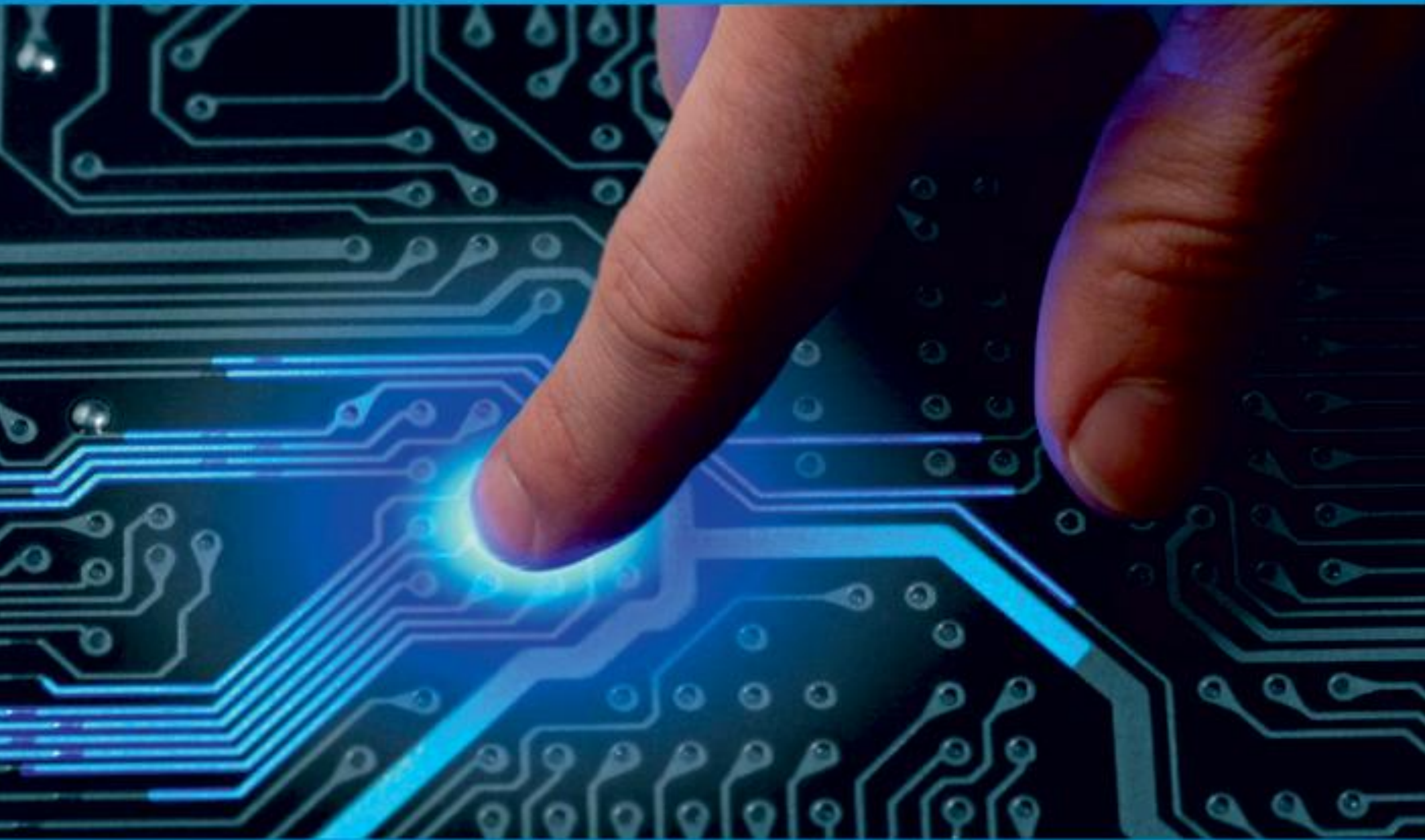
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 12, Issue 2, April 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | Impact Factor: 8.379 | Monthly Peer Reviewed & Refereed Journal |

|| Volume 12, Issue 2, April 2024 ||

International Conference on Recent Development in Engineering and Technology – ICRDET 24

Organized by

Dhaanish Ahmed Institute of Technology, KG Chavadi, Coimbatore, Tamilnadu, India

IOT based Smart Air Purifier with Air Quality Monitoring System

Ms. G. Brinda[1], K. Dinesh[2], J. Nithya shree[3], S. Sowmiya[4], M. Yuvaraj[5]

Assistant Professor, Department of ECE, M. P. Nachimuthu M. Jaganathan Engineering College,Erode, Tamil Nadu, India[1]

UG Student, Department of ECE, M.P. Nachimuthu M Jaganathan Engineering College, Erode, Tamil Nadu, India[2,3,4,5]

ABSTRACT: Air quality has become a major concern for citizens all over the world. It is well documented that Fine Particulate Matter (FPM) is a health hazard which can affect the cardiovascular system, respiratory system, etc. and lead to high mortality rates.This study presents the development and implementation of an innovative portable air purifier. The device can be used to improve air quality in small spaces.

