AMBIENT AIR QUALITY MONITORING PM$_{2.5}$ WITH QUADCOPTER IN RAJAM TOWN OF SRIKAKULAM DISTRICT OF ANDHRA PRADESH

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ABSTRACT

PM$_{2.5}$ is the fine particle matter with the size smaller than 2.5µm and is considered being one of the atmospheric pollutants whose effects are the greatest on the public health. The accurate measurement of PM$_{2.5}$ provides a crucial basis for health impact assessment and pollution management and control. Present research work proposes a novel platform to drones for monitor of PM$_{2.5}$ in the outdoor environment. This project demonstrates the feasibility of Quadcopter equipped with dust sensors effectively and flexibility to measure three-dimensional PM$_{2.5}$ concentration within 8M altitude, particularly peak hours of a day and measured for three months. The present case study of Rajam of the average concentration of PM$_{2.5}$ was recorded as moderate as per CPCB norms. The experimental results show that in the PM$_{2.5}$ concentrations decrease when height increases and the increasing concentration rate of PM$_{2.5}$ concentrations is larger in the morning than in the afternoon flights. The results demonstrated that there are fluctuations in concentrations during different peak periods of the day.

Keywords: Dust monitoring, Quadcopter, 8M altitude, Peak hours of day, PM$_{2.5}$ µg/m$^3$.

Cite this Article: S.Murali Krishna, M. Gangadhar and Ch.V.Kameswara Rao, Ambient Air Quality Monitoring PM$_{2.5}$ with Quadcopter in Rajam Town of Srikakulam District of Andhra Pradesh, International Journal of Mechanical Engineering and Technology, 9(4), 2018, pp. 780–785.
http://www.iaeme.com/IJMET/issues.asp?JType=IJMET&VType=9&IType=4
1. INTRODUCTION
Maintaining ambient PM$_{2.5}$ at appropriate levels is one of the greatest challenging problems facing society today. There are many sources that discharge large amounts PM2.5 into the atmosphere through different processes and The major sources are road dust, constructive and demolition activities, Automobiles, Domestic and Industries [1][2]. A person inhales PM2.5 then it can penetrates into alveolar region and it can lead several problems on human health asthma, cardiovascular and respiratory disorders [3]. 7.1 million People died due to air pollution include particulate matter in world as per WHO (2012) reports [4]. Therefore, identification of PM$_{2.5}$ origins is significant role to different flourishing strategies to monitor and reducing PM2.5 concentrations through targeted action.[5]. For identification of PM sources while monitoring a stack holders and research Persons leads adverse health effects. To address problem many tools are used for identification and quantification of PM$_{2.5}$ Sources [5].so we used Quadcopter equipped with dust sensors for monitoring PM$_{2.5}$ concentration [6]. In recent years Quadcopter have attained become interest in significant and expanding in number of applications includes Aerial photography, videography, surveying, oil and gas pipeline inspection[7].it requires detailed inspection of infrastructures of roads, bridges, power grids and water systems where difficult reach locations [8]. A task using Quadcopter in PM$_{2.5}$ monitoring is a novel concept and it is one of especially attractive for environmentalists, Stakeholders, and health victims for monitoring PM in surroundings. This paper proposes a system identification sources and approach to obtain more accurate the concentration of PM$_{2.5}$ and fastest way of assessment characteristics of ambient PM 2.5 concentration levels in peak hours Rajam town.

2. MATERIALS AND METHODOLOGY
2.1. Area of Interest
The study was carried out in Rajam Town, Andhra Pradesh. The position of Rajam 18.28 N 83.40E. It has an average elevation of 42 meters. It is occupies an area of 27.65 km$^2$[9].PM samples were collected periodically at Rajam Town during January 2018 to March 2018. The sampling site amenable to wind flow from all directions. we consider the traffic could be one of major source for producing PM$_{2.5}$,more The sample location taken in Rajam complex region. Traffic congestion is the order of the day in Rajam, the industrial town of Srikakulam district, owing to the inordinate delay in road-widening in important areas. Thousands of passenger’s travels from areas such as Saluru, Ramabhadruram, Cheepurpalli, Vizianagaram, Palakonda, and Srikakulam travel frequently to Rajam for business purpose. A villager of nearby mandal such as Santakaviti, Vangara, and Ponduru also depend on Rajam to buy essential goods. Haphazard development hastaken place in Rajam town which is growing as a commercial centre. The traffic situation is horrible near RTC complex and Rajam-Palakonda road with little space for the movement of vehicles. Road width is below 25 feet in many stretches. It has to be widened up to 40 feet so that vehicles can move freely. Property owners reportedly exerted pressure on officials not to take up road-widening works as it would lead to demolition of major portion of their shops and establishments.

Traffic congestion is also fostered by the increase of private car and by the increase of illegal parking of vehicles. These features reduce the roadway capacity and increase the commercial speed of public transportation. PM$_{2.5}$pollution due to a vehicular traffic, construction, demolition, road dust are a serious problem, especially for Rajam.
2.2. PM Measurements

The PM$_{2.5}$ mass concentrations at the study site were monitored using environmental dust monitor module fitted to drone and measured for the three months (January 1 to March 31) 2018. The dust monitor is a portable instrument designed to provide continuous concentrations of particulate matter PM$_{2.5}$ suspended in the ambient air. The dust particles are measured by the physical principle of orthogonal light scattering. It is designed to measure particle size distribution and particle mass based on a light scattering measurement of individual particles in the sampled air. Every single particle is illuminated by a defined laser light and each scattering signal is detected at an angle of 90° by a photodiode. The instrument kept at a distance above 8 meters from the road junction of Rajam complex region. During the monitoring, the average concentrations of PM$_{2.5}$ were recorded on a data storage card. The mean value can be displayed on dust module.

