DESIGN OF A REST ROOM EXHAUST VENTILATION SYSTEM SENSOR FOR ODOR ELIMINATION

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BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY
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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Mechanical and Manufacturing Engineering Technology

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A thesis submitted
in fulfillment of the requirements for the degree of
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DECLARATION

I declare that this project entitled " Design Of a Rest Room Exhaust Ventilation System Using sensor For Odor Elimination " is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Date : 17 Jan. 22

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 Engineering Technology (Refrigeration and Air-Conditioning Systems) with Honours.

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DEDICATION

I would like dedicate my dissertation work to my family and many friends. A special feeling of gratitude to my loving parennts who always giving words of encouragement and push for tenacity ring in my ears. Futhermore, I also would like to dedicate this work and give special thank to my supervisior, Ts. Azwan Bin Aziz for guiding me along the process with precious idea suggestion. I also dedicate this dissertation to my many friends and coursemates who have supported me throughout the process to complete this project.

ABSTRACT

Nowadays, many new inventions have been developed due to people's demands. This was supported by the development of new technologies. As technology develops there is more wastage happen. If we get to know the restroom at the UTeM technology campus there is a very bad smell if we pass by the restroom. Human comfort must be fulfilled without any wastage of energy. Most of the restroom is not ventilated properly or been ventilated with wastage of energy as the exhaust fan in the restroom will be operating all the time even there is no odor in the restroom. This project will only operate when there is unwanted gas in the restroom. This project aims to eliminate odor in the restroom. The sensor can identify the odor parameters such as CO2 and NH3 in the restroom prototype. Besides that, this system can compare the level of CO2 and NH3. Moreover, this project is to develop a low-cost fan system by using Arduino UNO as a platform to tackle the odor. The working process of this project is the carbon dioxide and ammonia sensor will be fixed at the top of the prototype and the pc fan will be located opposite of the sensors. The Arduino will be placed outside of the prototype to control the system. When the sensor detects the unwanted gasses, a signal will be sent to the Arduino and the Arduino will activate the pc fan to extract the odor in the space. Based on this project, can help the future industry by using this system in a building, can apply in the small and simple place and finally, user can be comfortable while using the restroom.

