THE PROTOTYPE OF WATER SPRAYING SYSTEM ON THE ROOF BY USING LOW-COST ARDUINO-UNO SENSOR

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A thesis submitted
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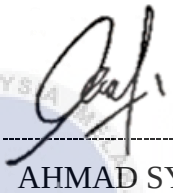
2022

DECLARATION

I declare that this report entitled “The Prototype of Water Spraying System on the Roof Using Low Cost Arduino Uno Sensor” is the result of my own research except as cited in the references.

Signature : 

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APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical And Manufacturing Engineering Technology (Air Conditioning And Refrigeration Syatem) with Honours.

Signature : .....

Supervisor Name : TS. AZWAN BIN AZIZ

Date : 17/01/2022

DEDICATION

To my beloved parents, my supervisor and my friends.

In the Name of Allah, the Most Gracious, Most Merciful

Firstly, I would like to thank to my supervisor, Ts. Azwan bin Aziz for his excellent guidance, encourangement, constant support, suggestion, patience and help to complete my final year project. He has contributed towards my understanding and I have learnt a lot from him. He motivated and inspired me to work on this report. Special thanks to UteM for providing a small financial allocation in the completion this project.

Special thanks to my parents Ismail bin Awang Noh and Norma binti Isa, also my siblings for giving me support and tolerance all the years.

I wish also to express deepest appreciation to my fellow friends for their moral support and lend their hands for helping me in completing this project. Lastly, thank you to all of you who had been crucial part of realization of this project and read my thesis. Stay safe everyone and remember to keep social distancing for our own safety.

ABSTRACT

Because of the cost, most traditional village homes have corrugated zinc roofs. Because zinc is a heat-absorbing material, it will cause discomfort. The temperature rises beneath the zinc covering will be proportionate to the quantity of heat provided by sunshine, and this will be worsened if the ventilation is inadequate. The goal of this research is to find a different way to decrease the temperature inside a zinc-covered home. The suggested technique involves the development of water spraying system prototype using low-cost Arduino-Uno sensor. Splattering water over the zinc roofing causing a heat exchange mechanism to occur when the two surfaces come into contact. The zinc heat will be dissipated throughout the process, but the water temperature will rise. The heated water will then fall into a specified cooling tower via gravity. The water temperature will be lowered by the same heat transfer method, which will be recirculated back to the roof by a water pump. The overall system will be controlled by Arduino-Uno temperature and humidity sensor that will detect the high temperature on roof and sends the output to the water pump. Fan will be installed at the cooling tower to aid in the faster cooling of the water. The studies indicate that the system can decrease the temperature of a zinc-covered home and cut cooling costs, making it ideal for Malaysia's low-income rural population.

ABSTRAK

Kerana kosnya, kebanyakan rumah kampung tradisional mempunyai atap zink bergelombang. Kerana zink adalah bahan yang menyerap panas, ia akan menyebabkan rasa tidak selesa. Kenaikan suhu di bawah penutup zink akan sebanding dengan kuantiti haba yang disediakan oleh cahaya matahari, dan ini akan bertambah buruk jika pengudaraan tidak mencukupi. Tujuan penyelidikan ini adalah untuk mencari cara yang berbeza untuk mengurangkan suhu di dalam rumah yang dilapisi zink. Teknik yang dicadangkan melibatkan projek prototaip sistem penyemburan air menggunakan sensor Arduino-Uno yang murah. Memercikkan air di atas bumbung zink menyebabkan mekanisme pertukaran haba berlaku ketika kedua permukaan bersentuhan. Panas zink akan hilang sepanjang proses, tetapi suhu air akan meningkat. Air yang dipanaskan kemudian akan jatuh ke menara penyejuk yang ditentukan melalui graviti. Suhu air akan diturunkan dengan kaedah pemindahan haba yang sama, yang akan dikitar semula kembali ke bumbung oleh pam air. Keseluruhan sistem akan dikendalikan oleh sensor suhu dan kelembapan Arduino-Uno yang akan mengesan suhu tinggi di bumbung dan menghantar output ke pam air. Kipas akan dipasang di menara penyejuk untuk membantu penyejukan air yang lebih cepat. Kajian menunjukkan bahawa sistem ini dapat menurunkan suhu rumah yang dilindungi zink dan mengurangkan kos penyejukan, menjadikannya sesuai untuk penduduk luar bandar berpendapatan rendah.

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My utmost appreciation goes to my main supervisor, Ts.Azwan Bin Aziz, for all his support, advice and inspiration. His constant patience for guiding and providing priceless insights will forever be remembered.