KEYWORDS: Portable Air Purifier (PAP), Clean Air Delivery Rate (CADR), Indoor Air Quality, Particulate Matter (PM) Concentration.

I. INTRODUCTION

Fine Particulate Matter (FPM) is a mixture of solid and liquid microscopic particles suspended in the air. They are the main component of air pollution and have the strongest effect on humans in comparison to any other air contaminant. Usually, the most toxic fine particles are those which are a byproduct of burning – especially, of burning fuel such as wood,charcoal, gasoline, jet fuel, oil, etc. and fossil fuels which cause serious harm to people and the environment.

In reality, fine particles have different shapes. The larger particles are mostly made up of dust and sand and are carried bythe wind or are a product of mechanical work. Even though coarse particles with a diameter equal to or less than can be inhaled through the nose or throat and get stuck there, they are not as harmful as fine particles, with a diameter equal to or less than which can penetrate deeply into the gas exchange area of the lungs. The smallest particles are called Ultrafine Particles (UFP). UFPs are defined as particles with a diameter smaller. One of their main characteristics is that they are small enough to pass through the lungs and into the bloodstream.

In recent years, the dangerous effect of FPM on human health has been well documented in publications by the Global Burden of Disease Study in one of the leading medical journals The Lancet. The results show that FPM contributes to three of the top ten causes of premature death in the world. Those causes are tobacco smoke, burning solid fuels indoors in developing countries and high concentrations of in our environment.

II. LITERATURE SURVEY

A. Smart Air Quality Monitoring and Filtering System

This paper represents a system to monitor Air Quality in the environment to alarm about the quality of air during daily activities in Indoor and Outdoor environment. The system consists of two main units, An Air quality Monitor, and a filtering unit. The air quality monitor unit is used to detect the air pollutants and particulate matters present in the environment. Thisinformation is shown on the screen unit which shows that the quality of the air is good or bad. If the quality of the air is notup to the mark them it issues an alert message accordingly. The prototype of this sensing device is tested to validate the system functionality. The results shown by this device is promising for daily air quality monitoring.

B. Problems due to Air pollution

Now-a-days the situation is gone worse because humans continuously using many sources which emit harmful gases in the environment. These gases evolve in the environment to make our environment unhealthy. In many cities the air

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Refereed Journal |

|| Volume 12, Issue 2, April 2024 ||

International Conference on Recent Development in Engineering and Technology – ICRDET 24

Organized by

Dhaanish Ahmed Institute of Technology, KG Chavadi, Coimbatore, Tamilnadu, India

quality level is reached to an alarming condition where it is difficult to survive. Air pollution acts as a slow poison and effects the human health. Due to air pollutants, many health diseases like Asthma, Pneumonia, Lung Cancer and Autismn etc. are to be found in Human beings. In a report published by World Health Organization (WHO) shows that 27% whichis approximately equal to the 7 million death happens in a year due to the Air pollution.

C. Pollution Detecting Device

The focus of this device is to sense the unhealthy pollutants present in the environment which is not good for health. The device sense and measures the air pollutants parameters such as “PM 2.5”, “PM 10”, “METAHNE”, “AMMONIA”, “CARBON DIOXIDE” “TEMPERATURE”, “HUMIDITY”,“DUST”, etc., to the detecting device. The device will reply back with a text containing the real time accurate temperatureand humidity of the place and will also provide the surrounding gases data, so that the monitoring system can keep track if the pollutants level not suitable for the human health. The secondary measure implemented was using a Fan or a Filter and a buzzer present on the device which can be activated when the air quality reached to worst condition. With this pollution monitor we continuously surveillance the accurate status of the Air quality. Hence this project aims at providing informationwhich is necessary for better human health with basic information like temperature and humidity in today's time. The drawback of this system is that the sensors is sensing only up to few meters.