2.3. Architecture of Quadcopter

In present research paper, we used a Vertical Take-off and Landing Quadcopter for 4 propellers that can be used in any context and it is able to follow flight planning for automated flights through a radio control system. It has a sophisticated inertial system and subsystems of integrated flight and it is equipped with dust sensors as well as a compact digital camera that can record video in high quality [10]. Quadcopter compared to other traditional platforms are like pollution measurement instruments are High volume sampler, etc., have many technical and logistic advantages.

- High altitude operations
- Flexibility and feasibility operation
- Reduced operating costs.

During flight operations, you have get in real time data from the video camera.

![Figure 1 UAV with video camera](image1)
![Figure 2 PM$_{2.5}$ sensors with remote control](image2)
![Figure 3 Ground control station](image3)
Table 1 Quadcopter Technical Features Specification

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Components of Drone</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Body</td>
<td>Glass Fiber</td>
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<tr>
<td>2</td>
<td>Rotors</td>
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<tr>
<td>7</td>
<td>Video quality</td>
<td>1 MG Pixel</td>
</tr>
</tbody>
</table>

3. DATA ANALYSIS

Figure 1 Variation of PM$_{2.5}$ concentration levels with different peak hours of day of January month

Figure 2 Variation of PM$_{2.5}$ concentration levels with different peak hours of day of February month
Ambient Air Quality Monitoring PM2.5 with Quadcopter in Rajam Town of Srikakulam District of Andhra Pradesh

Pollution levels in Rajam have crossed permissible limits of CPCB as per our results. Certain PM 2.5 have that can directly go into your blood streams leading to serious lung cancer, heart attacks, bronchitis…..etc. The present situation in Rajam is alarming to Children and the aged people pay for it. It is a death sentence for them. We felt that school-going children would get affected severely by the pollution as they leave for schools in the early morning. It is going to hit them hard. Their immunity level is low. Young bodies can't take it. It can lead to a cough, cold, irritation, numerous respiratory problems at a very young age so it is not advisable for the children and the old people to venture out till there is some reduction in the pollution level. The present results are moderate and the moderate values also affect breathing discomfort in people lung, asthma, and heart diseases. The PM 2.5 concentration is high in March month as per results we have tested peak hours of day are morning, afternoon and evening concentration data for PM 2.5 exceeded the permissible limit central pollution control board and the pollution levels high in afternoon section when comparing morning and evening sections because of average temperature is 33 °C. The general pollution levels PM2.5 in 24 hours is 40 µg/m³as CPCB norms, we measured the PM2.5 per peak hours only. The CPCB norms per one hour are 2 µg/m³, we have plotted graphs per three months. January, February, March months results exceed 2 µg/m³and average values are 4 µg/m³, the values represents moderate. The major sources are Fugitive dust from mismanaged construction and demolition (C&D) waste is a serious problem. Construction site dust typically comprises “small particles such as soot and cement and larger particles such as grit, sand and wood dust”. Construction activities like an extension of the road lines across Rajam main road along and building of residential areas in Rajam town degrade the air quality. "Dust and soil level in the air increase in summer when temperatures are high with less rainfall. However, in the winter season, when people use wood and other substances for heating, low temperature accompanied with little or no wind can lead to building-up of pollutants in the atmosphere. There has also been an ever-increasing number of diesel and petrol vehicles plying on the roads, which are largely responsible for the air pollution. The pollutants are moderate and sometimes leads to poor because of the schools, offices, commercial building opening in morning section as well as the sand transported vehicles. Road Sweepers should be regular cleaning of roads the dust is raised high in Rajam Town. The trucks and lorries carry construction materials like sand, bricks, aggregates and commercial goods so these can also lead.
4. CONCLUSION

The concentrations of PM2.5 mass were conducted tests during January 2018 to May 2018 at Rajam town, Andhra Pradesh. The concentration of PM$_{2.5}$ was crossed 2µg/m$^3$ for peak hours of the day in case study of Rajam when comparing with CPCB standards. The average concentration of PM$_{2.5}$ was recorded is 4 µg/m$^3$ per three months. The March month results are high when compared with last two months. Analysis has quantified that the Road dust, vehicle emissions, transportation of construction materials through trucks, tractors, sweeping of roads by municipalities the major sources of PM$_{2.5}$ mass at the observational site. The present study can help to understand the influence of regional and local sources of PM in Rajam town and thus to identify effective emission control strategies to improve the ambient air quality. The values The Quadcopter cannot fly when Strong electromagnetic fields, of the prevailing winds.

5. REFERENCES

[1] Samiksha, Shilpi PM10 and PM2.5 Chemical Source Profiles with Optical Attenuation and Health Risk Indicators of Paved and Unpaved Road Dust in Bhopal, India Environmental Pollution 222 (2017): 477-485.


