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AC or Kitchen Chimneys Exhaust Air Cooling System with Solar

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ABSTRACT:

This document outlines the creation of a versatile AC or Kitchen Chimneys Exhaust Air Cooling System with Solar which converts hot air from AC units or kitchen chimneys into natural air temperature. The device comprises key components including a Peltier modules, Heatsinks, Atmega328P Microcontroller, Temperature sensor, cooling fan, Solar Panel and Digital Thermometer Module. The AC or kitchen chimneys exhaust air cooling system with solar integration represents a significant development in kitchen ventilation technology. This unique technology in kitchens redefines sustainability, comfort, and functionality by integrating efficient air filtration, active cooling, and renewable energy.

Keywords: - Active cooling, Solar integration, Components, Various applications.

Introduction :

In the modern world, where environmental sustainability and energy efficiency are becoming more and more important, creative solutions are being looked for to deal with everyday problems. One such difficulty is found in kitchen settings, where comfortable and high-quality air are maintained only with effective ventilation. While traditional kitchen chimneys are effective at removing grease, smoke, and aromas, they frequently fail to cool the room sufficiently and use too much energy. An innovative solution to this problem has been the integration of solar-powered exhaust air cooling systems with kitchen chimneys. By actively cooling the air and eliminating contaminants, this cutting-edge system seeks to transform kitchen ventilation while utilizing the sun's abundant and renewable energy source.

We are aware that air conditioners cool homes, offices, cars, and shopping centers. We are also aware that large malls and commercial complex buildings have large air conditioning systems that release hot air out of the system through exhaust pipes and exhaust outlet units. Additionally, we are aware of hotel kitchen chimneys release heated air. The amount of AC units installed in banks, malls, and bedrooms has increased daily due to the annual rise in temperature. As a result, the exhaust hot air from these AC units has increased, which has an impact on the environment worldwide.

In order to maintain a healthy worldwide environment, we therefore developed the "AC or kitchen chimneys exhaust air cooling system with solar," which converts hot air from AC units or kitchen chimneys into natural air temperature. Using a solar panel placed on the exhaust unit of the air conditioning system or on the outside pipe of the chimney and powered by a lithium battery, we can turn hot air into enough cool air that is similar to the temperature of the natural air, all day long, without the need for electricity.

Sunlight is converted into electricity by solar panels during the day, and this electricity powers the cooling units and exhaust fans built into the kitchen chimneys. The chimneys pull in the contaminated air as cooking activities produce heat and pollutants the air is then cleaned, cooled, and finally released outside. This procedure greatly lowers energy use and carbon impact while also maintaining a hygienic and cozy kitchen atmosphere.

In conclusion, the AC or kitchen chimneys exhaust air cooling system with solar integration represents a significant development in kitchen ventilation technology. This unique technology in kitchens redefines sustainability, comfort, and functionality by integrating efficient air filtration, active cooling, and renewable energy.

Objectives of the Study

Design and build a versatile and effective system to enhance the quality of indoor air in kitchens by effectively eliminating smoke, grease, and smells produced during cooking. Design a reliable and high-performance system that satisfies the cooling and ventilation requirements of diverse kitchen settings. Low cost installation that does not affect quality and performance Developing low-cost solutions without compromising on quality and functionality. Minimize the amount of energy used by kitchen appliances like air conditioners and exhaust fans to help reduce dependency on traditional energy sources.

Literature Survey

D.B. Jani, Wagh Jitendra, Tank Jagdish, Taviyad Ani, Taviyad Nitin. The purpose of a chimney in a home is to remove pollutants from the living space that are produced by burning fossil fuels. The population is growing daily and technology is advancing these days, which is leading to an increase in environmental issues. Thus, it was decided to build a chimney that would benefit and be affordable for the general public. For the average person, this chimney is quite helpful, and it's also great for homes, hotels, restaurants, and other cooking areas.

Shiv Lal S.C. Kaushik P.K. Bhargava The building industry's biggest energy use is seen in the ventilation and air conditioning systems. The building sector's energy consumption can be significantly decreased by providing adequate ventilation in residential structures through the use of passive solar systems. The purpose of this study is to determine how wind shafts can be used as passive ventilation systems and solar chimneys, and to assess the system's effectiveness.

Rakesh Khanal, Chengwang Lei Because of its potential advantages over mechanical ventilation systems in terms of operating costs, energy requirements, and carbon dioxide emissions, passive ventilation systems are being advocated more often as a substitute. An great passive ventilation system, solar chimneys run on solar energy, which is their natural driving power. Since the 1990s, a substantial amount of research has been conducted on solar chimneys. An overview of the research done on solar chimneys during the past 20 years is given in this article. The review focuses on two primary research areas: how a solar chimney's ventilation performance is affected by its geometry and inclination angle. The majority of the published material to date has focused on experimental studies of solar chimneys. Nonetheless, there has been a growing interest in the numerical modeling of solar chimneys using the computational fluid dynamics (CFD) technique. Furthermore, this review discovered that there is still room for improvement regarding solar chimneys as passive ventilation techniques.

Pau Chung Leng , Siew Bee Aw , Nor Eeda Haji Ali ,Gabriel Hoh Teck Ling ,Yoke Lai Lee ,Mohd Hamdan Ahmad In order to potentially reduce the spread of airborne diseases, this study examines how well solar chimneys perform in multi-story public housing in tropical regions in terms of ventilation and air exchange rates. Six internal wind velocity sensor locations per floor were placed in virtual simulations of a typical apartment room with natural cross ventilation, which were repeated across four levels to resemble a multi-story block. The performance of the models was then assessed using the simulation program Energy2D, which was used to test both the existence of a solar chimney and the extent to which a supplementary ceiling fan affected the model of the solar chimney. Since wind velocity is a factor that influences ACH rates, it was also measured. The installation of a solar chimney was found to significantly affect air flow rates (a variable that positively affects air exchange rates) using a non parametric Wilcoxon signed rank test, yielding a p value of 0.000 and Z value of 3.920. A ceiling fan supplemented with a solar chimney increased its effect, according to regression study (R squared value: 0.4687). As a result, we suggest a number of design approaches that would make it possible to implement the solar chimney concept and enhance natural ventilation in residential buildings.

Madhan Anand Kumar, U. Krishnaven A system including an Evaporative Cooling Cavity (ECC) and a Solar Chimney (SC) has been presented as a low-energy-consumption way to improve natural ventilation and passive cooling in a solar house. The system's capacity to satisfy each person's specific thermal requirements as well as the impact of key geometric parameters on system performance have been examined. In order to ascertain the operating settings for optimal effectiveness, with respect to thermal comfort standards, the dependence of the system performance on the temperature of the external air has been researched. In addition, a theoretical study is conducted to look at the system's performance and provide some information on system sizing. Comparative research was done on three distinct cooling pad materials: cellulose, straw, coconut coir, and vegetaver.

Farhan Lafta Rashid , Muhammad Asmail Eleiwi The ability of a nation to deliver the energy resources necessary for its well-being, including a consistent supply at reasonable prices, is referred to as energy security. Development and expansion of the economy are impossible without access to dependable energy sources. The availability of energy is a major component of a nation's economic growth and technological advancement, serving as a gauge of that nation's standard of life. The most dependable and economical solution for supplying the world's energy needs is solar electricity. One example of a practical application for solar energy is air conditioning systems. In recent years, solar-powered air conditioners have grown in popularity. It may be possible to overcome the issues brought on by our dependency on fossil fuels by utilizing solar cooling systems that have sun collectors. Solar cooling systems are common in the construction sector since they may use inferior solar energy. Numerous studies have been conducted on photovoltaic–thermal (PVT) solar cooling systems in an effort to enhance their thermodynamic and financial efficiency. The purpose of this study is to investigate the possibility of using heat produced by the sun in cooling systems. In addition, this study will look at the difficulties that currently exist when utilizing solar energy for cooling purposes as well as potential advantages that could lead to further investigation and increased use of solar heat gain in cooling applications.

Prem Shankar Sahu, Praveen Kumar, Ajay Singh Paikra One of the most important criteria for any structure, whether residential or commercial, is proper ventilation. The traditional approach uses air conditioning or air cooling devices, which need a lot of power. It is possible to employ solar-powered ventilation systems in buildings without the need for external power. This study examines a number of studies that have been done to enhance passive ventilation systems and employ phase-change materials as energy storage devices. Buildings that are designed passively do not require mechanical or electrical systems to create a comfortable interior environment.

Myeong-Seon Chae, Bum-Jin Chung This paper examines the experimental and numerical increase of heat transmission in a chimney system by adjusting the chimney's height and diameter as well as the working fluid's Prandtl number. Based on analogous principles, mass transfer experiments are conducted with an electroplating system consisting of sulfuric acid and copper sulfate. Using FLUENT 6.3, numerical simulations are carried out. The Le Fevre correlation for natural convection on a vertical plate was found to be in good agreement with both natural convection experiments and numerical simulations carried out without a chimney. For all Prandtl numbers, the heat transfer rates increase with increasing chimney height; however, the enhancement rates decrease with increasing Prandtl number. The best chimney diameter for maximizing heat transfer is discovered. The buoyant force increases as a result of an additional improvement in heat transfer brought about by an increase in heat input or heated length. The temperature and velocity fields in the chimneys, as well as their interactions and flow regimes, are visualized thanks to numerical data.

Components & Specification

1. **Atmega328P Microcontroller**
- Microcontroller: ATmega328
- Input voltage (VIN): 6-20 V
- Power consumption: 19 mA
- Flash memory: 32 KB
- 40 mA of current per I/O pin

Fig.1 Atmega328P Microcontroller

2. **DS18B20 Temperature Sensor**

- Communicates over the 1-Wire protocol
- Voltage range for operation: 3 to 5
- Range of Temperature: -55°C to +125°C
- Precision: ±0.5°C
- Resolution of Output: 9-bit to 12-bit
- Multiplexing is enabled with a unique 64-bit address.
- Time of conversion: 750 ms @ 12-bit

Fig.2 DS18B20 Temperature Sensor

3. **Peltier Module**
- The model is TEC1-12706.
- 12V is the voltage.
- 15.4V is the maximum value (V)
- Imax (A): 6A
- QMax (W): 92 W
- 1.98 Ohm internal resistance +/- 10%
- Measurements: 40 x 40 x 3.6 mm
- Cooling Cell Type .

Fig.3 Peltier Module

4. **Cooling Fan**

- Rated voltage: DC 12 v
- Current rating: 0.15A
- Bearing: sleeve bearing and ball bearing
- Fan Life: 50000 hrs
- Power consumption: 1.8W

Fig.4 Cooling Fan

5. **Heatsink**

- Material: Aluminium alloy
- Color: Silver
- Item Size: 40mm x 40mm x 20mm
- Shape: Square
- Weight (g): 41

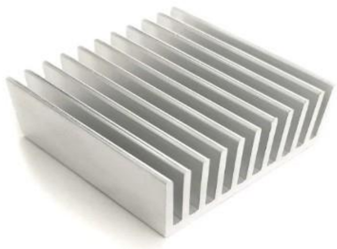

Fig.5 Heatsink

6. DigitalThermometerModule

- TemperatureRange(C):-50to+110
- TemperatureDisplayResolution:0.1
- TemperatureMeasurementAccuracy(C) :1
- DisplayDimensions(mm):48x29x16
- CableLength(Meter):1

Fig.6 DigitalThermometerModule

7. Solar Panel

- solar panel efficiency ranges from 15perc to 20perc
- Sunlight hitting the solar panel = 800 watts/sq meter
- Wind velocity = 1 m/s
- Air temperature = 20°C (68°F)
- Panel angle = 45° from horizon

Fig.7 Solar Panel

8. 12V 2000mAh Li-ion Battery

- Unit-by-unit voltage: 12 V
- Nominal Capacity: 150Ah at a 10-hour rate to EOD of1.8V per cell at 25°C
- Maximum Discharge Current: 1500A (5 sec)
- End of discharge voltage: Varies from 10.5V to 10.8V
- Recommended Max Charging Current: 45A

Fig.8 12V 2000mAh Li-ion Battery

9. 5V Relay

- Voltage of Trigger: 5 V DC
- 70mA is the trigger current.
- AC load current maximum: 10A at 250/125V AC
- DC load current maximum: 10A at 30/28V DC.
- 10 milliseconds of operation Time of release: 5 ms

Fig.5 Heatsink

Implementation

In implementation of an AC or kitchen chimney exhaust air cooling system Connect the heatsink to the Peltier module and use thermal paste to ensure optimal thermal contact. To keep an eye on the Peltier module's temperature, position the temperature sensor close to it. For control, attach the cooling fan and Peltier module to the Arduino Nano using a MOSFET or relay module. Give the fan and Peltier module the proper power. The system efficiently lowers temperature and eliminates pollutants from the kitchen area by employing Peltier modules ,heatsinks and cooling fan to cool the exhaust air and improve for airflow. With a solar panel installed on the exhaust unit of the air conditioning system or chimney outdoor pipe and a lithium battery to power the system for 24 hours a day without power, we utilize Peltier plates to convert hot air into enough cool air that is similar to the temperature of the natural air.

The integration of an Arduino Nano with a temperature sensor enables accurate system management and monitoring, resulting in optimal performance and energy efficiency. Create an Arduino sketch that uses the sensor's temperature measurements to regulate the Peltier module. Take temperature readings on a regular basis. To cool it down, activate the fan and Peltier module if the temperature climbs above a particular point. Turn off the fan and the Peltier module when the temperature falls below a predetermined level. Put safety measures in place in your code to stop the Peltier module from overheating. A maximum temperature limit can be specified, and if it is exceeded, the Peltier module will be turned off. Make sure there is enough ventilation to release the heat produced by the Peltier module and other parts. Adjust the temperature thresholds as necessary after testing your setup in a controlled setting. Over time, keep an eye on the system's functioning and make any required adjustments. The implementation of a solar-powered AC or kitchen chimney exhaust air cooling system with Peltier modules, heatsinks, a cooling fan, an Arduino Nano, and a temperature sensor provides a cost-effective and environmentally friendly way to enhance indoor air quality and comfort in kitchen settings.

Result & Conclusion

From the overall work carried out an AC or kitchen chimney exhaust air conditioning system provides a affordable, long-term solution to improve indoor air quality and comfort in kitchen settings. The unit efficiently lowers the kitchen's temperature and gets rid of smells and impurities by using Peltier modules, heatsinks, and a cooling fan to cool the exhaust air. The system can be precisely controlled and monitored, assuring optimal performance and energy economy, with the help of temperature sensor and an Arduino Nano. By using solar energy as its power source, the system also lessens its dependency on the electrical grid, which lowers energy prices and has a positive environmental impact. This creative strategy encourages the usage of renewable energy sources while improving user comfort and supporting sustainability initiatives. This system will be easy to use and convenient. It has a wide range of applications. This system is useful for personal purposes because of its low cost and great flexibility.

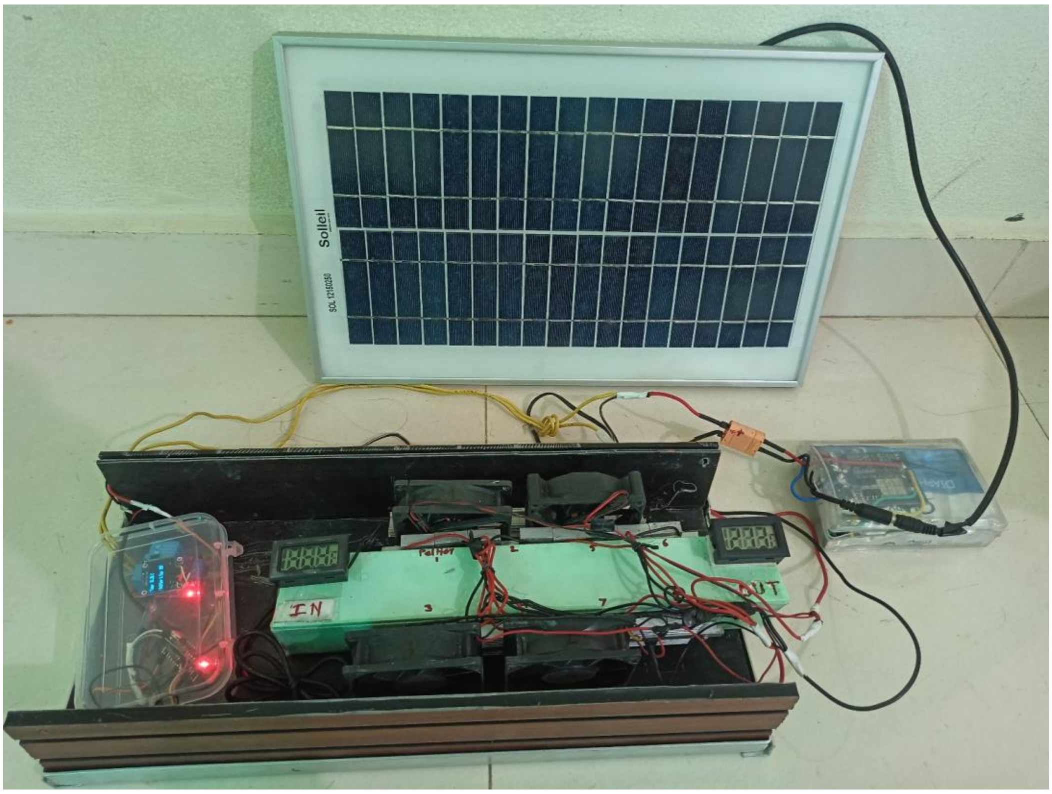

Fig.5 Result

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