Last but not least, from the bottom of my heart a gratitude to my fellow friends, for their encouragements and lend their hands for helping me completing this project. I would also like to thank my beloved parents for their endless support, love and prayers. Finally, thank you to all the individual(s) who had provided me the assistance, support and inspiration to embark on my study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABBREVIATIONS

°C	-	Temperature, celcius
CFC	-	Chlorofluorocarbon
HFC	-	Hydrofluorocarbon
PMV	-	Predicted Mean Vote
V	-	Voltage
A	-	Ampere
AC	-	Alternating current
DC	-	Direct current
DHT11	-	Temperature and humidity sensor
USB	-	Universal Serial Bus
LCD	-	Liquid Crystal Display
Psi	-	Pound per square
VCC	-	Voltage common collector
NC	-	Normally closed
NO	-	Normally open
RTD	-	Resistance temperature detector
ss	-	Sum of square
df	-	Degrees of freedom
Ms	-	Mean square
F	-	Variation of sample means
p-value	-	Area to the right of of statistic F
Fcrit	-	Critical value of variation sample means
MHz	-	Megahertz, frequency

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Corrugated zinc sheet roofs were still used by certain residents. This is a good choice since it's cheap, easy to make, and lasts a long time. In addition, this method has its own drawbacks if thermal comfort in the living space covered by the roof is reduced As a result of zinc's high heat conductivity, the sun's heat is efficiently captured and transferred to the living space. The problem will intensify when a little heat island phenomenon develops if the house does not have enough apertures to facilitate natural airflow (Ramakreshnan et al., 2018). The level of discomfort will be excruciating, especially in the afternoon, if the impacts of global warming are taken into consideration.

Installing an air fan would only serve to recycle warm air, and using an air conditioner would be prohibitively costly. Traditional mechanical methods are thus out of the question. To help the local population, an alternative cooling system must be created that provides enough thermal comfort while being cost-effective. Recirculated water is an ideal cooling agent for a proposed project, which will employ easily available natural resources for research.

1.2 Problem Statement

A building's radiant heat is affected by heat from the roof, which receives its energy from the sun. The residents of the home complained about how hot and stuffy it was because of the heat accumulation on the roof. Air conditioners are the most common method for lowering interior temperatures because of their high energy consumption. When cooling agents CFCs and HFCs are emitted by air conditioners, they contribute to the depletion of the ozone layer. Because of the high cost of air conditioning, some individuals are unable to use it.

Those same roof cooler systems, however, were only employed on sunny days to squirt water over the roof. The hot water is then flushed down the drain, wasting precious resources. This is followed by a water spray that was manually opened and closed by a restaurant employee. By using the cooling tower principle, the water will recycle the water back into your system instead of flushing it out.

Uncomfortable indoor temperatures have a negative influence on people's productivity, health, and quality of life (Jamaludin et al., 2015). Air conditioning was also recommended by the researchers as a cooling alternative for their homes.

Chicken growth, meat quality, laying rate, and egg quality all suffer from heat stress (Saeed et al., 2019). Because of these implications in Figure 1.1. The chicken agriculture also suffers significant economic losses. According to the study, it is important that the chicken house's exterior air flows freely in and out.

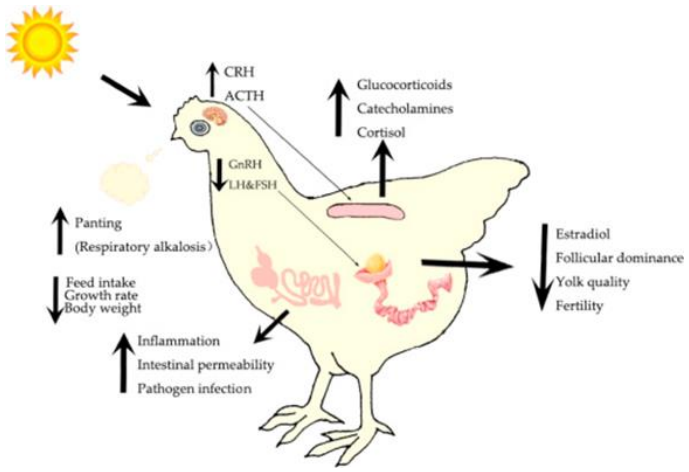

Figure 1.1 Mechanism of heat stress (Nawab et al., 2018)

1.3 Objectives

1.3.1 General Objective

To design low-cost water spraying system using Arduino-uno on roof to cooling down radiant heat.

1.3.2 Specific Objective

i) To design a low-cost Arduino temperature sensor for detecting the radiant heat from sun.

ii) To develop water circulation system cooling tower concept.

iii) To measure the temperature of radiant heat of the roof.

1.4 Scope of Project

Research activities linked to data collecting are the primary emphasis of this project, which includes the assessment of the existing status of research associated with this experiment. And in comparison to others. It is unusual to see a roof cooler in a home or building these days. Water is the primary cooling medium for the roof cooler, which sprays water over the roof to lower the temperature. A prototype roof cooling system with circulating water is being developed for the purposes of this research. The temperature differential between the interior prototype, zinc surface and outside temperature will also be examined. Besides that, a final evaluation of temperature sensor effectiveness in controlling water spraying systems is necessary.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Heating systems that utilize the ceiling to deliver heat are known as radiant heating systems. People and objects in a room may receive heat from a heated surface via infrared radiation. A hot stove element may be felt from across the room when it emits radiant heat. The most common technical response to the problems produced by increasing temperatures is air conditioning (AC), which regulates the humidity and temperature of the indoor air (Henning, 2007). However, if the energy source is not sustainable, increased air conditioning demand will contribute to the urban heat island effect and increase ambient heat exposure.

2.2 Thermal Comfort

A person's level of contentment with their thermal environment is referred to as their "thermal comfort." It's a state of affairs in which the vast majority of people are comfortable. In order to improve occupant satisfaction and well-being, it is crucial to take thermal comfort into account ((Frontczak & Wargocki, 2011). People's reactions to heat are described by the three concepts of thermal sensation, thermal preference, and thermal acceptability (Langevin et al., 2013). When it comes to comfort and feeling in the bath or sauna, the two terms are often used interchangeably. When it comes to things like thermal comfort and feeling, the two are quite different.

An investigation on the thermal environment and comfort of a Malaysian terraced house was conducted by (Nugroho et al., 2007). The authors investigated the influence of air movement on thermal comfort levels based on the climatic conditions of Malaysia and found that air movement of 1 m/s was inadequate to ensure thermal comfort. A majority of the time, thermal comfort is predicted by the PMV (Predicted Mean Vote), and thus results in an unpleasant thermal comfort condition. According to the author, one strategy for boosting thermal comfort in humid situations is to circulate the air throughout the room. Thermal comfort is often discussed in relation to factors such as room temperature, room ventilation and relative humidity; nevertheless, this has received very little attention.

Using air movement to create a thermally comfortable interior environment may improve and increase the effectiveness of energy saving measures in Malaysian buildings (Zain et al., 2007). A 0.7-m/s air flow is only useful at ambient temperature in creating a comfortable thermal environment, according to the researchers. This is the optimal temperature: 28.69 ° C. As can be seen, the effect of air movement on improving thermal comfort levels is dependent on the status of several other comfort-related variables. A greater influence on thermal comfort may be exerted by other factors, such as the status of other contributing variables. They should be examined in context with one another. Human thermal comfort behaviour, energy consumption, and building behaviour may be used to design ways to improve the interior thermal condition and energy usage.

2.3 Effect Thermal Radiation in Building

Every country building uses a substantial amount of energy, thus they must be extensively inspected to guarantee that they are running effectively (H. Mohamed et al., 2015). Space cooling accounts for a significant portion of energy consumption in hot areas like Iraq. There are many strategies to reduce the need for air conditioning, the most

important of which is to use energy-saving techniques. Improvements in building energy efficiency refers to efforts to reduce building energy usage while maintaining tenant living standards (Al-Homoud, 2005).

Figure 2.1 shows how much of Iraq's total power output is used by residential buildings, according to the country's Ministry of Electricity (Abbood et al., 2015). It is becoming more common for power outages and rolling blackouts to occur in the United States because of the increased use of air conditioning in homes. Building Iraq's infrastructure has become a top priority.

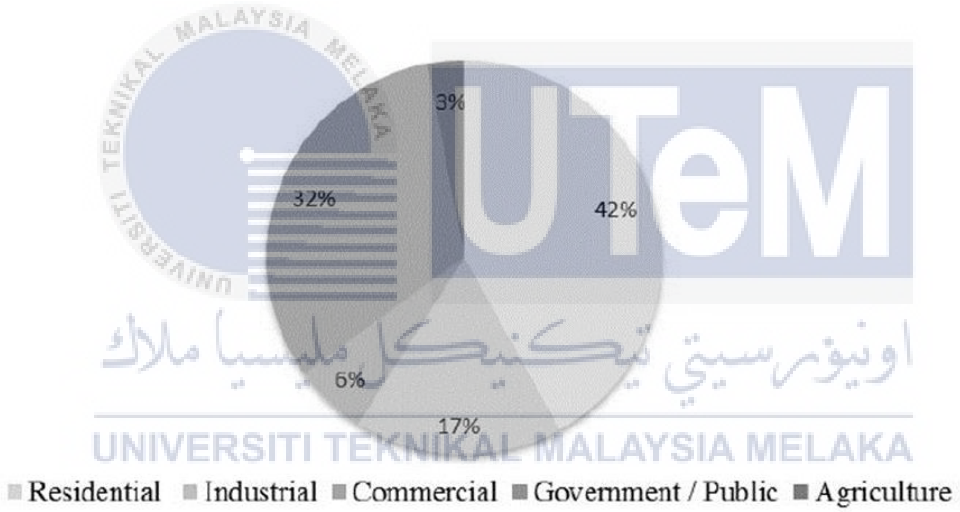

Figure 2.1 Electricity consumption by sector

Iraqi homes' cooling loads and power consumption were reduced by examining several roof solutions to boost the energy efficiency of residential buildings in very hot and dry conditions, such as external and internal thermal radiation technologies (H. I. Mohamed et al., 2016). Residential buildings' cooling needs were studied by comparing a variety of roofing options. Annual energy savings of between 6% and 17.4% may be obtained according to the simulation findings.