PERFORMANCE EVALUATION OF AN EVAPORATIVE TYPE AIR COOLER

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A thesis submitted to the Department of Mechanical, Sonargaon University of Bangladesh in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Mechanical Engineering.

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ABSTRACT

Evaporation serves as a natural cooling process. By applying the evaporative cooling principle to convert sensible heat into latent heat, evaporative cooling decreases the temperature of the air. Here, the idea of evaporative cooling is used to guide the work. The price of energy in all its forms is rising daily. It is now vital to consider alternative energy sources or to use alternative technologies to lessen energy use. Any business, home, or structure that uses an air conditioning system of any kind contributes to the production of waste that harms the environment. Environmentalists are aware of and concerned about their effects on ecological systems, living things, and the environment as a whole. This project involves working on a system that uses the evaporative cooling of water for direct air conditioning. On the basis of this idea, an air cooler that performs the same duties as an air conditioner is built at the expense of the air cooler. In contrast, dry and cold air is produced, but running costs are considerable because of expensive refrigerant, compression, and maintenance costs. Economical design and operation, humidity-free air, and lower running costs are all significant advantages of the evaporative air cooler system. Additionally, it has nothing to do with an issue like the thinning of the ozone layer. The technology has the ability to chill the area, lowering the temperature by 5 to 10 degrees Celsius. The objective of this project is to build a hybrid, cost-effective, and environmentally friendly system using the concepts of an air water cooler and a split air conditioner, using canvas as the construction material for the DC pump motor, AC fan, MIST maker, ESP32 micro-controller, LCD display, DHT11 temperature sensor, and PAD. Additionally, a smartphone app connected to Bluetooth allows for control of this device.

ACKNOWLEDGEMENT

First, we started in the name of almighty Allah. This thesis is accomplished under the supervision of **Dr. Md. Alamgir Hossain**, Professor, Department of Mechanical, Sonargaon University. It is a great pleasure to acknowledge our profound gratitude and respect to our supervisor for this consistent guidance, encouragement, helpful suggestion, constructive criticism and endless patience through the progress of this work. The successful completion of this thesis would not have been possible without his persistent motivation and continuous guidance.

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DECLARATION

We do hereby solemnly declare that, the work presented here in this project report has been carried out by us and has not been previously submitted to any University/ Organization for award of any degree or certificate.

We hereby ensure that the works that has been prevented here does not breach any existing copyright.

We further undertake to indemnify the university against any loss or damage arising from breach of the foregoing obligation.

[Authors]

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Evaporation is a natural process that cools things off. In contrast to conventional air conditioning systems that employ vapor compression refrigeration or absorption refrigerator, evaporative cooling reduces the temperature of the air utilizing the evaporative cooling principle. By adding water vapor to the air, evaporative cooling lowers the air's temperature. The energy required to evaporate the water is removed from the air in the form of sensible heat, which influences the temperature of the air, and turned into latent heat, the energy contained in the water vapor component of the air, while the air remains at a constant enthalpy value. Due to the fact that this sensible heat to latent heat conversion takes place at a constant enthalpy value, it is referred to as an adiabatic process. As a result, evaporative cooling lowers air temperature proportionally to the sensible heat loss while also increasing humidity proportionally to the latent heat gain.

The primary disadvantage of evaporative cooling is its reliance on the surrounding air quality. Since evaporative cooling is fueled by the temperature differential between the ambient air's dry- and wet-bulb temperatures. This difference is negligible in mild and/or humid climates, which limits cooling capability [1].

1.2 Background

For the purpose of improving overall quality of life, productivity, and well-being, access to cooling is no longer a luxury but rather a need for achieving thermal comfort. An individual is said to be in a state of thermal comfort when they feel comfortable in their surroundings. This state is determined and influenced by a number of variables, including an individual's clothing insulation and metabolic rate, as well as microclimatic conditions such as temperature, relative humidity, airflow, air temperature, and dew-point temperature. The pursuit and enjoyment of thermal comfort are necessary for a person's psychological and physiological health.

The need for cooling in a nation is influenced by factors such as population increase, fast urbanization, growing per capita income, and global warming. Refrigeration and air-conditioning (RAC) technologies are used to a large extent to meet the nation's cooling needs. There are five different climate zones in Bangladesh, including hot and dry, warm and humid, moderate, composite, and cold [4]. There is a tremendous potential to promote evaporative air coolers given the tropical climate of India, the effect of room air conditioners on electricity consumption, and the accompanying greenhouse gas (GHG) emissions.

Evaporative air coolers can prove to be a useful alternative technology since they employ a low-GWP, non-toxic refrigerant-based cooling system to provide thermal comfort. They also perform pretty well in Indian climates, with the exception of excessively humid situations. In addition to reducing the user's reliance on room air conditioners with high GWP, evaporative air coolers will also assist India in meeting its nationally defined commitment (NDC).

Swamp or desert coolers are other names for evaporative air coolers, which have uses in both domestic and professional settings. They operate on the fundamental tenet that water evaporates while simultaneously serving as a refrigerant. In

Bangladesh's two main climatic zones, hot-dry and composite, which together make up the bulk of the nation, several research and literatures have shown that evaporative air coolers may efficiently provide thermal comfort [5][6][7].

1.3 Motivation

A. Air-condition

- Capital cost and installation cost is high. Operating cost is also very high due to high Power consumption.
- Maintenance cost is also more due to costly refrigerant.
- It is not eco-friendly because of more power consumption and usage of refrigerant.

B. Air-cooler

- It gives humid air which can create health problem Temperature drop is limited.
- In India during summer, climate conditions are such that the designed hybrid system can give best result.

1.4 Objectives:

The objectives of this project are:

- To study about **Evaporative Type Air Cooler**
- To design and construct of an Evaporative Air Cooler.
- To implement Air Cooler using microcontroller.
- To test the performance of the Air Cooler system.

1.5 Structure of the Project

The six chapters that make up this project book are. The opening statement, background research for the project, study goals, and project organization are all found in the first chapter. The literature study and detailed explanation of the evaporative air cooler system are in Chapter 2. The design of this project, including its block diagram, circuit diagram, and operating principle, is covered in Chapter 4. The history, actual project, and component and instrument specifics are all covered in depth in Chapter 3. In chapter five, we talk about the findings and discussions and present the finished prototype of the project that we created. We examine the project's future scope and completion in the last chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this section topics related to Evaporative Type Air Cooler are included. These provide a sampling of problems appropriate for application of Evaporative Air Cooler. The references are summarized below.

2.2 Literature Review

The human species has succeeded in depleting a significant percentage of the earth's natural resources, polluting the air we breathe, and (according to scientists) burning a hole in the ozone layer due to the excessive usage of chlorofluorocarbons (CFCs), which may contribute to global warming. One of the main sources of CFCs in the environment is conventional air conditioning. As a crucial first step in the solution to this issue, an alternate cooling method that does not release CFCs is extremely desirable. As a result, adiabatic cooling is eco-friendly since it is a passive cooling technique that doesn't release CFCs. It uses only fresh air to cool, which even contributes to the air's purification. (Robert E. Frost, 1996) [8].

When air is moving through a wet cooling medium or a water spray, adiabatic cooling is used to cool the air. The earliest effort at air conditioning was made by the ancient Egyptians, who put damp mats on their doorways and windows, allowing wind to pass through and chill the air. This fundamental concept saw several iterations throughout history, including mechanical fans to create air movement in the 16th century, cooling towers with fans that blasted water-cooled air into industries in the early 19th century, and swamp coolers in the 20th century. The efficiency and efficacy of adiabatic cooling have significantly enhanced thanks to modern technologies. (WESCOR, 1992)[9]

Adiabatic saturation is a wonderful option for people on a tight budget since it doesn't require a refrigerant, condenser, or pressured pipes to deliver comfort cooling. In addition, it uses less energy than other cooling systems. Another benefit is that it only consumes fresh air, which makes it healthful because it draws in outside air and exhausts stale air, smoke, smells, and germs. Natural humidity levels are maintained, which benefits both humans and furnishings and reduces static electricity. The building inhabitants can open doors and windows since it does not require an airtight structure for optimal efficiency. (VehiCool, 1999)[10]

Shakerin and Contreras (1998) [11], for use in a lab for undergrads studying psychrometrics, an instrumented evaporative cooler was created. At the entrance and outflow, the air flow and water consumption rates were monitored, as well as the air temperature and relative humidity. Psychrometric equations were used to estimate the parameters of the outlet air given the experimental data for the intake air and water, and a good comparability with the experimental result was discovered.

Qureshi and Zubair (2007) [12], For both design and rating calculations, it is crucial to accurately forecast many elements of the thermal behavior of evaporative fluid coolers. Because a percentage of the recirculating water evaporates to cool the process fluid, increasing the concentration of dissolved solids and other contaminants, it is important to accurately anticipate evaporation losses. Based on a manufacturer-recommended rule of thumb that is straightforward, accurate, and applicable in a variety of situations, an empirical connection to forecast evaporation losses is constructed. The highest error was determined to be roughly 4% although frequently s of heat and mass transfer in main and secondary air and water flows, the projected values are in good agreement with the numerical values derived from the calibrated model.

GH. Heiderinejad and M. Bozorgmehr (2007) [13], It has been modeled how indirect evaporative cooling works in an air cooler. The governing equation for heat and mass transport in main and secondary air and water flows was used to create this model. It has been studied how variables like mass flow rates, shape, and flow arrangement impact evaporative cooling performance. Results indicate that the mass flow rates of the primary and secondary air flows and the distance between the plates of the wet and dry passageways have a significant impact on cooling efficiency. It has been looked into how well this cooling system performs under typical city conditions. In most areas of Iran, a first stage indirect evaporative cooling system used before traditional direct evaporative cooling systems would provide cooling comfort conditions as a low energy option.

Mizushina (2008) [14], a numerical process and a simple analytical model, respectively, were designed as two separate evaporative cooler rating methodologies.

Finlay and Grant (2009) [15], by supposing that the vapor pressure of saturated wet air is a linear function of temperature, one may simplify the equations describing the mass transfer in an evaporative cooler. Given that this is the analytical formulation's sole significant main assumption, the model may be predicted to be quite accurate. The fairly complex final design equations necessitate a numerical solution process.

R. Effatenjad and A. B. Salehian (2009) [16], Iranian national standard number 4910-2 introduces a new approach for energy labeling of evaporative air coolers. The usual test procedure has been created according to Australian Standard AS 2913-1978 and Iranian Standard IS3315-1974. The criteria were defined experimentally and analytically, based on energy usage and test results from evaporative air coolers during the previous three years. In Iran, the term EER (Energy Efficiency Ratio) is used to specify energy labeling. Useful cooling capacity of air power of the whole input is calculated using an index of the previous standard of energy consumption and cooler label. The sensible cooling capacity of air power is often referred to as the EER.

2.3 Conclusion

This chapter includes a summary of earlier publications. Such a project overview aids in the proper completion of our project. This genre of writing employs a variety of methods and modifications. We only get work that we can use for our project.

CHAPTER 3

METHODOLOGY AND IMPLEMENTATION

3.1 Introduction

In this chapter we describe history of Evaporative Type Air Cooler, about its operation, working procedure and its applications. In this chapter we gave some idea of solar box type cooker.

3.2 History

- The earliest known uses of evaporative cooling may be found in ancient Egyptian fresco paintings depicting slaves fanning huge, porous clay jars filled with water.
- Roman Empire: To maintain a lower indoor temperature, affluent Romans pumped water from the aqueducts through the walls of their homes. By draping damp mats over the doorways of their tents or homes, many of the ordinary people were able to tolerate the heat.
- The first man-made evaporative cooling structures are said to have originated in medieval Persia. These towers captured wind and directed it past water at the base and into a building.
- Renaissance: Through his drawings of water and energy, one of history's most innovative minds, Leonardo DaVinci, contributed to furthering the understanding of evaporative cooling systems.
- 1800s: To cool the air in their mills, New England's textile makers started utilizing water evaporative systems.
- 1902: Willis Haviland Carrier creates and patents the first contemporary

electrical air conditioning system for American industrial buildings.

- 1916 saw the introduction of the first "swamp cooler," or evaporative cooling system, at the Adams Hotel in Downtown Phoenix, Arizona.
- In order to stay cool at night, settlers who traveled across the West in the 1920s and 1930s reportedly slept on screened-in porches and hung damp linens on the mesh.
- The 2000s saw an increase in environmental consciousness and efforts by several HVAC businesses to redesign their products to be more efficient. Products don't provide a complete answer to the demands of cooling and the environment.
- 2008: Evaporative Cooling Method offers a proprietary, clever, and eco-friendly system that updates evaporative cooling for the twenty-first century.

