by Bannister (2020), when the air is saturated with moisture, as it is in humid weather, sweat cannot evaporate, leaving people's bodies hot and sticky. Their bodies have to work harder to cool off. Excessive sweating, increased pace and depth of blood circulation, and increased respiration are the effects. While humidity can cause mildew, mold, flaking paint or wallpaper, rotting furniture, and damaged walls. If high humidity levels are not controlled, this can produce more mold and mildew which will feed off on furniture and objects around. As a result, this led to the making of this study. To alleviate the humidity levels present in the air.

The goal of this research is to make an improved air dehumidifier consisting of Peltier modules and DC fans to reduce indoor humidity levels using environmentally friendly and cost-effective materials. The output is termed "Catching dehumidifier" for the researchers purposely shaped it like the head of a cat with the inclusion of the idea of its purpose to catch the dust and reduce the humidity level in the selected parts of the house. Comparing the humidity levels of bedroom and living room using humidity level application in the researcher's smartphone they were able to come up with the results with and without the installation of the product of the study in the before and after observations. The product also collects dust particles in different time intervals and is measured using visual analog

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scale. Lastly, the collection of water the product collected over the time set was noted using a milliliter spoon.

Having a dehumidifier can impact people's health and provide a suitable temperature for one's convenience. Without a dehumidifier, it can make people breathe harder due to having moisture in the air. It can also cause trouble to people who have asthma (Watson, 2020).

Research Questions

The objective of this study is to make a Catching Dehumidifier Out of Peltier Module and DC Fans. Specifically, this research aims to answer the following questions:

1. What is the indoor humidity level of the two selected rooms under the same household without and with Catching Dehumidifier, using percentage measurement:
    1.1. Without a Catching Dehumidifier; and
        1.a. Living Room; and
        1.b. Bedroom?
    1.2. With a Catching Dehumidifier, after 1 hour?
        2.a. Living Room; and
        2.b. Bedroom?
2. How much humidity can the Catching Dehumidifier reduce in the two mentioned selected rooms under the same household, in terms of humidity level using percentage measurement in:
    2.1. 3 hours; and
    2.2. 6 hours?
3. How much humidity can the Catching dehumidifier convert to liquid water in the two mentioned selected rooms under the same household, in terms of milliliter measurement in:
    3.1. 3 hours; and
    3.2. 6 hours?
4. How much dust particles can the two mentioned selected rooms under the same household, store using the Catching Dehumidifier in terms of Visual Analog Scale in:
    4.1. 3 hours; and
    4.2. 6 hours?

Alternative Hypothesis

H1: The Catching Dehumidifier is capable of reducing high humidity levels.

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METHOD

The experimental research design was used in this study. Harappa (2021), defined experimental study which follows a scientific research design. Experimentation is carried out in a controlled environment, while the researcher collects the data and analyzes it. It has a hypothesis which will be supported or rejected based on the findings. This research study will be utilizing both quantitative and qualitative research. According to Bhandari (2020) The procedure for gathering and interpreting numerical data is known as quantitative research. Quantitative research is used to quantify questions in the statement of the problem. This will be used to determine the humidity level in each room and how much humidity can the dehumidifier reduce in the given hours. Qualitative research is a method which uses colors, qualities, condition, and descriptions to describe a certain phenomenon (McLeod, 2019). This will be used in the study to describe the amount of dust collected through a visual analog scale.

3. RESULTS

The prominent findings of the study are:

1. The Indoor Humidity Level of the 2 Rooms
    1.1. Without a Catching Dehumidifier
        1.a. Living Room
        1.b. Bedroom

Table 1 Humidity Level in the 2 Selected Rooms without the Catching Dehumidifier

Room	Living Room	Bedroom
Photos (time & humidity level)		
Humidity Level (%)	45.9%	43.9%

The researchers calculated the humidity levels of the 2 selected rooms under the same household, using the Galaxy Sensors App found in the Play Store. This uses the percentage measurement to determine the humidity level.