ABSTRAK

Pada masa kini, banyak penemuan baru telah dikembangkan kerana permintaan orang. Ini disokong oleh pengembangan teknologi baru. Apabila teknologi berkembang, terdapat lebih banyak pembaziran. Sekiranya kita mengetahui tandas di kampus teknologi UTeM ada bau yang sangat buruk jika kita melewati tandas. Keselesaan manusia mesti dipenuhi tanpa pembaziran tenaga. Sebahagian besar tandas tidak berventilasi dengan betul atau berventilasi dengan pembaziran tenaga kerana kipas ekzos di tandas akan beroperasi sepanjang masa walaupun tidak ada bau di tandas. Projek ini hanya akan beroperasi apabila terdapat gas yang tidak diingini di tandas. Projek ini bertujuan untuk menghilangkan bau di tandas. Sensor dapat mengenal pasti parameter bau seperti CO2 dan NH3 dalam prototaip tandas. Selain itu, sistem ini dapat membandingkan tahap CO2 dan NH3. Lebih-lebih lagi, projek ini adalah untuk membangunkan sistem kipas kos rendah dengan menggunakan Arduino UNO sebagai platform untuk mengatasi bau. Proses kerja projek ini adalah karbon dioksida dan sensor amonia akan dipasang di bahagian atas prototaip dan kipas pc akan terletak di seberang sensor. Arduino akan diletakkan di luar prototaip untuk mengawal sistem. Apabila sensor mengesan gas yang tidak diingini, isyarat akan dihantar ke Arduino dan Arduino akan mengaktifkan kipas pc untuk mengeluarkan bau di ruang tersebut. Berdasarkan projek ini, dapat membantu industri masa depan dengan menggunakan sistem ini di sebuah bangunan, dapat mengaplikasikannya di tempat yang kecil dan sederhana dan akhirnya, pengguna dapat merasa nyaman ketika menggunakan tandas. Proses kerja projek ini adalah karbon dioksida dan sensor amonia akan dipasang di bahagian atas prototaip dan kipas pc akan terletak di seberang sensor. Arduino akan diletakkan di luar prototaip untuk mengawal sistem. Apabila sensor mengesan gas yang tidak diingini, isyarat akan dihantar ke Arduino dan Arduino akan mengaktifkan kipas pc untuk mengeluarkan bau di ruang tersebut. Berdasarkan projek ini, dapat membantu industri masa depan dengan menggunakan sistem ini di sebuah bangunan, dapat mengaplikasikannya di tempat yang kecil dan sederhana dan akhirnya, pengguna dapat merasa nyaman ketika menggunakan tandas. Proses kerja projek ini adalah karbon dioksida dan sensor amonia akan dipasang di bahagian atas prototaip dan kipas pc akan terletak di seberang sensor. Arduino akan diletakkan di luar prototaip untuk mengawal sistem. Apabila sensor mengesan gas yang tidak diingini, isyarat akan dihantar ke Arduino dan Arduino akan mengaktifkan kipas pc untuk mengeluarkan bau di ruang tersebut. Berdasarkan projek ini, dapat membantu industri masa depan dengan menggunakan sistem ini di sebuah bangunan, dapat mengaplikasikannya di tempat yang kecil dan sederhana dan akhirnya, pengguna dapat merasa nyaman ketika menggunakan tandas. isyarat akan dihantar ke Arduino dan Arduino akan mengaktifkan kipas pc untuk mengeluarkan bau di ruang tersebut. Berdasarkan projek ini, dapat membantu industri masa depan dengan menggunakan sistem ini di sebuah bangunan, dapat mengaplikasikannya di tempat yang kecil dan sederhana dan akhirnya, pengguna dapat merasa nyaman ketika menggunakan tandas. isyarat akan dihantar ke Arduino dan Arduino akan mengaktifkan kipas pc untuk mengeluarkan bau di ruang tersebut. Berdasarkan projek ini, dapat membantu industri masa depan dengan menggunakan sistem ini di sebuah bangunan, dapat mengaplikasikannya di tempat yang kecil dan sederhana dan akhirnya, pengguna dapat merasa nyaman ketika menggunakan tandas

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cm – centimetre

mm – millimetre

ppm – parts-per-million

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CHAPTER 1

INTRODUCTION

1.1 Background

Ventilation is very important everywhere in a building. Fresh air is unquestionably essential to humans; we need it to live. In a perfect world, we would be outside all of the time, breathing clean, pure air. Unfortunately, this is not the case for many people. Because of our work and the environment, we live in, we are likely to spend a significant amount of time indoors, necessitating the installation of a good ventilation system. To begin, it is critical to define the term "ventilation." Ventilation is the method of deliberately supplying 'clean' (usually outdoor) air to space while removing stale air. Air conditioning (including fan coils), air curtains, air recirculation, and air infiltration are all examples of ventilation systems that can be used. Commercial and industrial spaces, in particular, require ventilation to regulate indoor air quality by diluting and displacing indoor contaminants. Temperature, humidity, and air movement can all be regulated with ventilation. We may be required to spend a significant amount of time indoors and in poorly ventilated spaces depending on our place of employment. If we spend a significant amount of time at work in these areas, it can be harmful to our health. That is why, both at home and work, it is important to have well-ventilated spaces. In this project, I am going to do restroom ventilation. A bathroom vent fan is a mechanical ventilation system that uses a flexible tube or metal duct to exhaust indoor air to the outdoors. The air quality in the bathroom can be improved by using a vent fan to remove moisture and odors. Installing one is not only a smart idea but also building codes now mandate it for new construction or large bathroom remodeling projects.

1.2 Problem statement

Odour is the main problem in the restroom because most of the place that does not have good ventilation. If we notice in most of the restrooms in a building or for an easy example the Technology campus at UTeM is very smelly due to irresponsible user. The strong odor in a restroom can lead a person to be in health problems mainly for the pregnant woman. The odor can cause a person to vomit which can affect a pregnant woman. Besides that, the elderly person also can be affected because the smell can make the elderly faint.