D. Air Filtering System

Indoor air pollution is a complex mixture of pollutants migrating indoor from outside sources and pollutants generated by indoor sources. Some sensors are used in this device like PM 2.5 Sensor, MQ 135 Sensor, DHT 11 Sensor. This pollution detecting device keeps the environmental undesired particles under surveillance. The monitoring unit of setup will get continuous update about the air quality status so that they aware about the unhealthy air about their child and other people. This will create some fear to the persons those continuously evolving the smoke and other type of pollutants in the air. As like well-known proverb “Environmental pollution is not only humanity’s treason to humanity but also a treason to all other living creatures on earth!”

III. PROPOSED METHOD

It is IOT based product, all the functional units are connected in a network. All things such as sensors, microcontroller work together by means of communication over network. Data collected from uploaded to cloud servers instantly. We can draw conclusions and can take action instantly.

IV. EXPERIMENTAL RESULTS

A.Single-pass particle collection efficiency

The impact of a particular air purifier on particle concentrations in a given space can be quantified by the effectiveness of the air purifier. Miller-Leiden et al. (1996) defined air cleaner effectiveness #, as one minus the ratio of the indoor PM concentration with an operating air purifier to the indoor concentration with no air purifier operating. The air purifier effectiveness is in the range [0, 1], with zero indicating a completely ineffective air purifier ($ P Mremoval) and one indicating a perfectly effective air purifier ($ PM removal).The measurement setup presented is used for the air purifier single-pass particle collection efficiency calculation in percentage.

Optical particle counters OPC-N3 are used for PM measurement at the input and output of the purifier. These sensors canmeasure number and mass concentration of particles with spherical equivalent size in the range from to divided into 24 bins. The sensors were tested and calibrated in the laboratory before the tests.

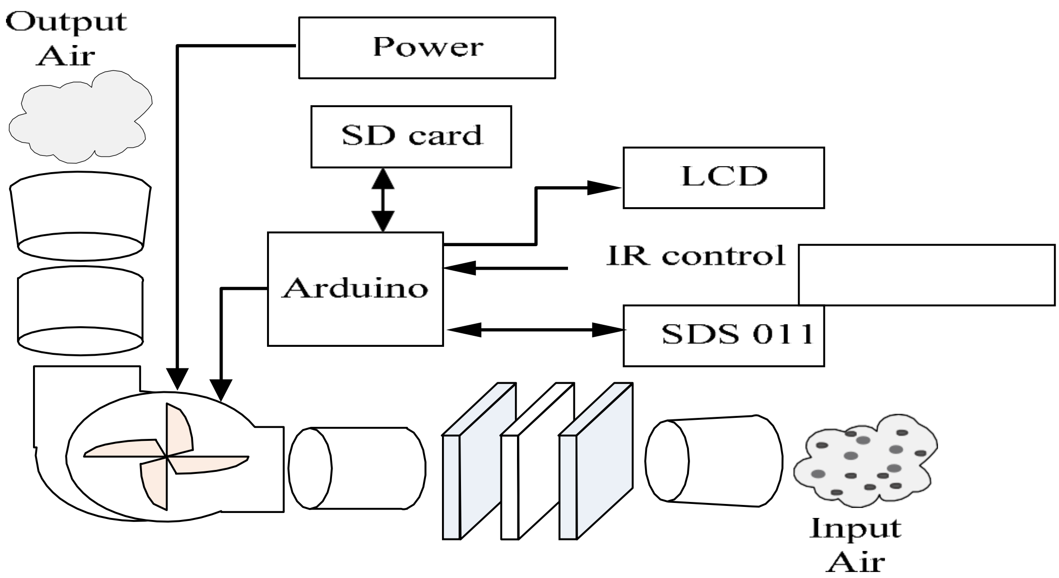
| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Refereed Journal |

|| Volume 12, Issue 2, April 2024 ||

International Conference on Recent Development in Engineering and Technology – ICRDET 24

Organized by

Dhaanish Ahmed Institute of Technology, KG Chavadi, Coimbatore, Tamilnadu, India



Architecture of the PAP

The tests were performed in a test room with closed windows and a switched off ventilation system. The particle concentrations of the inlet and outlet were collected simultaneously. There were no particle sources in the test room and theconcentrations at the inlet and outlet were relatively stable. The initial indoor particle concentration in each test was kept nearly constant.

The particle collection efficiency and the CADR of the PAP under different operating modes in the test room were calculated using the Association of Home Appliance Manufacturers method.Each test run continued for about minutes and was repeated 3 times. From the obtained and averaged data, the single- pass efficiency was calculated.

The size distributions for both experiments were similar as peak concentrations were observed at 9 7 and most particles observed were in that size range, whereas the concentration of particles larger than 7 were minimal. The total particles number concentrations between and were about for single-pass collection efficiency. It shows the variation in the single-pass collection efficiency for particles under different flow rates through the purifier.