The researchers first measured the humidity level of the 2 rooms when the Catching Dehumidifier was not present. This is done in order to test the effectiveness of the constructed output. The time which the experiment was started on, was also noted down to have a constant variable, and to track the span of 1

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hour. At 2:10 PM, the 1st room, living room, showed a result of 45.9% as its humidity level. While the 2nd room, bedroom presented 43.9% as its humidity level.

This supports the statement of Lennox (2019), saying that the relative humidity in a room should be in between 30-50%. This is the ideal humidity level of an indoor environment, and is said to be the most comfortable for the people living in the house. The living room and bedroom's humidity levels were around 40%, which is the ideal level in a household.

1.2. With a Catching Dehumidifier, after 1 hour
2.a. Living Room
2.b. Bedroom

Table 2 Humidity Level Reduced in the 2 Selected Rooms after 1 Hour, with the Catching Dehumidifier

Room	Living Room	Bedroom
Hours	1	1
Photos (time & humidity level)		
Humidity Level	40.5%	43.4%

The researchers calculated the humidity levels of the 2 selected rooms under the same household, using the Galaxy Sensors App found in the Play Store. This uses the percentage measurement to determine the humidity level.

The succeeding step that the researchers did is to measure the humidity levels of the 2 chosen rooms after 1 hour, to see if the product is efficient. For the living room, the humidity level was 40.5% at 3:12 PM. Then, the bedroom gave a humidity level of 43.4% at 4:25 PM. These results show that the built dehumidifier is efficient in lowering the humidity levels of the 2 rooms under 1 hour.

This proves the claim of Christian Heating and Air Conditioning (2019), stating that dehumidifiers can reduce and maintain humidity levels in the air. It assisted the results as after 1 hour in the living room, it reduced 5.4% of humidity level, while in the bedroom, 0.5%.

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2. The Reduced Humidity Level of the 2 Rooms

2.1. 3 hours

Table 3 Humidity Level Reduced in the 2 Chosen Rooms after 3 Hours, by the Catching Dehumidifier

Room	Living Room	Bedroom
Hours	3 hours	3 hours
	Photos (time & humidity level)	
Before		
After		
	Humidity Level (in percentage, %)	
Before	47.9%	40.6%
After	50.1%	41.5%

The Galaxy Sensors App was once again used in the 2 rooms in 2 different hours using the percentage measurement (%), to determine the humidity level.

The humidity level was checked before the experiment was initiated at 4:49 PM, to have a constant variable, and to track the 3 hour interval. The humidity levels of the living room and bedroom gave humidity levels of 47.9% and 40.6%, respectively. Following is to turn on the Catching Dehumidifier for 3 hours. After the 3 hour interval had finished at 7:49 PM, the living room had a humidity level of 50.1%, and the bedroom at 41.5%.

From the results obtained, it negates the affirmation of Christian Heating and Air Conditioning (2019), asserting that humidity level can be reduced by the dehumidifier. From the results of the 2 rooms after 3 hours, the living room increased the humidity level by 2.2%, while the bedroom increased it by 0.9%.

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However, this aids the statement of Gregory (2021), noting that relative humidity can be higher in cold than in warm temperatures because the cold air takes less time to become saturated than warm air. As a result, the relative humidity is higher during cold temperatures. This can be seen in the results as the dehumidifier is functioning, it turns the air around it cold to condensate the air into water. This explains why the humidity level has increased.

2.2. 6 hours

Table 4 Humidity Level Reduced in the 2 Chosen Rooms after 6 Hours, by the Catching Dehumidifier.

Room	Living Room	Bedroom
Hours	6 hours	6 hours
	Photos (time & humidity level)	
Before		
After		
	Humidity Level (in percentage, %)	
Before	37.2%	47.9%
After	39.0%	51.2%

The Galaxy Sensors App was used again to determine the humidity level using percentage measurement. As practiced, the humidity level will be taken note of at 11:23 AM, before the output is turned on, to track the 6 hour interval. Firstly, the living room presented a humidity level of 37.2%, and the bedroom at 47.9%. After 6 hours at 5:23 PM, the humidity level in the living room revealed a percentage of 39%, and the bedroom at 51.2%.

As observed from the results, it disagrees again with Christian Heating and Air Conditioning's (2019) words proclaiming that humidity level is decreased with the use of dehumidifier. From the findings of this experiment, the living room increased the humidity level by 2.2%, while the bedroom by 4.3%. The humidity level is higher than the 3 hour interval since the 6 hour interval was turned on for a longer time. Thus, making the air colder which leads to a greater surge in the humidity level.

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3. Amount of Condensed Water Produced from the 2 Rooms

3.1. 3 hours

Table 5

The Amount of Condensed Water the Catching Dehumidifier Converted after 3 Hours

Room	Living Room	Bedroom
Hours	3 hours From 4:49 to 7:49	3 hours From 4:49 to 7:49
Photos		
Amount of Liquid Water (in milliliter, mL)	1/9 tsp - (0.56 mL)	1/16 - (0.31 mL)

The amount of condensed water was calculated using a teaspoon measuring spoon by the researchers, since the condensed water is just a small amount.

The teaspoon measuring spoon is kept clean before the experiment at 4:49 PM, to make sure that it will gather the right amount of condensed water later on. After 3 hours of the Catching Dehumidifier being turned on at 7:49 PM, it condensed 0.56 mL of liquid water in the living room. In the bedroom, it produced 0.31 mL.

This proves the claim of Watson (2020) stating that dehumidifiers condense air to water through the presence of cool coils. From the results of the experiment, the living room obtained 0.56 mL after 3 hours, then 0.31 mL for the bedroom. This shows that a dehumidifier brings condensed water from the air around.

3.1. 6 hours

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Table 6
The Amount of Condensed Water the Catching Dehumidifier Converted after 3 Hours

Room	Living Room	Bedroom
Hours	6 hours From 11:23 to 5:23	6 hours From 11:23 to 5:23
Photos		
Amount of Liquid Water (in milliliter, mL)	¼ tsp - (1.25 mL)	1/10 tsp - (0.49 mL)

Before the experiment at 11:23 AM, the teaspoon measuring spoon is kept clean to make sure that it will gather the right amount of condensed water later on. After 6 hours at 5:23 PM, it resulted with the humidity levels of 1.25 mL of liquid water from the living room, and 0.49 mL from the bedroom.

This supports the statement of Watson (2020) acclaiming that from the existence of coils, it condendenses air to water. Based on the outcomes, the living room had 1.25 mL after 6 hours, then 0.49 mL for the bedroom. Comparing the 3 hour interval in table 5 from the 6 hour interval in table 6, the living room increased up to 0.69ml, while in the bedroom it increased up to 0.18 ml. Hence it implies that the more the dehumidifier is turned on, the more condensed water it can produce.

It can also be observed here that the living room has converted more air into water because it is near to a kitchen which is a humid area. As Eva-Dry (2021), mentioned, a kitchen is filled by sinks, refrigerators, and other sources of moisture. Hence, it is very liable to dampness, which results in high humidity levels.

4. Collected Dust Particles from the 2 Rooms

4.1. 3 hours

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Table 7
The Catching Dehumidifier's Collected Dust after 3 Hours

Room	Living Room	Bedroom
Hours	3 hours	
	Photos	
Before 4:49		
After 7:49		
	Amount of Dust (Visual Analog Scale, VAS)	
Before	0 (No dirt)	0 (No dirt)
After	1 (Mild)	1 (Mild)

To figure the amount of dust collected by the Catching Dehumidifier, the researchers made a simple dust paper collector using a puncher, strings, hard paper like oslo or cartolina, and the most essential material which is petroleum jelly. Petroleum jelly is used in order for it to stick on the paper well. It might seem that the dust paper collector is empty, however when seen first-hand, the dust on the paper is seen.

Before putting the paper inside the dehumidifier, smear a clean layer of petroleum jelly, to make the dust stick. A clean dust paper collector with a measurement scale of 0 (No Dirt) at 4:49 PM is observed. It uses the Visual Analog Scale (VAS), which ranges from 0 to 10. This scale is used to visually describe how dirty the dust paper collector became. After 3 hours, the 2 rooms which are the living room and bedroom ended with the scale of 1 (Mild).

Roberts'(2020), it verifies that dehumidifiers draw in dust. This happens through attracting air through their vents. Dehumidifiers then purifies the air through a filter, which captures dust, pollen, and other spores or bacteria in the air. From the experiment's findings, the living room and bedroom obtained a scale of 1 (Mild) after 3 hours. This verifies that dehumidifiers are able to collect dust.

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4.1. 6 hours

Table 8 The Catching Dehumidifier's Collected Dust after 6 Hours

Room	Living Room	Bedroom
Hours	6 hours	
	Photos	
Before 11:23		
After 5:23		
	Amount of Dust (Visual Analog Scale, VAS)	
Before	0 (No Dirt)	0 (No Dirt)
After	2 (Mild)	1 (Mild)

The scale of 0 (No Dirt) was taken note for both rooms at 11:23 AM, to track the time. After 6 hours, the living room had a scale of 2 (Mild), while the bedroom had 1 (Mild). From the outcomes given, it means that the more hours the Catching Dehumidifier will be left working, the more dust will be collected.

This proves the assertion of Roberts (2020) that dehumidifiers gather dust through their vents and purify it through a filter, as previously stated. After two hours, the living room had a scale of 2 (Mild), verifying this claim. When compared to the 3 hour interval, the 6 hour period collected more dust because it was left on for longer. To reiterate, the living room contains more dust than the bedroom since it is likely to be close to a kitchen, which is a humid environment (Eva-Dry, 2021). As a result, it accumulated more dust than the bedroom.

Alternative Hypothesis

The alternative hypothesis: The Catching Dehumidifier is capable of reducing high humidity levels is rejected. From the results of the experiment, the Catching Dehumidifier may have reduced the humidity level of the 2 rooms after 1 hour. However, it did not reduce it for the 2 different time intervals which were the 3 and 6 hour time intervals, which are the long term time intervals.

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4. DISCUSSION

The findings revealed that the Catching Dehumidifier is effective in reducing the humidity level after 1 hour, but not the 3 and 6 hour intervals. This unveils that a dehumidifier can reduce humidity levels from a short-term time, but not in long-term time intervals. A cause behind this is relative humidity increases during cold temperatures, because cold air takes less time to be moist than warm air. Furthermore, the longer the dehumidifier is turned on, the colder the air becomes because the air is being condensed. To infer more, the dehumidifier is adept in producing condensed water, and attracting dust.

After a thorough examination of the findings and conclusions of the study, the researcher genuinely suggests the following recommendations: Philippine School Doha (PSD) may adopt the use of Catching Dehumidifier out of Peltier modules and DC fans as it is functional, cost-effective, and eco-friendly. The implementation of this study may aid in reducing allergies, dust mites, mold, and mildew. This is recommended to be placed in humid areas in the school. Students, teachers, and future researchers are welcome to change the different types of thermo-electronics, such as the Peltier module and DC fans. In the future, they may take advantage of bigger fans and a thermal conductor which has a stronger conductivity. Since the peltier module is just a low energy conductor, it would be better to find stronger ones which may yield better results especially in reducing humidity level. These experiments will aid in uncovering different materials which will improve the product and make a better output. Researchers who have a similar topic to this study may also use this as a guide for them while writing their research paper. They may also experiment with different methods and materials which can produce a better and more efficient dehumidifier. The Qatar government may consider placing dehumidifiers in their facilities and buildings. Doing this will reduce the mold and mildew that high humidity is causing. This may also reduce the events of allergies of a person. Although relative humidity levels of 30% to 50% must be kept. Consequently, it should only be placed in areas with high humidity.

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