3.3 Evaporative Air Coolers

Swamp or desert coolers are other names for evaporative air coolers, which are used in both home and commercial settings. They use water, a naturally occurring refrigerant34. The basic idea of water evaporation is the basis for the usage of evaporative air coolers to chill the air. They offer chilled air with enhanced particular humidity. In hot, dry, and mixed weather, evaporative air coolers may function effectively and efficiently and offer thermal comfort. However, they are unable to function properly in environments with greater humidity since the evaporation process is slowed down by high relative humidity or very saturated air. They may also make water shortages worse in desert locations as they need water to function. Even so, this is still better to standard air conditioners because the latter use a lot of water and are relatively energy-intensive, drawing their electricity from thermal power plants. Additionally, not all of these plants have effective water recovery. Evaporative air coolers are most efficient in areas that are sufficiently or naturally aired; nevertheless, they are ineffective in enclosed areas since they require a continual flow of fresh air to support the evaporation process. Evaporative air coolers come in three different varieties.

i. Direct Evaporative air Cooler (DEC)
ii. Indirect Evaporative air Cooler (IEC)
iii. Indirect – Direct Evaporative air Cooler (IDEC)

Figure 3.1: Evaporative Air Coolers

3.3.1 Direct Evaporative air Cooler (DEC)

A direct evaporative air cooler (DEC) consists of cooling pads, blower fan, water reservoir tank, water distributor, pipe, pump, and float valve, as shown in Figure 3.3.

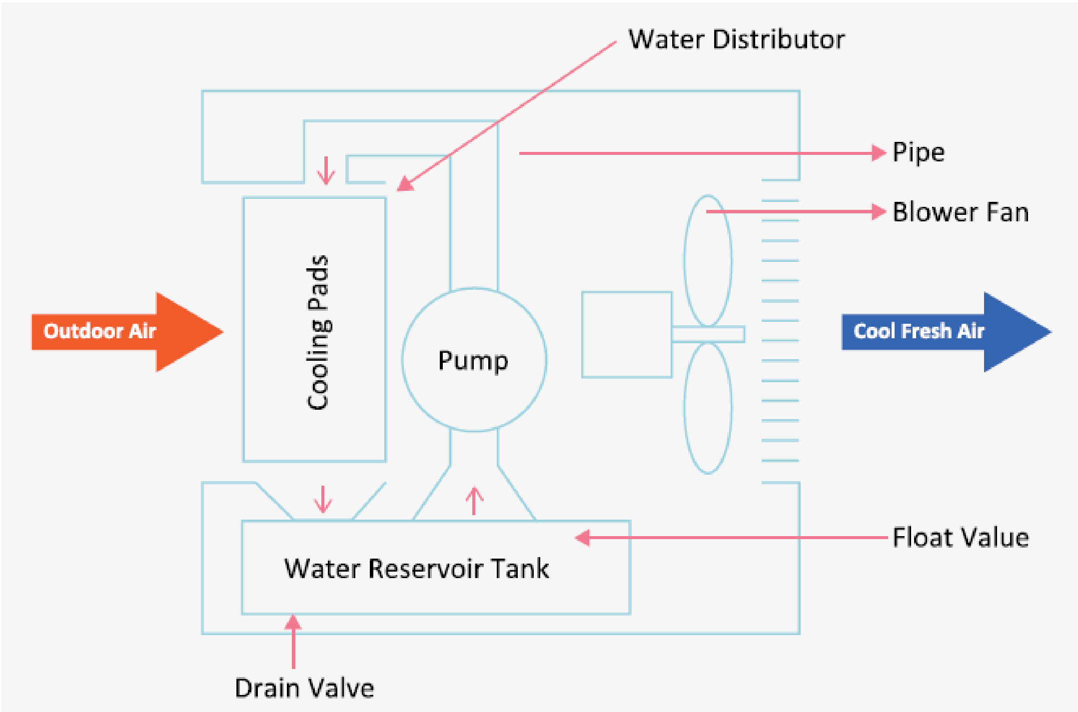

Figure 3.2: Basic Structure of a DEC

The above-mentioned components of an evaporative air cooler have the following functions:

Pump: From the water tank to the cooling pads, the pump facilitates water circulation. The blower fan starts running as soon as the appliance is turned on, then the pump.

Water reservoir tank: Water fed to the cooling pads is kept in the water storage tank for further use. Depending on the kind of evaporative air cooler, it can be filled manually or automatically.

Float Valve: The float valve allows for freshwater ingestion, monitors the water level in the tank, and stops water overflow.

Blower Fan: The room's airflow is maintained and circulated by the blower fan. Low pressure airflow is produced by the blower fan, however it is effective for usage in settings with big rooms. The blower fan brings in outside air and circulates cooled air into the space.

Water distributor and pipe: To provide an uniform distribution of water across the cooling pads, the pipe is utilized to circulate water with the assistance of the pump from the water reservoir to the water distributor.

Drain Valve: As its name implies, the drain valve is used to periodically drain the water from the float valve of the evaporative air cooler.

Cooling pad: The cooler's sides are equipped with cooling pads that contain water, allowing cool outside air to travel through them and chill the air within. The cooling pad may be honeycomb-shaped or cross-fluted.

3.3.2 Indirect Evaporative air Cooler (IEC)

Figure 3.4 illustrates the components of an indirect evaporative air cooler (IEC), which includes a heat exchanger, blower fan, water tank, water distribution system containing a water distributor and pipe, and pump. With the exception of the extra component, the heat exchanger (HE), which is described below, the roles of these components are the same as those previously outlined in Section 3.3.1:

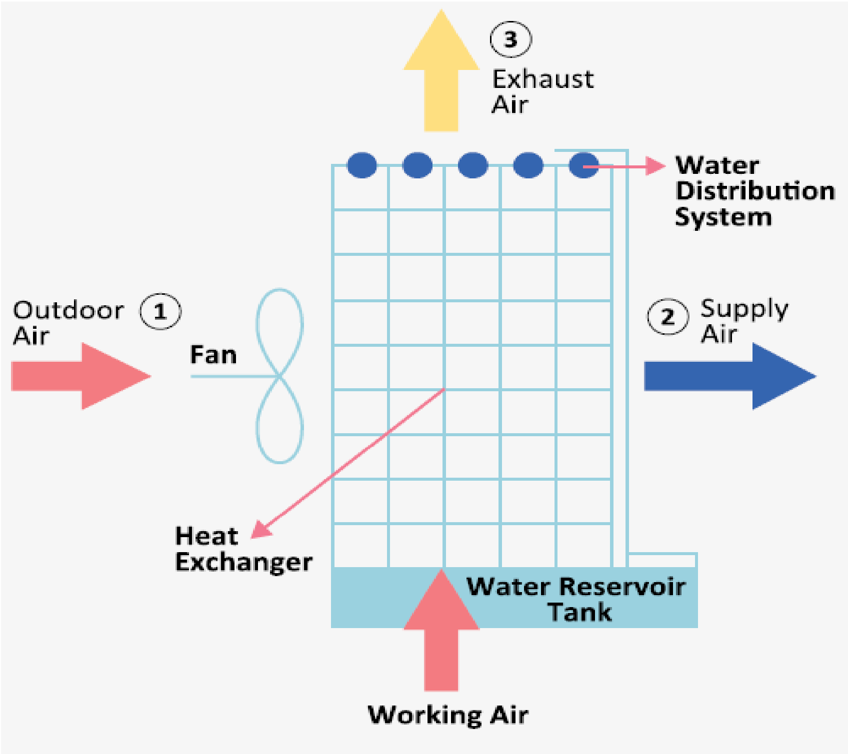

Figure 3.3: Schematic of an IEC

Heat exchanger: a device that allows water and air to exchange heat without coming into touch directly.

3.3.3 Indirect – Direct Evaporative air Cooler (IDEC)

A sensible HE, cooling pad, blower fan, water tank, water distributor, pipe, and pump make up an indirect-direct evaporative air cooler (IDEC). These components' functions mirror those described in Sections 3.3.1 and 3.3.2 above.

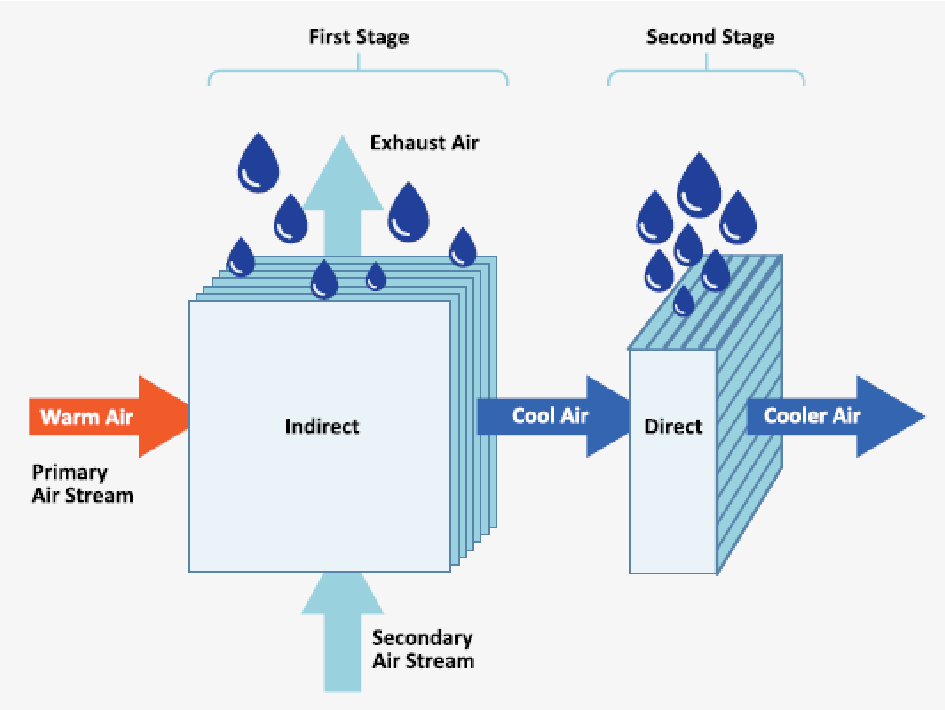

Figure 3.4: Schematic of an IDEC

3.4 DEC Technology Description

This method relies on the movement of mass and heat between water and air. Through the evaporation of water and the transformation of sensible heat into latent heat, direct evaporative air coolers assist in lowering the air temperature. Direct contact between air and water occurs as a result of the air passing over the cooling pad of the evaporative air cooler during this procedure. This causes the cooled supply air to become more humid as a result. Although DECs can function well in dry climates, they should not be used in areas with high humidity or low dry-bulb temperatures. This is due to the very saturated state of the ambient air in high-humidity climate zones, which slows down evaporation and renders DECs useless.

3.4.1 DEC Working Principle

As seen in Figures 3.5 and 3.6 below, the DEC draws in warm, dry air containing sensible heat, which is then forced through cooling pads.

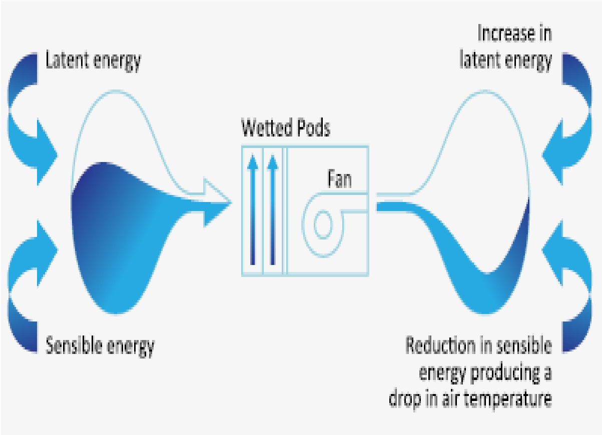

Figure 3.5: Sensible and Latent Heat in Evaporative Air Cooling Process

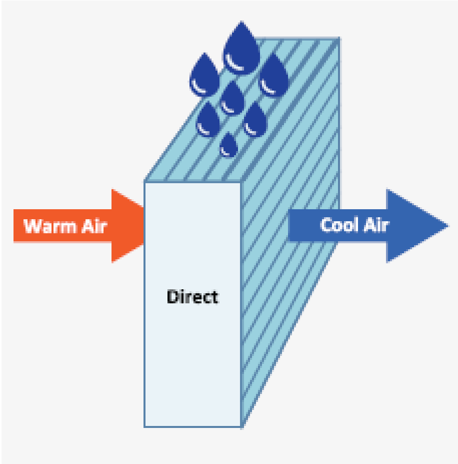

Figure 3.6: Working of a DEC

The pump and distributes water over the cooling pads as the dry, heated air passes past them. As seen above in Figures 5 and 6, the water absorbs the heat from the air, causing the water to evaporate and the sensible heat to be transformed into latent heat, which lowers the dry-bulb temperature of the air. The cooled air is given humidity throughout this procedure. A motor-driven fan then disperses the cooled air throughout the space with increased humidity and a lower dry-bulb temperature (due to the drop in sensible heat). The air's wet-bulb temperature doesn't change.

3.5 Conclusion

We spoke about solar cookers in this chapter. The most efficient Evaporative Type Air Cooler approach we wish to attempt using in real life is the Evaporative Air Cooler operation, operating procedure, and its application.

CHAPTER 4

EXPERIMENTAL PROCEDURES FOR METHODOLOGYASSESMENT

4.1 Introduction

This chapter includes a brief summary of our project process, work flow, guiding principles, and end project view. We learn a little bit about the structure of our project in this section.

4.2 Methodology

Making a design and list of the materials and components needed to build an evaporative type air cooler to determine which materials and components are required. assembling the necessary parts and materials to build the system. Finally, we built this system and verified that it was operating effectively.

4.3 Working Flow Chart

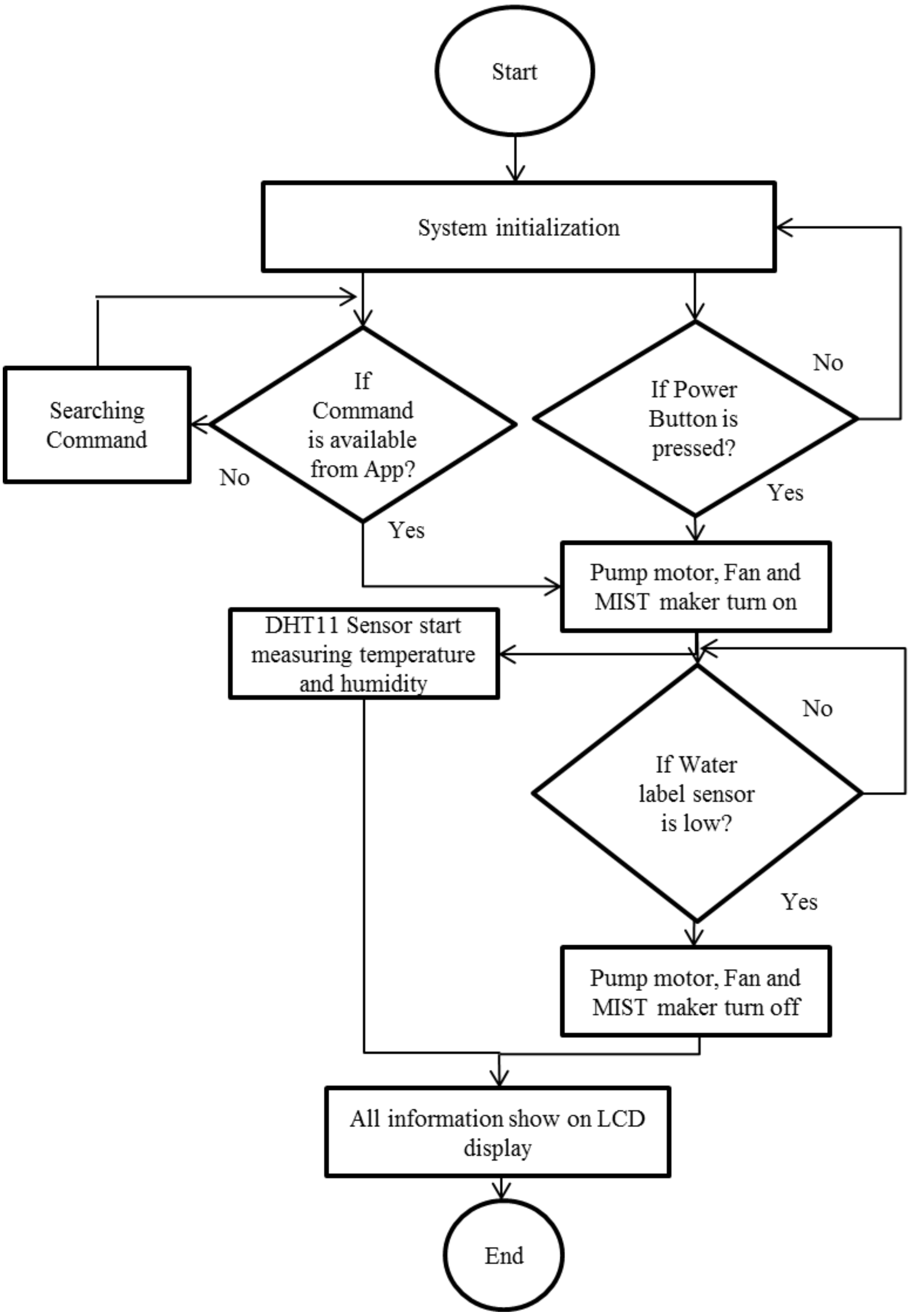

Figure 4.1: Working Flow Chart of Our Project.

4.4 Block Diagram:

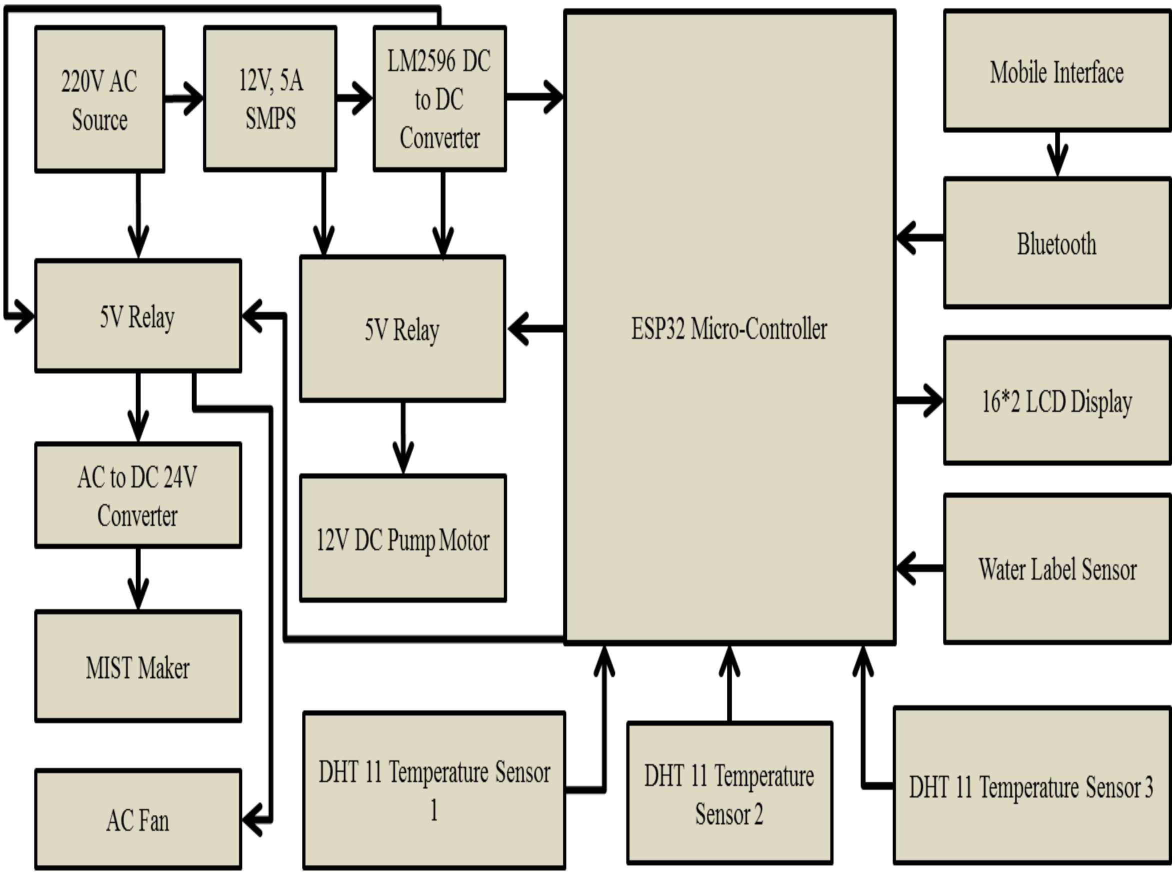

Figure 4.2: Block Diagram of Evaporative cooling system

4.5 Circuit Diagram

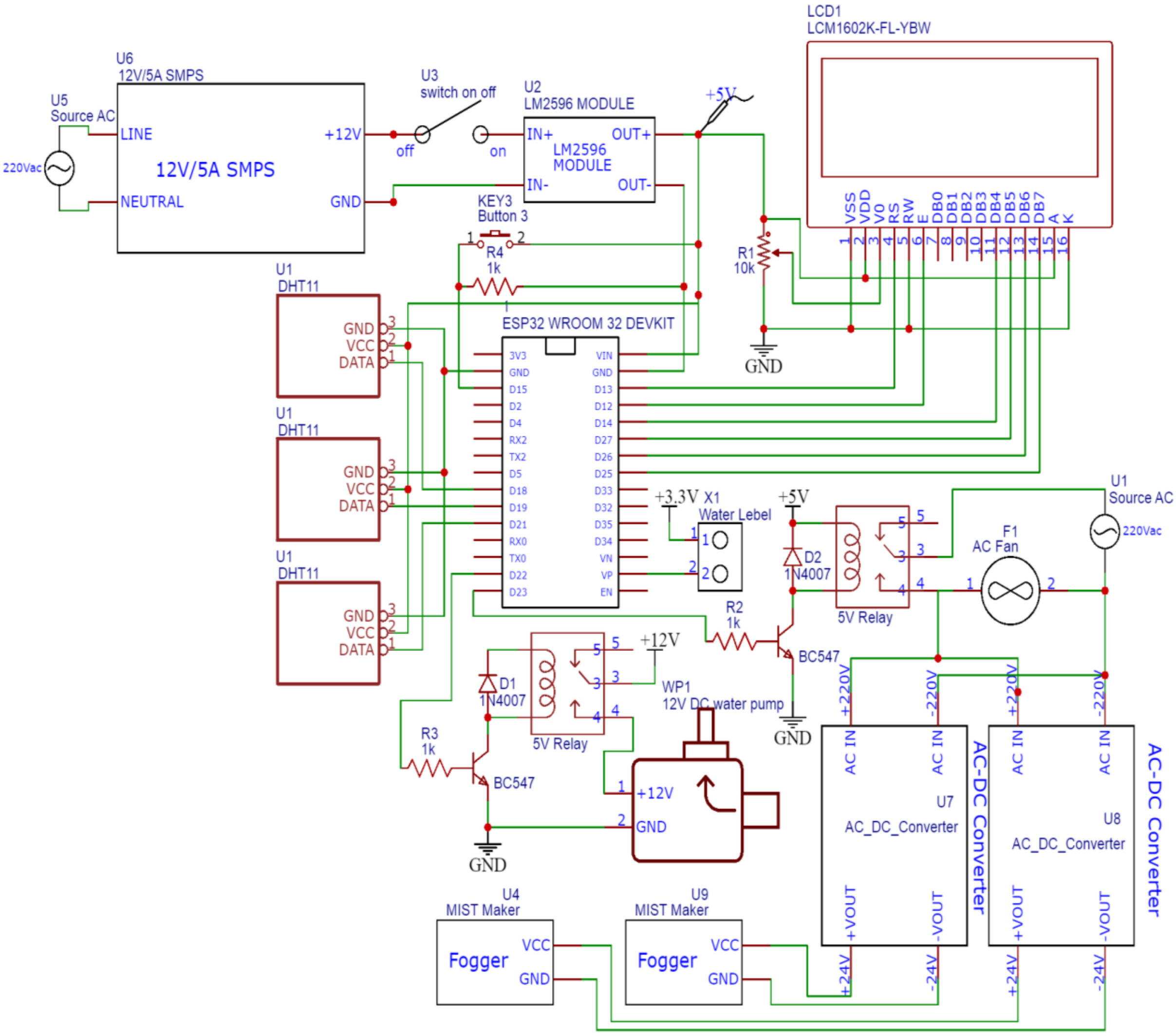

Figure 4.3: Circuit Diagram of Evaporative cooling system

4.6 Working Principle

Energy utilization by EACs is comparable to turning on a lamp. A supply fan motor, a tiny DC pump, and a low-voltage control thermostat make up the EAC's electric parts. The quantity of power used remains constant when an EAC system is activated. If the supply fan is powered by a speed or variable speed fan motor, this is an exception. The ON/OFF actions of the supply fan, fan HIGH/LOW speed, and pump are normally controlled by three EAC control points. Other EAC-related controls include media pre-wetting cycles, dump controls, and relief air interlocks. The EAC will likely be winterized as part of seasonal maintenance, thus freeze protection is often not required.

It could be helpful to think of air as a kind of sponge while attempting to comprehend evaporative cooling. Air absorbs water like a sponge when it comes into touch with it. How much water is already present in the air has a significant impact on how much water is absorbed. After all, how dry of a sponge you are using will determine how quickly you can clean up a spill. The amount of water in the air is referred to as the "humidity" level. The humidity would be 20% if the air is only 20% full. The air can contain all the moisture it can when the humidity is 100%. The more water that the air can contain when the humidity is low, and the more water that can evaporate.

When describing the amount of moisture in the air, the term relative humidity is used because the sponginess of air changes relative to air temperature. The warmer the air, the spongier it becomes and the more water it can hold. As a result, we must describe the level of humidity relative to the type of sponge we are referring. Is it a 50° F sponge or an 80° F sponge? An 80°F sponge will hold more water than a 50°F sponge at 50% humidity.

4.7 Complete Project Prototype Image

Figure 4.4: Front View of the project

This is our final project prototype picture as shown Figure 4.3. In our system we are now fully prepared to measure the temperature

Figure 4.5: Side View of the project

This is a blurry photograph of the prototype for our final project, which is examining the temperature as illustrated in Figure 4.4. On our project, we kept this configuration for a very long period. In a temperature sensor, the quantity of cold produced here may be seen.

Figure 4.6: Inner View of the project

This is an inner view of our final project prototype as shown Figure 4.5. We can see all kinds of components that are installed according to circuit design.

Figure 4.7: Full View of the project

4.8 Components List:

- **ESP32 Micro-controller**
- **SMPS 24V**
- **16*2 LCD display**
- **LM2596 DC to DC converter**
- **DC pump motor**
- **AC Motor**
- **DHT11 Temperature sensor**
- **Mist Maker Fog Humidifier**
- **Relay 5V**
- **1N4007 Diode**
- **BC547 NPN Transistor**
- **Push Button**
- **Jumper Wire**
- **ON OFF Switch**
- **Plastic Box**
- **Evaporative cooling pad**
- **Vero Board**
- **PVC Board**

4.8.1 ESP32 Micro-controller

A new development board is introduced as ESP32. ESP32-WROOM-32D and ESP32-WROOM-32U are Wi-Fi, Bluetooth and BLE MCU modules. Many applications can be extended, from low-impact networks to demanding services such as voice encryption, MP3 streaming conversion, Bluetooth LE, and Wi-Fi connection. This module can be used in a variety of ways: Wi-Fi allows users to connect to the Internet via physical connection from a Wi-Fi router, while Bluetooth allows users to connect to their phone. The ESP32 explorer has a sleep time of less than 5 seconds, making it ideal for batteries and wearable applications. To ensure maximum bandwidth, the module supports data rates up to 150 Mbps with an antenna output of 20 dBm. As a result, the module has the necessary characteristics in the industry and provides excellent performance for electrical system installation and integration.

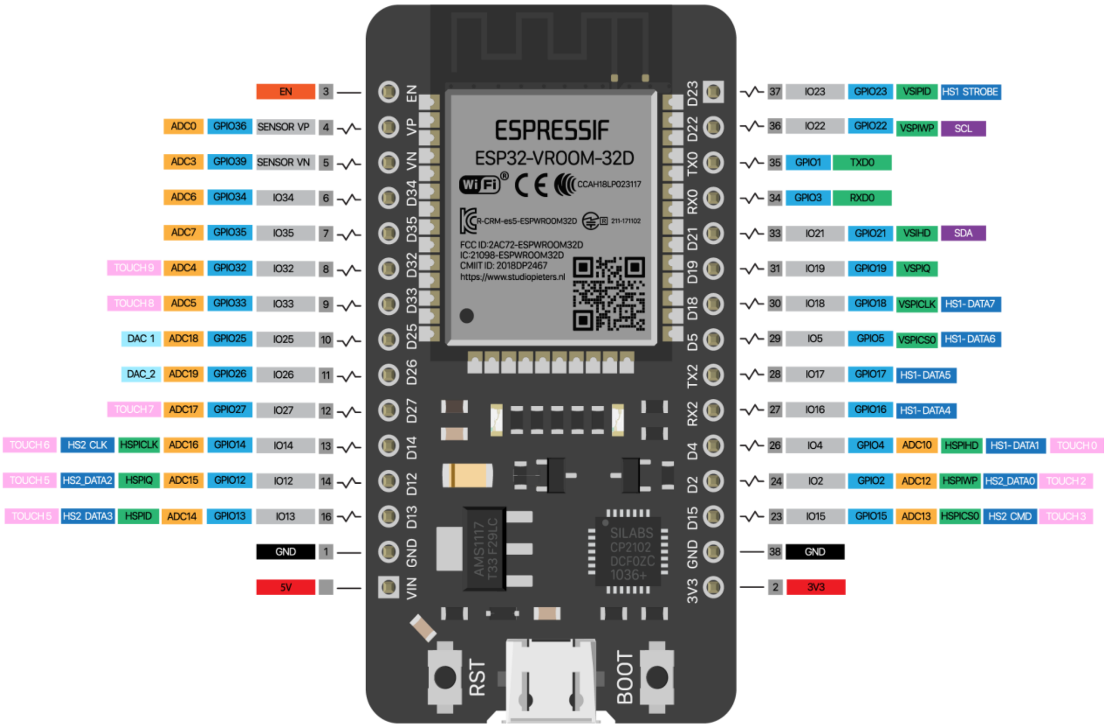

Figure 4.8: ESP32 Micro-controller

4.8.2 24V SMPS

SMPS is an electronic circuit that converts power by turning the device on and off at high speeds and storing equipment such as inductors or capacitors to provide power when the switching device is in idle mode.

The light switch provides efficient operation and is used in many electronic devices. Including computers and other sensitive devices, which requires a strong and effective power Transformer power supply mode is also called power supply switch mode or power supply mode.

Fig.4.9: SMPS 12V 5A

4.8.3 16*2 LCD display

The liquid crystal display LCD is an electronic display system and has many applications. 16x2 LCD is a compact module commonly used in various circuits. The 16 × 2 water crystal display means that up to 16 characters can be displayed in series and there are two symbols. Each character on this LCD is represented by a 5 × 7 mat 7 pixel matrix. The 16 2 2 x's size can display 224 characters on this double LCD.

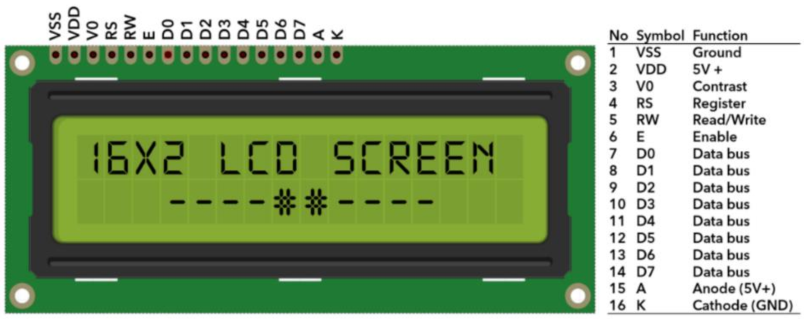

Fig.4.10: 16*2 LCD Display

4.8.4 LM2596 DC to DC converter

The LM2596 is a well-known IC deer adaptor. This converter can accept input voltages ranging from 4.5 to 40 volts and convert them to an alternating voltage with a current flow of up to 3 amps. It's often utilized in power modules and heavy load management because of its high current capacity. The present high level of 3A is known for LM2596. It comes in a variety of output voltages, including 3.3V, 5V, and 12V. The LM2596-ADJ, which features a variable output voltage, is the most well-known. The main converter, which operates at a frequency of 150 kHz, consumes the input voltage and adjusts the needed output voltage using an internal switching circuit. It has a high level of performance, as well as thermal and current maximum performance closure. So, if you're seeking for a low-cost, simple-to-use IC converter, go no further.

Fig.4.11: LM2596 Converter

4.8.5 DC pump motor

It can run from a low-cost, small-sized submersible engine pump that supplies 12V power. It will take up to one hundred twenty liters per hour with a really low current consumption of 220mA. Just connect the tube to the engine outlet, submerge it in water and give it power.

Fig.4.12: Pump Motor

4.8.6 AC Motor

We are aware that the motor is an apparatus that transforms electrical energy into mechanical energy. The motor will use input electrical power (voltage and current) and output mechanical power when operating a fan (Torque & Speed). Due to its widespread availability in the past, AC electricity had the most popularity.

- Size: 300mm
- Voltage: 220V
- Rated Input: 60 W
- Speed (RPM): 2700
- Frequency: 50GHz
- Power Factor: 0.90
- Insulation class: class-E
- Air Delivery: 50mm3/min

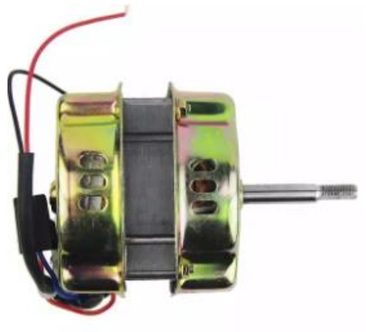

Fig.4.13: AC Motor

4.8.7 DHT11 Temperature sensor

The temperature sensor is an additional circuit sensor. Voltage output falls in line with temperature centigrade. The sensor shows that the number is compatible with the Arduino UNO device. Application of temperature sensor is in microwave oven, refrigerator, home appliances, air conditioning and water monitoring. It can soothe not only body temperature but also body temperature. There are two types of sensors, they are contact temperature sensor and temperature sensor contact. Another contact temperature sensor is divided into three types: electromechanical, resistive heat resistance, and semiconductor temperature sensor.

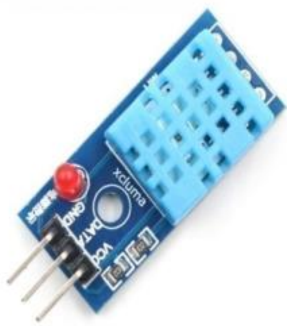

Fig.4.14: DHT11 Temperature sensor

4.8.8 Mist Maker Fog Humidifier

MIST producers are UL approved and have great security, so there is no need to be concerned about any risks. Utilizing it is quite safe. It is safe to use because the voltage is 24V and the mist occurs when it is submerged in water. Mister Fogger has a lot of mist to offer. 300 mL/H of aerosolized material, no heat or chemicals utilized. The LED lights will randomly change colors, shine brightly at night, and draw a lot of attention.

Fig.4.15: Mist Maker Fog Humidifier

4.8.9 Relay 5V

The relay is an electromagnetic chamber that can be ignited with a small amount of water. In fact, we will use the torch to turn the engine on and off.

Fig.4.16: 5V Relay.

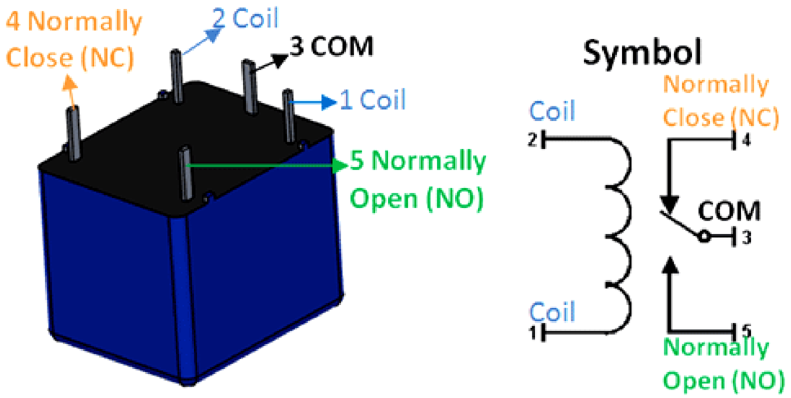

Fig.4.17: 5V Relay Pin out Details.

The current is used to open and close contacts with a relay. When the transmitter is designed, the source contacts are usually held together with the cable, preserving the source. There are two advantages to using this system. The relays can now be used for micro-controlling power grids from long-range digital systems for two reasons: first, the connection must be less than the change in contact current, and secondly, partners must separate the grids and contacts.

4.8.10 1N4007 Diode

It's possible that 1N4007 PN is a semiconductor diode. At the moment, due to their nature, there is only one pair of these diodes. Therefore, it can be converted from AC to DC power and used in conjunction with the Happy Diode system. Inverter rectifier for normal power supply includes vertical diode.

Fig.4.18: 1N4007 Diode

4.8.11 BC547 NPN Transistor

In fact, the transistor is a controlled electric field. BC547 is an NPN transistor that transmits power from the receiver to the emitter when the power is supplied in the settings (control line). NPN carriers are often "switched" on the device so they can be placed in circuits after production.

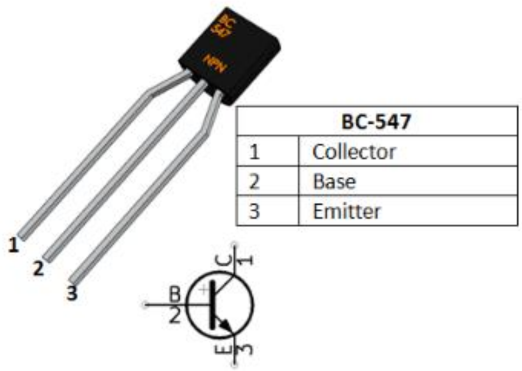

Fig.4.19: BC547 Transistor.

4.8.12 Push Button

An input button switch is a type of switch that turns a switch on or off using a simple electrical or pneumatic system. Depending on the model, they may have less time or pause. Buttons are usually made of durable materials such as metal or plastic. Variations of push buttons are available in different sizes and styles.

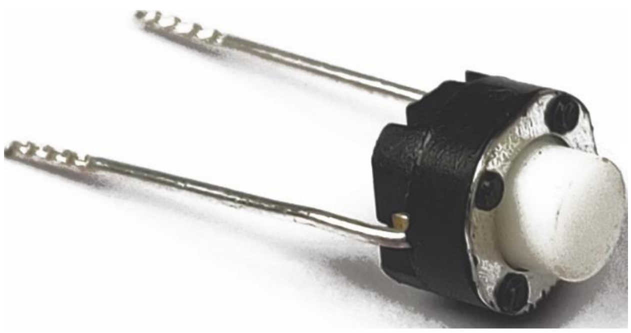

Figure 4.20: Push button

4.8.13 Jumper Wire

The jumper wires, which are wires that have a connecting point at each end, are used to connect two densities to each other randomly. Commonly used wires are used on different boards to support the business for circuit switching.