As there is poor ventilation in a restroom the temperature in the restroom also will increase and can cause the cleaner to feel uneasy to work as the environment more heaty and mist. Moreover, most of the building management spending money on the cleaner to maintain the odor in the restroom.

1.3 Research Objective

General Objective

- To eliminate odor in the restroom using the sensor.

Specific Objectives

- To identify the odor parameters such as CO2 and NH3 in the restroom prototype.
- To compare the level of CO_2 and NH_3.
- To develop the low-cost fan system by using Arduino UNO as a platform to tackle the odor.

1.4 Research scope

I. Use the sensor to ventilate the restroom.

II. Arduino should be used as the controller.

III. The exhaust fan only needs to operate when needed.

CHAPTER 2

LITERATURE REVIEW

2.1 Ventilation

To keep occupants healthy buildings are vented to get outside air into a building or space and disperse it throughout it. The three most important aspects of building ventilation are the rate of exterior air ventilation, the direction of airflow, and the air distribution or airflow pattern in the area. The most important parameter in ventilation design and operation is ventilation rate. The fundamental concept of ventilation, the ventilation equation, the argument for specifying ventilation requirements from a health standpoint, the revitalization of natural ventilation, the development of mechanical ventilation, and critical issues related to isolation room ventilation are all discussed. For the general research difficulties connected to the relationship between ventilation and health in buildings, there is a need to promote a multidisciplinary research culture. A paradigm shift is also necessary in the research on ventilation with a renewed health focus so the effects of ventilation on both short- to long period health can be better understood and the minimum ventilation levels can be established on the basis of scientific evidence. (Nielsen and Li 2019). According to the pandemic right now ventilation one of the important issues to take in action. Building ventilation in hospitals and public spaces is critical for controlling the disease, safely exiting lockdown, and reducing the risk of recurrent outbreaks. Appropriate alternatives to negative pressure insulation chambers should be displaced ventilation (mechanical or natural ventilation) in hospitals, in which there is little air intake and extracts are high. Negative pressure is created at the occupant level, which draws fresh air in from the outside, and positive pressure is created towards the ceiling, which expels hot, dirty air (Bhagat and Linden 2020).

Ventilation systems must be implemented in highly insulated, and airtight buildings to ensure the requisite air change rate and to provide adequate, standard-compliant IAQ and comfort. They can also be utilised in air conditioning systems for heating, cooling, and (de-)humidification (Mesenhöller, Vennemann, and Hussong 2020). In a subway station, ventilation has a remarkable dual influence on environmental health. Ventilation ensures human comfort and health by controlling temperature, humidity, and indoor air quality. Ventilation also, poses the risk of spreading air contaminants or fire smoke via the complicated wind environment, as well as generating constant noise (Wen et al. 2020).

2.1.1 Natural Ventilation

Mechanical air conditioning systems utilize the most energy in buildings. Natural ventilation is needed as it consumes less energy. They must, however, be able to cope with rising heatwaves and pollutants, especially in hotter climes. Natural ventilation's potential to provide enough thermal comfort, resilience against heatwaves, and good Indoor Air Quality in warm areas were examined in this review study (Ahmed, Kumar, and Mottet 2021). One of the most significant factors in achieving a comfortable home temperature is air movement. People are growing more interested in using natural resources to achieve their objectives because of public concern about the environment. Buildings are intended to be able to provide sufficient internal natural ventilation flow, thereby maintaining comfort in their habitable spaces, if they are designed properly (Wahab, Aziz, and Salam 2019). Wind or buoyancy drive natural ventilation; the most frequent natural ventilated building forms are wind-driven ventilation, buoyancy-driven ventilation, and a mix of the two. In addition, atrium ventilation, ventilation caps, and solar chimneys are among the methods that can be designed to improve natural ventilation performance (Zheng et al. 2018). Natural ventilation solutions such as windcatchers have resurfaced as a result of the high energy use and growing

demand for improved indoor air quality in the built environment. Under the operation of wind pressure and buoyancy forces, a windcatcher is a roof-mounted device that feeds fresh airflow into space while expelling contaminated air (Jomehzadeh et al. 2020). When pressure differences caused by wind (wind-driven NV) or buoyancy forces (stack-driven natural ventilation) act on one or more openings in the building envelope, natural ventilation occurs. The unpredictable pressure differences that drive NV to make engineering these systems complex, in contrast to the controllable energy source employed in mechanical ventilation (Carrilho da Graça and Linden 2016).

2.1.2 Mechanical ventilation

In neonates with respiratory failure, mechanical ventilation may save their lives. Mechanical ventilation's major goal is to achieve appropriate gas exchange, which includes appropriate oxygenation and enough ventilation for CO2 excretion. Due to the capacity to quantify and manage small flows and tidal volumes, the most immature neonates have developed relatively complex techniques for assisted mechanical ventilation, including targeted ventilation, increasingly used by doctors. Mechanical ventilation necessitates a fundamental understanding of respiratory physiology as well as the pathophysiology of the disease that causes respiratory failure (Chakkarapani et al. 2020). For patients undergoing general anaesthesia or experiencing respiratory failure in the setting of serious disease, mechanical ventilation is an essential type of life support. These patients are at risk for a variety of problems as a result of their underlying illnesses as well as the mechanical breathing (Rackley 2020).

2.1.3 Toilet ventilation

Toilets in Japan are typically aired 15 times each hour. Despite advancements in toilet technology, the frequency of toilet ventilation has remained unchanged in recent years. As a result, there is a chance that bathrooms are being overly aired. Reduced ventilation frequency boosts return air to the heat exchanger, improving the heat exchanger's efficiency. They have developed a method that uses sensors to manage the exhaust air for appropriate ventilation frequency. The main problem is the stench that results from limiting the ventilation frequency (Kimura et al. 2019).

2.1.3.1 Toilet ventilation experiment

An experimental scatter odor model in a structured washroom is presented from a toilet. A bath, a lavatory and a restroom existed in the washroom. One person in the bathroom sitting on the toilet created a supposed smell (SF6 tracer gas). In the bathroom, instead of a standard ceiling exhaust system, a new negative pressure wall exhaust ventilation system was used. The effects in the concentration distribution of repulsive aromas in the bathroom of 6.5, 8.5, 17 and 24 ACH (air changes per hour) ventilation rates and toilet positions have been investigated. The local air quality index, QI and odor removal efficiency, ORE, were introduced to assess the success of odor removal in the bathroom. This research examines a quantitative odor removal assessment in the bathroom based on our experimental results (Tung, Hu, and Tsai 2009).

Experimental measurement

Researchers used a structured bathroom, an internal test chamber of 2.36 m (length) 2.22 m (width) 2,36 m (height) and a Sulphur Hexafluoride tracer gas to imitate odors made of the toilet (SF6). The current study used a ventilation system with a lower wall mechanical exhaust rather than the traditional mechanical exhaust. The airflow rate of supply was 1.15 times the airflow rate of the exhaust. Air vents (a 126-pitch stainless steel sheet with each slot in the middle of the ceiling) and one 0,24 m diameter exhaust air vent, at the bottom level of one wall, were fitted to the bathroom with one 20cm x 40cm supply air (a free aperture), at the centre of the ceiling (the lower part of the air vent exhaust: 64cm height from the floor). The air supplied to the bathroom at a balanced rate of flow via ceiling ventilation and exhausted air from the room outwards flowing from the wall air flow system, which was located outside the bathroom. The disagreeable smells caused by the individual sitting on the toilet have been diluted and removed with a lot of fresh air from the bathroom. According to their findings, fatty acids accounted for about 90% of the malodorous compounds: ascetic acid (65%), propionic acid (15%), butyric acid (6.5%), i-valelic acid and n-valeric acid. The N-containing compounds included Ammonia (6.5%), pyridine, pyrrol, indole, skatole and trimethylamine. Another smell-causing and minor substance was found to be S-containing compounds (approximately 2%), hydrogen sulphide (1.6%), and methyl mercaptan. (Tung, Hu, and Tsai 2009).