B.Decay Constant and CADR

Decay Constant Calculation

Air exchange is negligible and the air exchange rate is not included in the calculations. The time-resolved decay constant k is calculated by fitting a linear regression line to the slope of AJ@DE@ which is the negative of the natural log of the time-varying concentration (@DE) normalized by the initial concentration at the time the incense was extinguished (@), versus time.

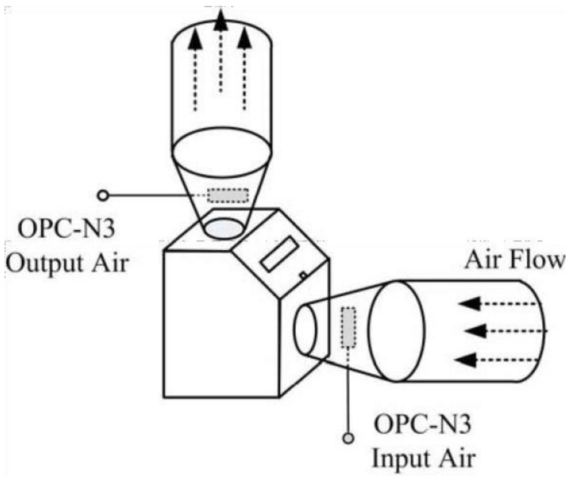
| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Refereed Journal |

|| Volume 12, Issue 2, April 2024 ||

International Conference on Recent Development in Engineering and Technology – ICRDET 24

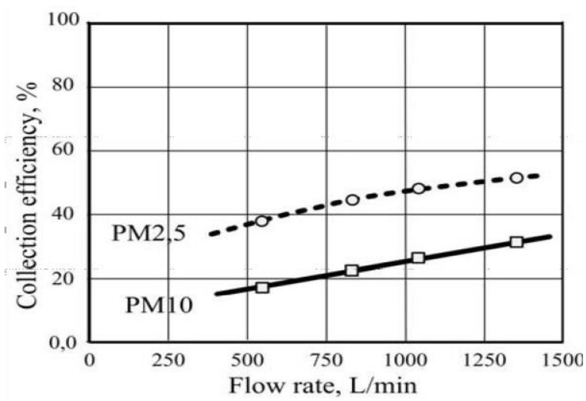
Organized by

Dhaanish Ahmed Institute of Technology, KG Chavadi, Coimbatore, Tamilnadu, India

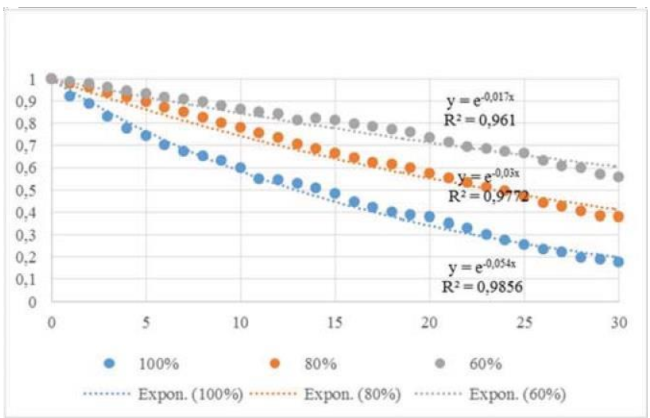


Measurement setup for single-pass particle collection efficiency calculation

Flow rate	0.53	0.79	1.05	1.32
8$ PM2.5	18	22.7	25.8	28.7
PM10	38.5	43.2	47.5	50.6



Variation in the single-pass collection efficiency for different particle size and set flow rates of 530, 790, 1050 and 1320 L/min

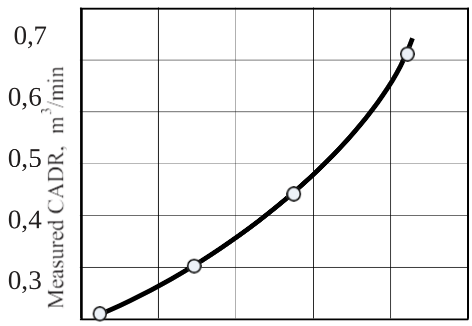


Normalized PM concentrations and fitted curves for different flow rates

A performance metric based on the capability of an air purifier to reduce PM in a closed chamber can be calculated usingthe following equation: PQRS*-I
where:
T!UN* clean air delivery rate ?J V
* chamber volume V I* decay constant ?J^{G}
shows the variation in the CADR of the PAP for different flow rates. The measured CADR increased almost linearly withthe rise of the flow rate.