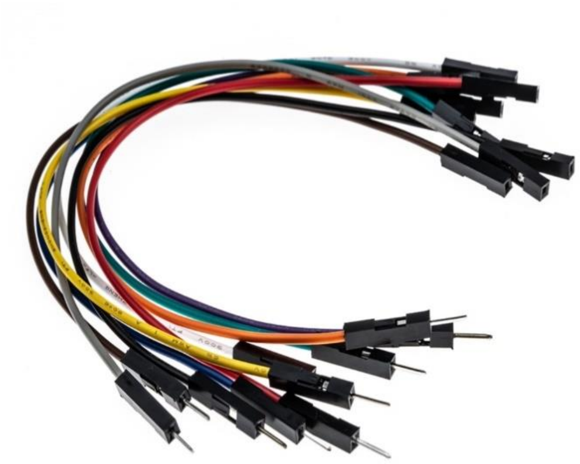

Fig. 4.21: Jumper Wire

Individual jumping wires are installed by inserting your "end connector" into an intro slot in the baking sheet, inserting the head connector to the circuit board, or a piece of test equipment.

4.8.14 Plastic Box

A storage container is any type of storage bin used for storage. They can be called storage bins. High strength polypropylene is used for plastic storage and some are made from high quality polypropylene and come in a variety of sizes depending on their load capacity. Plastic storage devices can hold heavier work products, but last longer and more stable.

Fig.4.22: Plastic box

4.8.15 Evaporative cooling pad

Evaporative cooling pad made of corrugated cellulose paper that is adhered in the opposite direction, creating an air route inside the pads. Paper sheets are comprised of a particular cellulose craft paper that has a very high water absorption capacity. Each paper is chemically treated to stop it from disintegrating. When utilized in a cooling system, cooling pads lower temperature without gas emissions and at a low energy cost, making them energy-efficient, ecologically benign, and commercially feasible. The pads have a 5 mm flute size and an excellent water absorption capacity, which significantly reduces heat transfer. It is offered in brown hue.

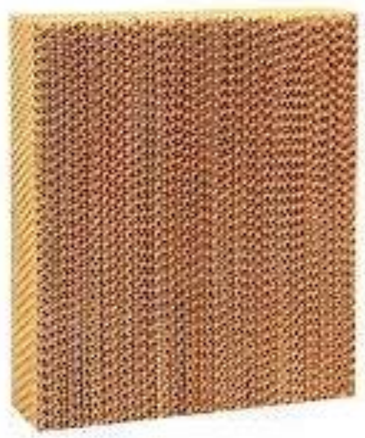

Fig.4.23: Evaporative cooling pad

4.8.16 Vero Board

A Vero board is a solder less gadget for an impermanent model with hardware and test circuit plans. Most electronic segments can be interconnected in electronic circuits by embedding's their leads or terminals into the openings and making associations through wires where conceivable. Under the board, the Vero board has metal strips and the openings on the most elevated purpose of the board are associated.

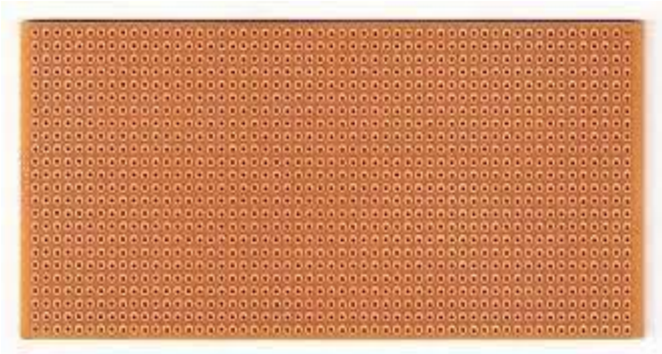

Fig.4.24: Vero Board

4.8.17 PVC Board

PVC foam board is a feather light, extended unbending PVC froth sheet that is utilized for an assortment of uses including signs and shows, display corners, photograph mounting, inside plan, thermoforming, models, model making and substantially more. It very well may be effectively sawed, stepped, punched, cut, sanded, bored, screwed, nailed, or bolted. It tends to be fortified utilizing PVC cement. It properties incorporate brilliant effect opposition, exceptionally low water ingestion and high erosion obstruction.

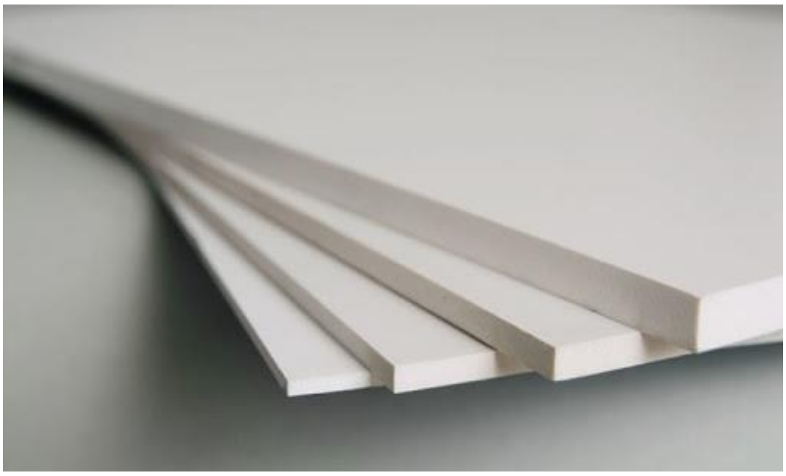

Fig.4.25. PVC Foam Board

4.9 Conclusion

In this chapter we have discuss about our project hardware which we use in our project.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 Introduction

This chapter covers the experimental data gathering for our project, the graph of temperature differences, project output temperature information, and project constraints. Due to the difficulty of the data collecting and graph creation for us, this chapter's most crucial section. After overcoming all challenges, we completed our task effectively.

5.2 Result

Table 5.1: Only fan with low speed Data Collection Reading

Table:1.1										
Only with fan										
SL.No	Time	Temp.Sensor 1		Temp.Sensor 2		Temp.Sensor 3		Fan position	Water Temp
		T °C	H%	T °C	H%	T °C	H%		
1	11.00am-11.10am	30.7 °	86%	25.9°	90%	28.30°	87%	Low	27°
2	11.10am - 11.20am	30.8 °	86%	25.9°	90%	28.40°	86%	Low	27°
3	11.10am - 11.30am	30.10 °	86%	25.9°	89%	28.70°	84%	Low	27°
4	11.10am - 11.40am	30.10 °	86%	25.9°	88%	28.90°	84%	Low	27°
5	11.10am - 11.50am	30.10 °	86%	25.9°	88%	28.80°	86%	Low	27°
6	11.10am - 11.60am	30.30 °	86%	25.9°	88%	28.90°	84%	Low	27°

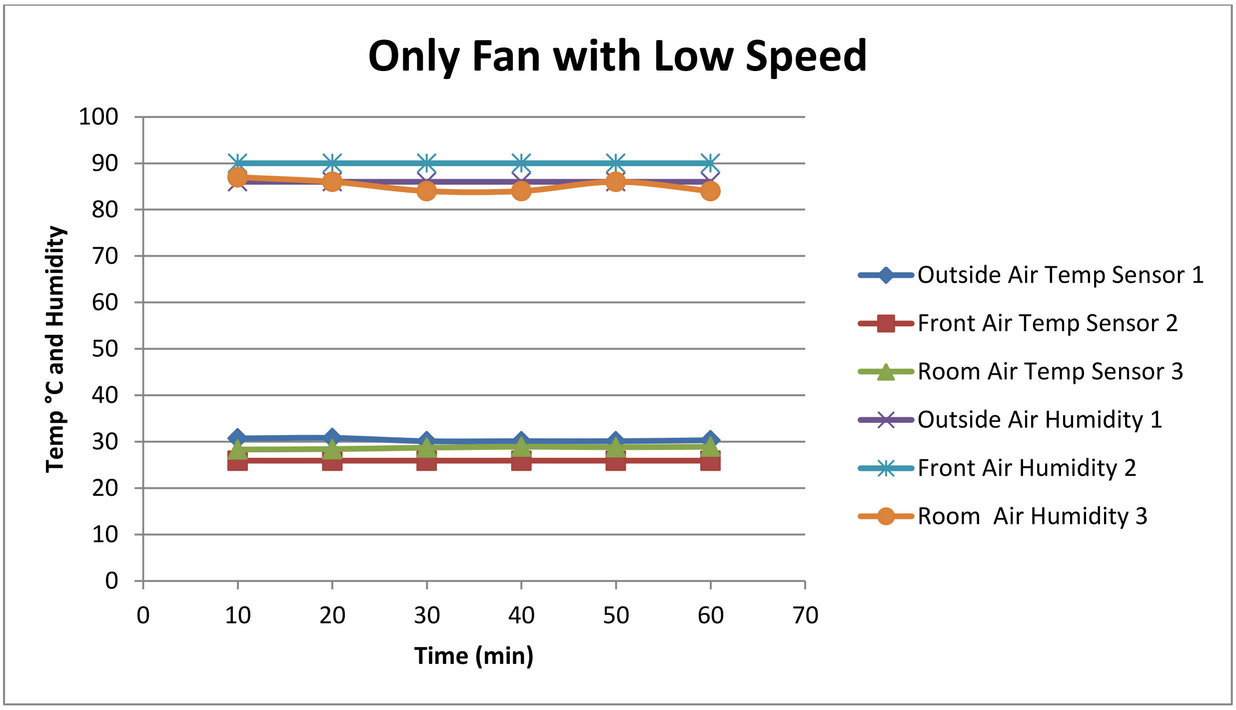

Figure 5.1: Temperature Chart for Experiment 01

In our final project prototype, this is the first experimental data reading [5.1] of air temperature without any water or fog. The data was gathered in the middle of September. Nevertheless, we made an effort to gather data every ten minutes, and they are displayed above in the form of data sheets and charts.

Table 5.2: Only fan with Medium speed Data Collection Reading

Table:1.2									
Only with fan									
SL.No	Time	Temp.Sensor 1		Temp.Sensor 2		Temp.Sensor 3		Fan position	Water Temp
		T °C	H%	T °C	H%	T °C	H%		
1	12.00pm-12.10pm	30.8 °	86%	26.8°	88%	28.70°	85%	Medium	27°
2	12.10pm-12.20pm	30.8 °	86%	26.8°	86%	28.70°	85%	Medium	27°
3	12.20pm-12.30pm	30.8 °	86%	26.7°	87%	28.80°	84%	Medium	27°
4	12.30pm-12.40pm	30.70 °	86%	26.7°	86%	28.80°	83%	Medium	27°
5	12.40pm-12.50pm	30.70 °	86%	26.8°	86%	28.80°	84%	Medium	27°
6	12.50pm-12.600pm	30.70 °	86%	26.7°	86%	28.70°	83%	Medium	27°

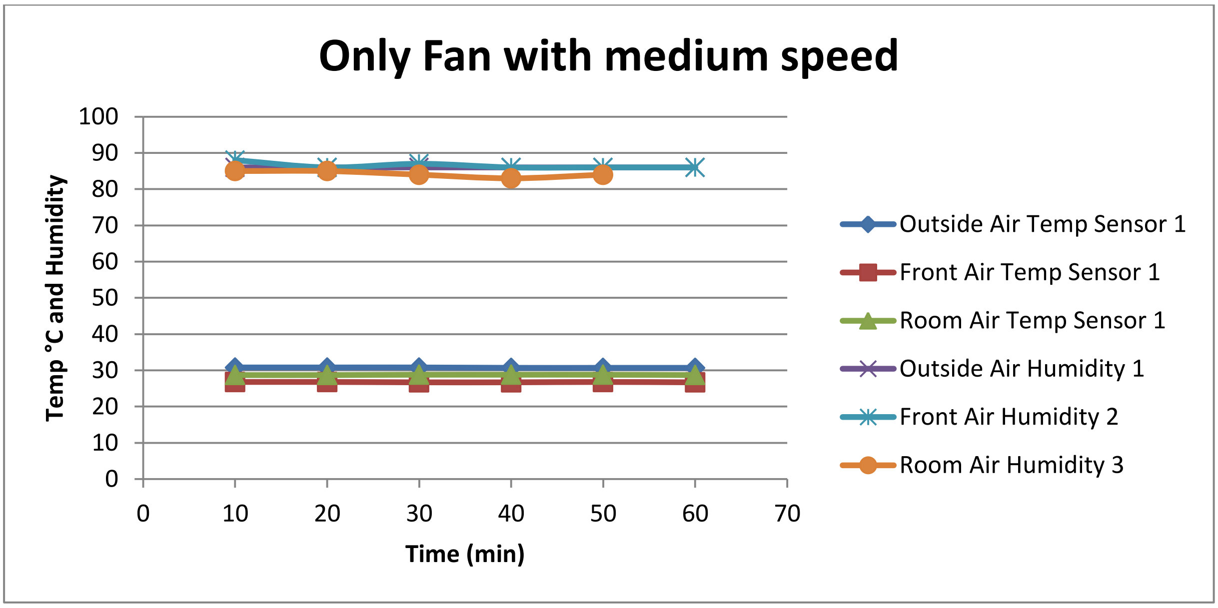

Figure 5.2: Temperature Chart for Experiment 02

In our final project prototype, this is the second experimental data reading of ambient temperature [5.2] with a medium fan speed. This data was gathered on September 13, 2022. However, we made an effort to gather data every ten minutes, and they are displayed above as data sheets and infographics.

Table 5.3: Only fan with High speed Data Collection Reading

Table:1.3									
Only with fan									
SL.No	Time	Temp.Sensor 1		Temp.Sensor 2		Temp.Sensor 3		Fan position	Water Temp
		T °C	H%	T °C	H%	T °C	H%		
1	2.00pm-2.10pm	30.7 °	85%	27.10°	84%	28.70°	85%	High	27.4°
2	2.10pm-2.20pm	30.7 °	85%	27.10°	84%	28.70°	82%	High	27.4°
3	2.20pm-2.30pm	31.3 °	83%	27.50°	83%	28.80°	83%	High	27.4°
4	2.30pm-2.40pm	31.4 °	83%	28.00°	80%	28.80°	82%	High	27.4°
5	2.40pm-2.50pm	31.4 °	82%	28.00°	80%	28.80°	80%	High	27.4°
6	2.50pm-2.60pm	31.2 °	83%	28.00°	83%	28.70°	80%	High	27.4°

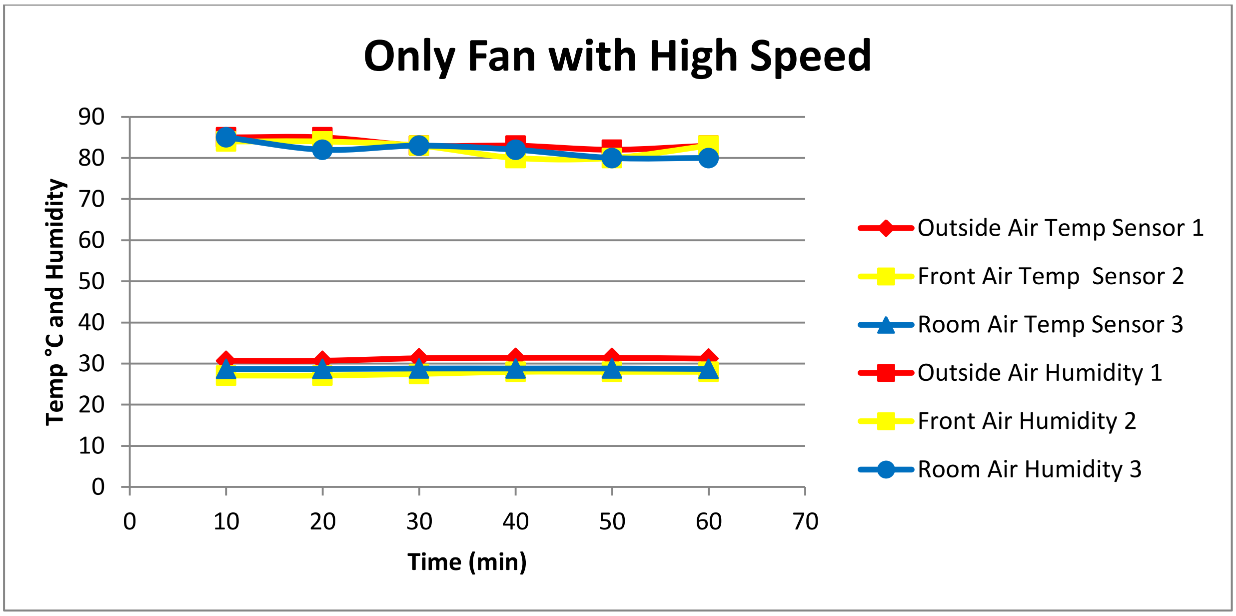

Figure 5.3: Temperature Chart for Experiment 03

In our final project prototype, this is the third experimental data reading [5.3] of air temperature with high fan speed. This information was gathered in the middle of September. However, we made an effort to gather data every ten minutes, and they are displayed above as data sheets and infographics. The results of this experiment were quite promising. The box's inside temperature is warmer than the prior reading.

Table 5.4: Fan and Water with low speed Data Collection Reading

Table:2.1									
Fan with Water									
SL.No	Time	Temp.Sensor 1		Temp.Sensor 2		Temp.Sensor 3		Fan position	Water Temp
		T °C	H%	T °C	H%	T °C	H%		
1	4.00pm-4.10pm	30.4 °	87%	26.50°	90%	28.50°	86%	Low	27.4°
2	4.10pm-4.20pm	30.1 °	88%	27.40°	90%	28.40°	87%	Low	27.4°
3	4.20pm-4.30pm	30.1 °	89%	27.40°	90%	28.40°	87%	Low	27.4°
4	4.30pm-4.40pm	30.1 °	89%	26.30°	90%	28.30°	87%	Low	27.4°
5	4.40pm-4.50pm	30.1 °	89%	26.30°	90%	28.30°	88%	Low	27.4°
6	4.50pm-4.60pm	30.1 °	88%	26.30°	90%	28.30°	88%	Low	27.4°

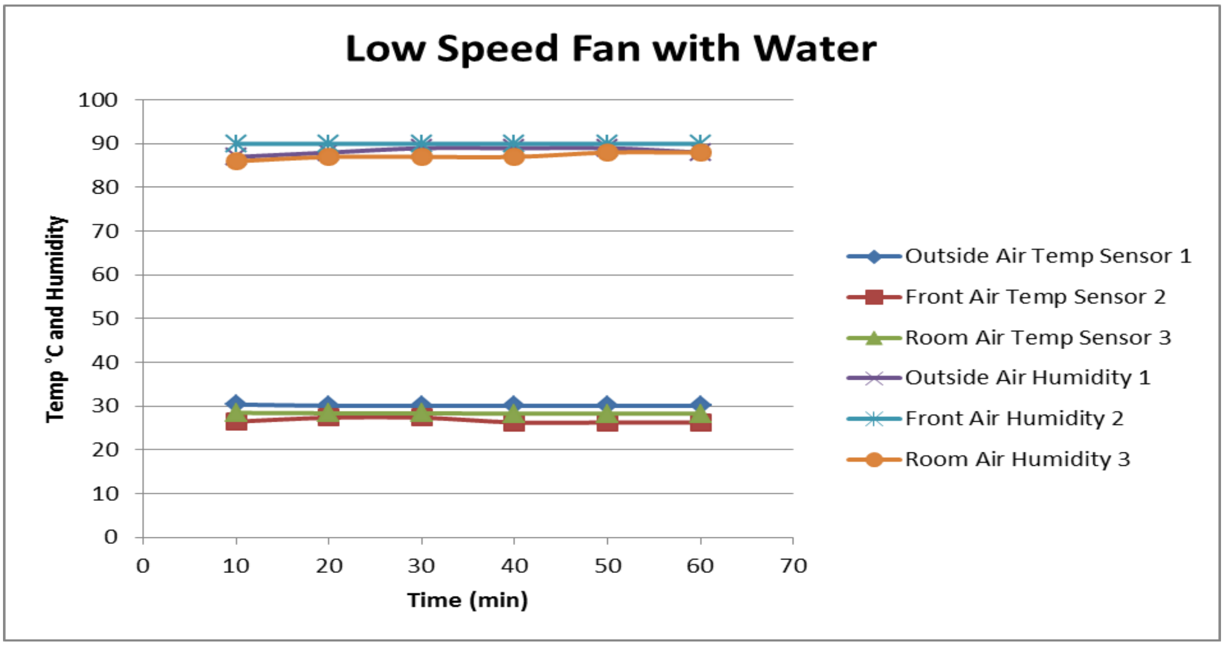

Figure 5.4: Temperature Chart for Experiment 04

Our final project prototype's fourth experimental data reading of air temperature with a low speed fan and water is [5.4]. This information was gathered in the middle of September. But we made an effort to gather statistics every ten minutes, and they are displayed above in the form of data sheets and table charts. The results of this experiment were quite promising.

Table 5.5: Fan and Water with medium speed Data Collection Reading

Table:2.2									
Fan with Water									
SL.No	Time	Temp.Sensor 1		Temp.Sensor 2		Temp.Sensor 3		Fan position	Water Temp
		T °C	H%	T °C	H%	T °C	H%		
1	10.00am-10.10am	30.1 °	89%	26.10°	90%	27.90°	88%	Medium	27.2°
2	10.10am-10.20am	30.1 °	89%	26.10°	90%	27.90°	88%	Medium	27.2°
3	10.20am-10.30am	30.2 °	89%	26.10°	90%	27.90°	89%	Medium	27.2°
4	10.30am-10.40am	30.1 °	89%	26.10°	90%	27.80°	87%	Medium	27.2°
5	10.40am-10.50am	30.0 °	89%	26.10°	90%	27.80°	89%	Medium	27.2°
6	10.50am-10.60am	30.1 °	89%	26.10°	90%	27.80°	88%	Medium	27.2°

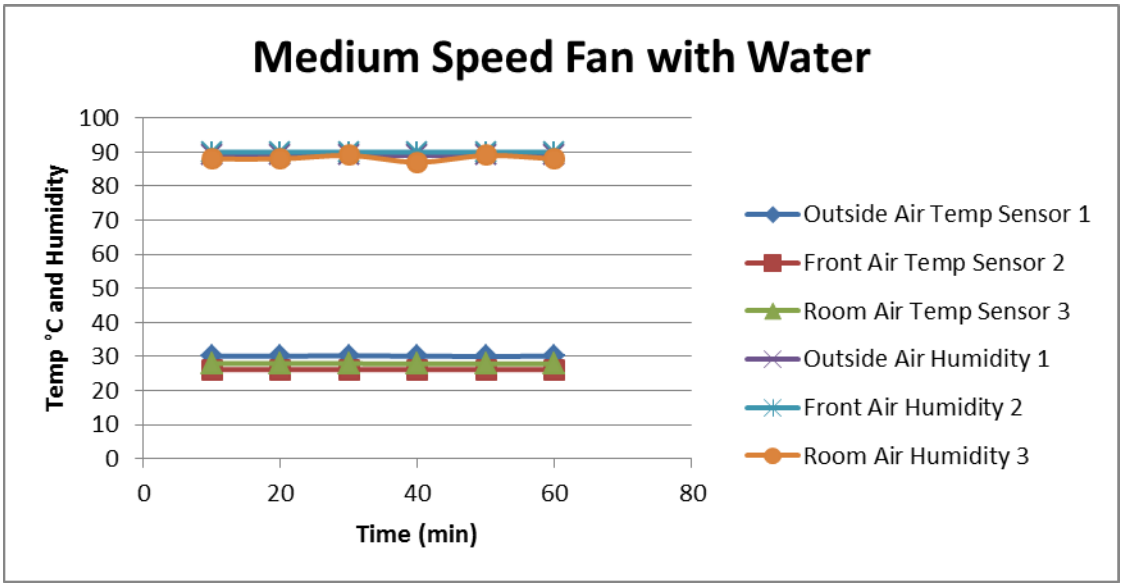

Figure 5.5: Temperature Chart for Experiment 05

This system produces a lot of mist since it uses two MIST Makers. The major range of the temperature differential is 2 to 5 degrees Celsius. The temperature falls to 25°C when the room becomes cooler, and the graph slopes downward. This technique is actually quite helpful for our nation and works best in arid areas.

Table 5.6: Fan and Water with high speed Data Collection Reading

Table:2.3									
Fan with Water									
SL.No	Time	Temp.Sensor 1		Temp.Sensor 2		Temp.Sensor 3		Fan position	Water Temp
		T °C	H%	T °C	H%	T °C	H%		
1	12.00pm-12.10pm	30.1 °	88%	25.70°	92%	27.30°	90%	High	27.3°
2	12.10pm-12.20pm	29.90 °	89%	25.70°	92%	27.20°	88%	High	27.2°
3	12.20pm-12.30pm	29.80 °	89%	25.60°	92%	27.10°	89%	High	27.2°
4	12.30pm-12.40pm	29.70 °	89%	25.60°	93%	27.10°	87%	High	27.2°
5	12.40pm-12.50pm	30.60 °	87%	25.60°	93%	27.20°	89%	High	27.2°
6	12.500pm-12.60pm	30.60 °	86%	25.70°	93%	27.10°	88%	High	27.2°

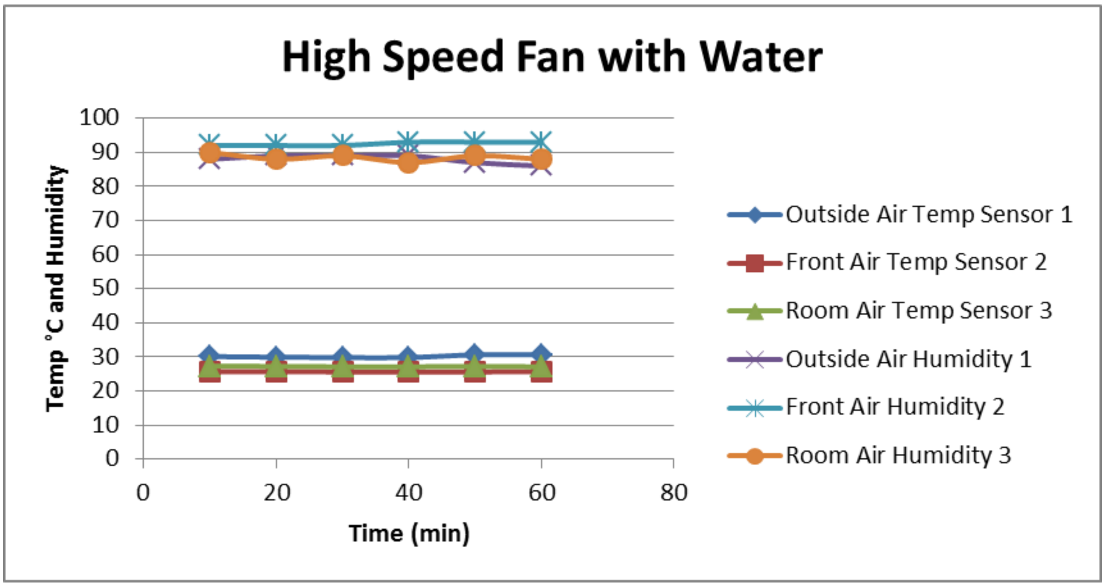

Figure 5.6: Temperature Chart for Experiment 06

This system uses two MIST Makers, which produces a lot of mist. This approach is truly quite helpful for our nation and works best in arid regions. The majority of the temperature change is between 2 and 5 degrees Celsius. The temperature falls to 25°C when the room becomes colder, and the graph slopes downward.

Table 5.7: Fan and Water with low speed Data Collection Reading

Table:3.1									
Fan with Water and Fog mixture									
SL.No	Time	Temp.Sensor 1		Temp.Sensor 2		Temp.Sensor 3		Fan position	Water Temp
		T °C	H%	T °C	H%	T °C	H%		
1	2.00pm-2.10pm	30.7 °	86%	25.60°	90%	27.20°	90%	Low	27.3°
2	2.10pm-2.20pm	30.5 °	87%	25.70°	90%	27.20°	88%	Low	27.2°
3	2.20pm-2.30pm	30.72°	88%	25.50°	92%	27.10°	89%	Low	27.2°
4	2.30pm-2.40pm	30.74°	86%	25.40°	93%	27.00°	87%	Low	27.2°
5	2.040pm-2.50pm	30.9°	87%	25.60°	89%	26.90°	89%	Low	27.2°
6	2.50pm-2.60pm	31.0 °	86%	25.70°	89%	27.00°	88%	Low	27.2°

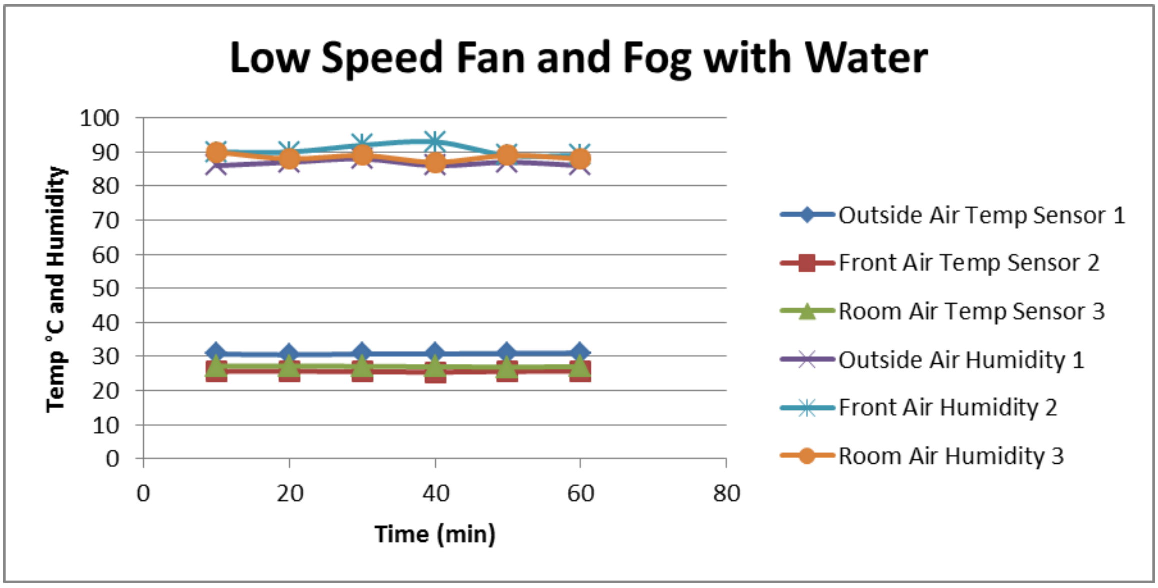

Figure 5.7: Temperature Chart for Experiment 07

With the help of two MIST Makers, a lot of mist is produced by this system. In fact, this approach is highly helpful for our nation and works best in arid areas. Mainly 2 to 5 degrees Celsius separate the two temperatures. The temperature decreases to 25°C and the graph slopes downward when the room becomes cooler.

Table 5.8: Fan, Fog and Water with low speed Data Collection Reading

Table:3.1										
Fan with Water and Fog mixture										
SL.No	Time	Temp.Sensor 1		Temp.Sensor 2		Temp.Sensor 3		Fan position	Water Temp
		T °C	H%	T °C	H%	T °C	H%		
1	2.00pm-2.10pm	30.7 °	86%	25.60°	90%	27.20°	90%	Low	27.3°
2	2.10pm-2.20pm	30.5 °	87%	25.70°	90%	27.20°	88%	Low	27.2°
3	2.20pm-2.30pm	30.72°	88%	25.50°	92%	27.10°	89%	Low	27.2°
4	2.30pm-2.40pm	30.74°	86%	25.40°	93%	27.00°	87%	Low	27.2°
5	2.040pm-2.50pm	30.9°	87%	25.60°	89%	26.90°	89%	Low	27.2°
6	2.50pm-2.60pm	31.0 °	86%	25.70°	89%	27.00°	88%	Low	27.2°

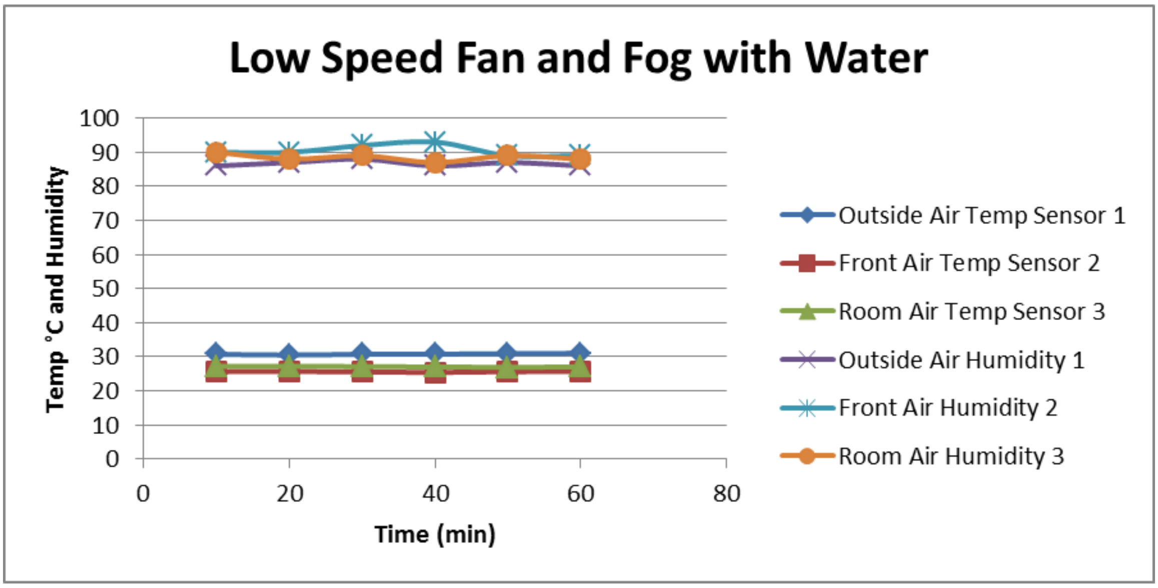

Figure 5.8: Temperature chart for Experiment 08

This system uses two MIST Makers, which generates a lot of mist. This method is excellent for desert areas and is truly quite helpful for our nation. Typically, there is a 2 to 5 degree Celsius temperature differential. The temperature in the room falls to 25°C when it becomes colder, and the graph slopes downward.

Table 5.9: Fan, Fog and Water with medium speed Data Collection Reading

Table:3.2									
Fan with Water and Fog mixture									
SL.No	Time	Temp.Sensor 1		Temp.Sensor 2		Temp.Sensor 3		Fan position	Water Temp
		T °C	H%	T °C	H%	T °C	H%		
1	4.00pm-4.10pm	30.7 °	86%	25.60°	90%	27.20°	90%	Medium	27.3°
2	4.10pm-4.20pm	30.7 °	87%	25.70°	90%	27.10°	88%	Medium	27.2°
3	4.20pm-4.30pm	30.60°	88%	25.50°	92%	27.10°	89%	Medium	27.2°
4	4.30pm-4.40pm	30.30°	86%	25.80°	93%	27.00°	87%	Medium	27.2°
5	4.40pm-4.50pm	30.30°	87%	26.00°	89%	27.00°	89%	Medium	27.2°
6	4.50pm-4.60pm	30.10 °	86%	26.00°	89%	27.00°	88%	Medium	27.2°

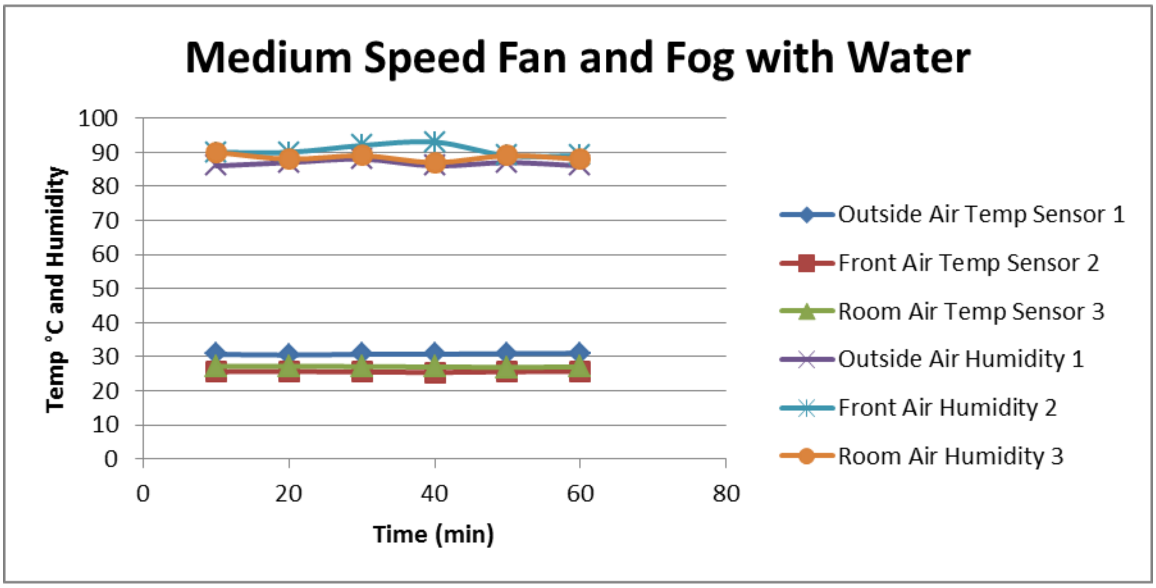

Figure 5.9: Temperature Chart for Experiment 09

Two MIST Makers are used in this system which creates a lot of mist. This system is best for desert region and actually very useful for our country. The temperature difference is mainly 2 to 5 degrees Celsius. When the room is cooler, the temperature drops to 25°C and the graph dips down.

Table 5.10: Fan, Fog and Water with high speed Data Collection Reading and Experimental room size 97.6 m3

Table:3.3										
Fan with Water and Fog mixture										
SL.No	Time	Temp.Sensor 1		Temp.Sensor 2		Temp.Sensor 3		Fan position	Water Temp
		T °C	H%	T °C	H%	T °C	H%		
1	5.00pm-5.10pm	30.6 °	86%	25.50°	90%	26.90°	90%	High	27.4°
2	5.10pm-5.20pm	30.75°	87%	25.50°	93%	26.80°	88%	High	27.4°
3	5.20pm-5.30pm	30.40°	88%	25.40°	93%	26.70°	89%	High	27.4°
4	5.30pm-5.40pm	30.60°	86%	25.50°	93%	26.70°	87%	High	27.4°
5	5.40pm-5.50pm	30.30°	89%	25.50°	89%	26.80°	89%	High	27.4°
6	5.50pm-5.60pm	30.10 °	89%	25.50°	90%	26.70°	88%	High	27.4°

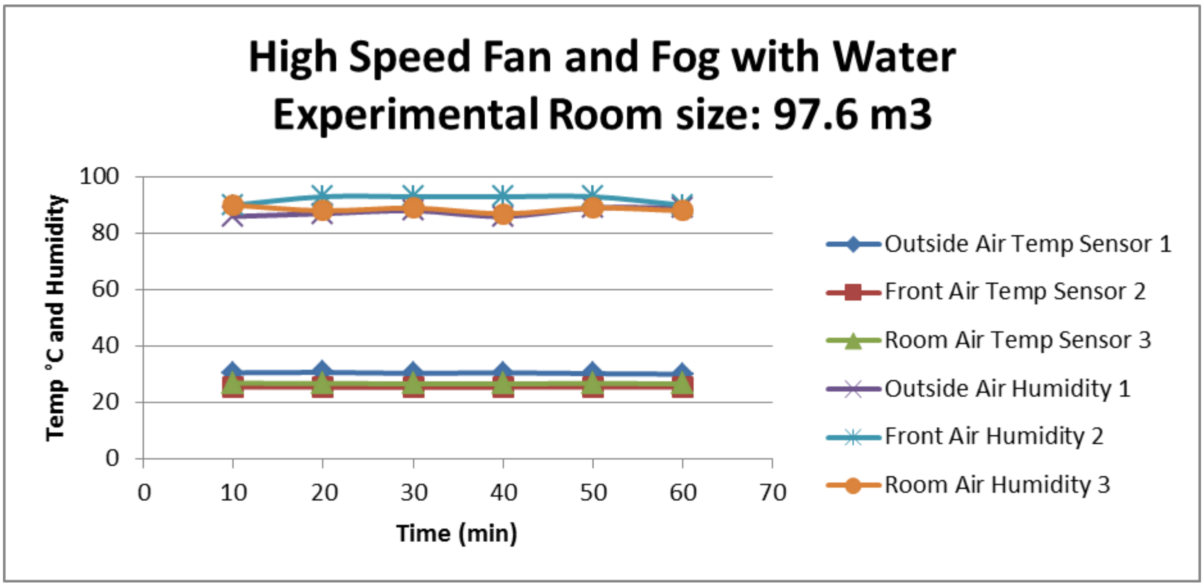

Figure 5.10: Temperature Chart for Experiment 10

This system produces a lot of mist since it uses two MIST Makers. This technique is actually quite helpful for our nation and works best in arid areas. The major range of the temperature differential is 2 to 5 degrees Celsius. The temperature falls to 25°C when the room becomes cooler, and the graph slopes downward.

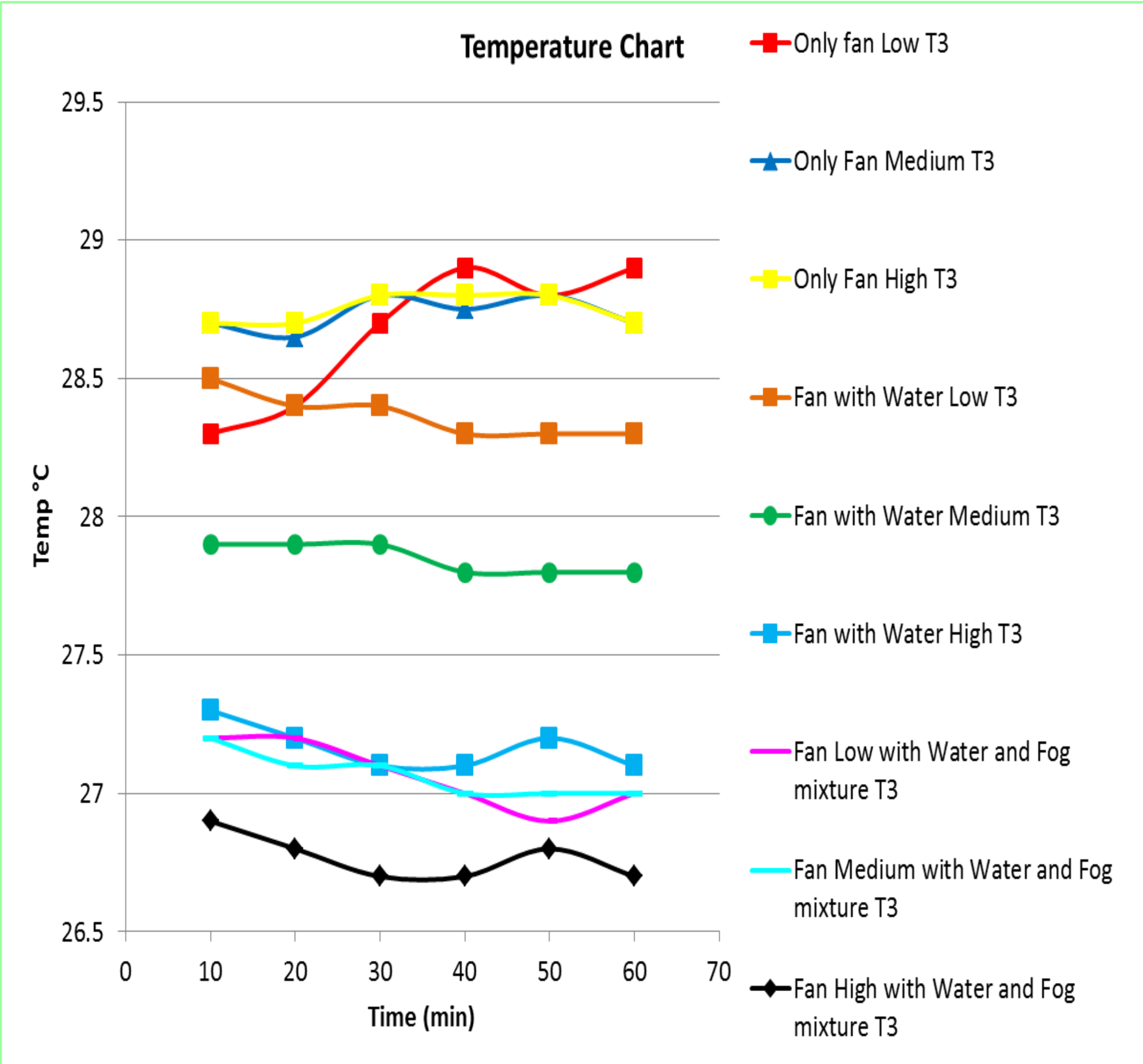

Figure 5.11: All Temperature Chart for Experiment 10

This chart shows the temperature readings of all the sensors together with water motor and fog. Also humidity is shown along with temperature. The graph essentially changes over time. Time is shown on the x axis and temperature and humidity on the y axis. Now when the system is turned on the room temperature is higher so the graph shows that the curve is upward. As the room gradually cools, the curve slopes downward.

Figure 5.12: Temperature Reading Collect in Room (01)

In this picture [5.11] we get 25℃ inside temperature. This picture was taken in the final part of taking the reading.

5.3 Electricity Consumption

More and more people are utilizing air coolers to combat the oppressive summer heat since they have a far lower power usage than air conditioners and are therefore a wonderful, less expensive option. Depending on the size of the space to be cooled, air coolers with capacities ranging from 20 liters to 100 liters might be employed. Energy utilization by EACs is comparable to turning on a lamp. A supply fan motor (which is dependent on the air flow rate), a tiny DC pump motor, and two fog producers make up the electric components of an EAC. The quantity of power used remains constant when an EAC system is activated.

AC Motor = 60 watt

DC Pump motor = 8 watt

MIST Maker = 2 watt

Others = 2 watt

So, Total watt is 72 watt

A unit of electricity is represented in kilowatt-hour (KWh). To calculate units, we need to find the energy consumption. It is easy, just multiply power with time.

Energy = Power x Time

[For getting Energy in "Kilo Watt hour or unit", Power in kilo Watts and Time in Hours].

So Here,

Power = 72 Watts or 0.72 kilo Watts

Time = 8 Hours

So Energy (in kWh or Unit) = 0.072 kW x 8 hour = 0.576 kWh or 0.576 Unit per day.

For 30 days,

0.576 Unit x 30 days = 17.28 Unit per month

This is the electricity consumption of evaporative air cooler per hour.

5.4 Water Consumption

In EACs, water is used in two separate ways. Water is mostly utilized in the EAC working fluid, which causes it to evaporate and disperse. The amount of water utilized will vary depending on the type of media being used, the volume of supplied air, the temperature, humidity, and the number of operation hours. More water will be consumed and the evaporative cooling effect is greatest when the air is hot and dry. The second purpose of water in an EAC is to prevent the settling of naturally occurring solids. By using the bleed-off technique, the solids that may be in the water supply will not accumulate and the dust and other particulates that were captured by the wet medium will be washed away. Water usage by an EAC system varies somewhat, as was covered in the Environmental Considerations section. The existence of a bleed-off system, the rate of bleed-off dilution, and the manner of solids accumulation management are the causes of this.

There are three options for water bleed systems. They are presented in order of increasing water use:

i. No water bleed off.

ii. Intermittent water bleed off.

iii. Continuous water bleed off.

Our proposed evaporative air cooler uses 5 liter water in 8 hours. So This system consumes 1.6 liter of water in one-hour.

5.5 Limitations

Although our project has numerous uses and benefits, it also has certain restrictions. The good news is that these restrictions are modest and have no impact on the system's effectiveness. Following are some restrictions:

The majority of issues with the performance of evaporative cooling systems are frequently attributable to inadequate original EAC installation and/or supply air design, unskilled EAC operators, inadequate maintenance, and meteorological conditions. The impression of evaporative cooling's capabilities is frequently problematic. Some building inhabitants are so used to the "flip a switch" environment that they assume comfort levels will always be able to be maintained. Evaporative cooling and the majority of chilled air systems do not operate in this manner (as discussed in the section on Performance). Acceptance of the trade-off between occasional under-cooling for lower energy bills, better air quality and reduced pollution is common in the dry southwest. Some of the common issues related to operation and maintenance of EAC's are summarized in Table M1: System Problems and Solutions in Part II – Maintenance and Operations, along with proposed solutions. That section also lists maintenance responsibilities and recommended frequency of maintenance tasks.

5.6 Discussion

It is evident from a review of the literature and experimental results that a direct evaporative cooling system may reduce the air temperature within the building as well as the water temperature by a combined 5 to 10 degrees Celsius. Given that air and water come into direct contact inside the unit and that less electricity is used than with air conditioning systems, direct evaporative cooling systems deliver air that is free of humidity when compared to other cooling systems.

5.7 Advantages

- Coolers bring fresh, cooled, outside air into the home.
- Low cost and high effectiveness, permitting a wide range of applications and versatility in the buildings, dwellings, commercial and industrial sectors.
- They can be specially applied in dry and hot climates, as the minimum cooling temperature for the air depends on its the wet bulb temperature.
- Evaporative air coolers, which are used for air conditioning in hot and dry climates, have considerably low energy consumption compared to refrigerated systems because they do not need any refrigerant.

- Humidity free air using direct air cooling:
- Economic design and operation of air condition.
- Evaporative air coolers have another important advantage over refrigerated systems, which are associated with the ozone layer depletion problem.

5.8 Disadvantages

- Does not perform well in humid climates or during rainy periods
- Temperature control is limited
- Not ideal for those with asthma or respiratory issues
- Possible risk of water leakage from ceiling outlets unless fitted with covers
- Higher installation costs for ducted systems
- Filters need to be cleaned or replaced regularly to maintain effectiveness
- Doors and windows need to be kept closed for maximum cooling
- Outdoor units can be a noise issue if placed near bedrooms or neighbors windows.

5.9 Applications

The project has a major application in the

- Residential areas
- Schools
- Commercial areas like offices, shops, warehouses, laundries, kitchens and institutional facilities.
- Power plant evaporative cooling towers
- Process cooling water
- Turbine engine air intake cooling.

- Portable cooler applications
- Automobile interior cooling
- Solar powered EAC’s
- Exterior spot cooling
- Electronics and optic fiber equipment cooling
- Green house, and manufacturing process cooling
- Animal housing facility cooling

5.10 Conclusion

We use several temperature outputs from our project in this chapter. Our effort produced a variety of results, primarily. We prioritize results in a variety of circumstances. We conduct the data reading portion in September. This month's temperature has dropped because we had trouble gathering data. However, we are able to effectively complete our task. This chapter is entirely about our data, which illustrates the effectiveness of our initiative.

CHAPTER 6
CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Evaporative air cooling is a normal, easy, and inexpensive phenomenon. Numerous system kinds have been created and are still in use today that are based on this idea. Systems like home air conditioners, for instance, produce humid air that can lead to health issues like asthma; air conditioning systems produce dry, chilly air at a high operational and maintenance expense. These all have advantages and disadvantages. The method chosen here is superior to all of the systems mentioned above since it uses less energy, is more cost-effective, and does not contribute to the problem of ozone layer depletion. Using indirect air cooling, humidity-free air may be produced. The finest idea for lowering temperatures in a dry, hot climate that is ideal for Bangladeshi weather in the months of March, April, May, and June is this one.

6.2 Future Scopes

Its degree of operational efficiency will be raised. Although the evaporative cooling phenomena has been explored somewhat, nothing is known about the specific Zeer-pot use. To maximize the cooling capacity, several variables and parameters might be looked at. This could make it simpler to introduce the idea to the market.

The various wind velocities would have been checked once more to confirm the results and provide the research statistical value if it had additional time to test the pots. In order to obtain a more accurate curve of findings, smaller intervals of the various velocities would also be investigated. In order to determine if the inconsistent findings are accurate or should be disregarded, the hanging structure and glazed inner pot would also be examined once again.

If more sophisticated testing equipment or a more realistic climate had been available, tests would have been performed to check for relatively consistent relative air humidity. This would have produced results that are more precise and simpler to compare.

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