CADR OF THE PAP FOR DIFFERENT FLOW RATES

Flow rate, ?J	0.53	0.79	1.05	1.32
T!UN ?J	0.11	0.19	0,33	0.62



Variation in the CADR of the PAP for different flow rates

A. Electrical power consumption

Test conditions: ambient temperature W with a relative humidity (RH) of 42 % for CADR. The electrical power drawn by the air purifier at different air flow settings was measured with a Mextech BM 9911 Power Meter. The results are summarized in Table.

ELECTRICAL POWER CONSUMPTION AT DIFFERENT FLOW RATES

Flow rate, ?J	0.53	0.79	1.05	1.32
Power consumption, W	3.4	6.3	11.7	22.5

The effectiveness of the PAP was tested using its SDS 011 sensor in a room. The test had two stages:

- In the first stage, the air quality was sampled every thirty minutes for four and a half hours with the fan working at maximum speed and with the door and window of the room closed.
- In the second stage, air sampling continued for an hour and a half, with the fan turned off and the window and door of the room open.

As expected, in the first stage air quality improved significantly, with PM values dropping nearly by half, whereas in the second stage air quality worsened drastically, with PM values nearly tripling compared to the first readings which were taken when the room was closed but the air was not being filtered.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Refereed Journal |

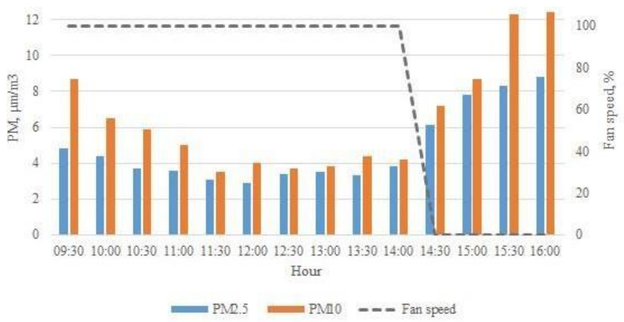
|| Volume 12, Issue 2, April 2024 ||

International Conference on Recent Development in Engineering and Technology – ICRDET 24

Organized by

Dhaanish Ahmed Institute of Technology, KG Chavadi, Coimbatore, Tamilnadu, India

“Umi” Ai Purifier Test



V. CONCLUSION

This study presents the development of a novel portable air purifier with a set of filters for improvement of air quality inside living rooms and offices. Detailed hardware and software design are shown and experiments in a real world office environment are performed.

The PM particle collection efficiency of the PAP was examined for particles with a diameter in the range 9 in a test roomunder different operating modes. The experiments confirm the good effectiveness of the proposed solution. It can be extended to humidity control as wellas to control over wireless sensor networks.

REFERENCES

1. European Environment Agency, "Air quality in Europe — 2017 report".
2. "Engineering Data for Selecting and Using Portable HEPA Filtration Units and Accessories for Nuclear Applications," RadiationProtection Systems, Inc., 2011.
3. S. Miller-Leiden, C. Lobascio, W. Nazaroff and J. Macher, "Effectiveness of in-room air filtration and dilution ventilation fortuberculosis infection control , .," Journal of the Air and Waste Management Association, vol. 46, p. 869–882, 1996.
4. Hak-Joon Kim, Bangwoo Han, Chang Gyu Woo, Yong-Jin Kim, Gi-Taek Lim, Weon Gyu Shin, "Air Cleaning
5. Performance of a Novel Electrostatic Air Purifier Using an Activated Carbon Fiber Filter for Passenger Cars," IEEE Transactions onIndustry Appl., vol. 53.
6. "OPC-N3 Particle Monitor, Technical Specification," Alphasens Alphasense Ltd, Sensor Technology House, Great Notley, UK, March2019.
7. "Method for Measuring Performance of Portable Household Electric Room Air Cleaners,," Association of Home ApplianceManufacturers (AHAM) Standard ANSI/AHAM AC-1-2006, 2006.
8. S.-L. von der Weiden, F. Drewnick and S. and Borrmann, "Particle Loss Calculator – a new software tool for the assessment of theperformance of aerosol inlet systems," Atmos. Meas. Tech., vol. 2, no. 2, pp. 479-494, 2009.
9. D. Brugge, Particles in the Air, Springer, 2018.
10. H. Ma, H. Shen, T. Shui, Q. Li and L. Zhou, "Experimental Study on Ultrafine Particle Removal Performance of Portable Air Cleaners with Different Filters in an Office Room," Int J Environ Res Public Health, vol. 13(1), no. 102, pp. 1-15, 2016.

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING