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A bridge between science and innovation

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Founder of the international scientific journal “Engineer” – Tashkent State Transport University, 100167, Republic of Uzbekistan, Tashkent, Temiryo‘lchilar str., 1, office: 465, e-mail: publication@tstu.uz.

The “Engineer” publishes the most significant results of scientific and applied research carried out in universities of transport profile, as well as other higher educational institutions, research institutes, and centers of the Republic of Uzbekistan and foreign countries.

The journal is published 4 times a year and contains publications in the following main areas:

- Engineering;
- General Engineering;
- Aerospace Engineering;
- Automotive Engineering;
- Civil and Structural Engineering;
- Computational Mechanics;
- Control and Systems Engineering;
- Electrical and Electronic Engineering;
- Industrial and Manufacturing Engineering;
- Mechanical Engineering;
- Mechanics of Materials;
- Safety, Risk, Reliability and Quality;
- Media Technology;
- Building and Construction;
- Architecture.

Tashkent State Transport University had the opportunity to publish the international scientific journal “Engineer” based on the **Certificate No. 1183** of the Information and Mass Communications Agency under the Administration of the President of the Republic of Uzbekistan. **E-ISSN: 3030-3893, ISSN: 3060-5172.** Articles in the journal are published in English language.

Methods and solutions for reducing the amount of dust in order to ensure the sustainability of cities

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Abstract: The purpose of scientific work is to provide the population with clean air and reduce the dust content of the city of Tashkent in order to avoid the formation of foggy dust generated from road transport, manufacturing enterprises and various causes.Moderate conditions are created by turning dusty areas into clean and tidy areas with water spray drones. They will be fitted with water tanks and a LIDAR system, the flight altitude and the object will be determined.. Using the findings of this project, it became possible to prevent viral infections in the city by cleaning the air from dust that contains microbes. As a result, the amount of dust in the environment decreases slightly depending on the number of drones. Also, the dust accumulated on the trees will be removed by artificial rain. The habitat becomes temperate for breathing.

Keywords: dust, rain, drone

1. Introduction

Dust is formed inside the apartment and penetrates into it from the street. It is weightless and almost invisible in itself, but in a few days a gray coating almost always collects on the surfaces in an apartment or house, which most likely may contain harmful substances. The dusty air contains soot from fires, plant pollen, skin and hair cells of people and pet hair, wear particles of surrounding objects. The danger is primarily due to yeast fungi, mold and dust mites, which are part of the dust, as well as plant pollen, which causes trouble for allergy sufferers.

2. Research methodology

Sand and dust storms lead to the formation of a dusty haze, or dust haze, a suspension in the air of dust or sand particles raised from the ground. The World Meteorological Organization notes that a dust or sandstorm can occur at the location of the observation of haze, near or at a distance from it. It was such a dusty-sand haze that covered Tashkent and other regions of Uzbekistan on the evening of November 4, 2021.

According to Uzhydromet, such a phenomenon was observed in the country for the first time in 150 years, that is, for the entire time of meteorological observations. Visibility in a number of areas deteriorated to 500-1000 meters, and in Tashkent - up to 200 meters [1].

Fig. 1. Air quality index levels by number

Table 1

Air quality index levels [2]

AQI	Air Pollution Level	Health Implications	Cautionary Statement (for PM2.5)
0 - 50	Good	Air quality is considered satisfactory, and air pollution poses little or no risk	None
51 -100	Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.
101-150	Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.
151-200	Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects	Active children and adults, and people with respiratory disease, such as asthma, should avoid prolonged outdoor exertion; everyone else, especially children, should limit prolonged outdoor exertion

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AQI	Air Pollution Level	Health Implications	Cautionary Statement (for PM2.5)
201-300	Very Unhealthy	Health warnings of emergency conditions. The entire population is more likely to be affected.	Active children and adults, and people with respiratory disease, such as asthma, should avoid all outdoor exertion; everyone else, especially children, should limit outdoor exertion.
300+	Hazardous	Health alert: everyone may experience more serious health effects	Everyone should avoid all outdoor eertion

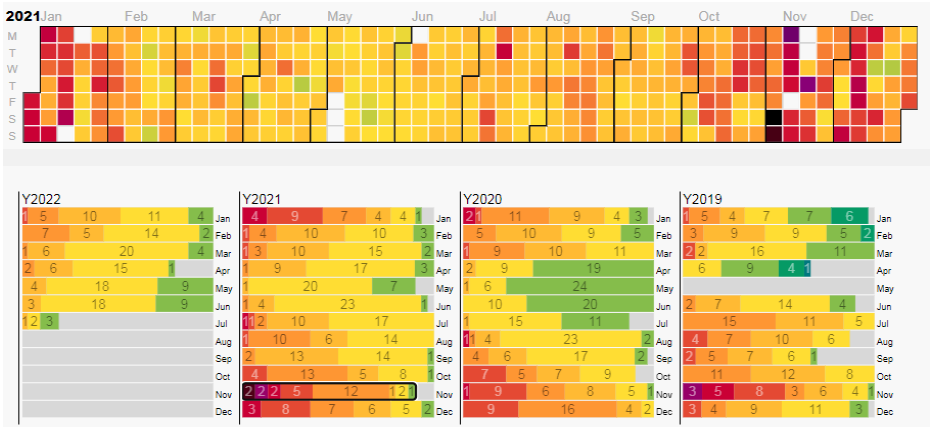

Fig. 2. Air quality historical data for Tashkent [2]

Of course, there are measures to eliminate the above incidents, let's consider some of them.

- creation of algorithms and technological solutions for the analysis of the natural environment at transport facilities and territories adjacent to them, ways to control the ways and flows of vehicles to increase and increase the capacity of road networks;
- improvement of environmental management mechanisms;
- increasing the level of logistics in the field of transportation and traffic;
- creation of means limiting the access of harmful substances to humans;
- increasing the level of work on landscaping parks, roadside areas, as well as the improvement of the entire city as a whole;
- reducing the amount of carbon monoxide substances with the help of green spaces.

The volume of pollutant emissions from vehicles in Tashkent is 395,000 tons per year. They account for 90% of air emissions [3].

Those most at risk of health problems due to sand and dust storms are:

- infants and children;
- elderly people;
- people with respiratory diseases;
- people with cardiovascular diseases;
- people with diabetes.

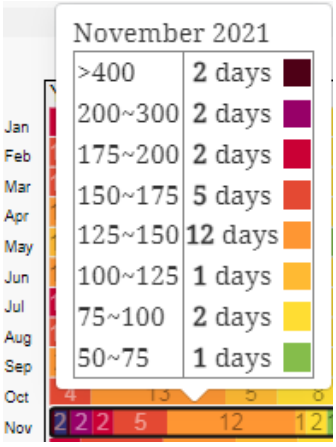

Fig. 3. Air quality historical data on November in Tashkent [2]

Fig. 4. Chilanzar district. Tashkent

https://doi.org/10.56143/3030-3893-2026-1-84-88

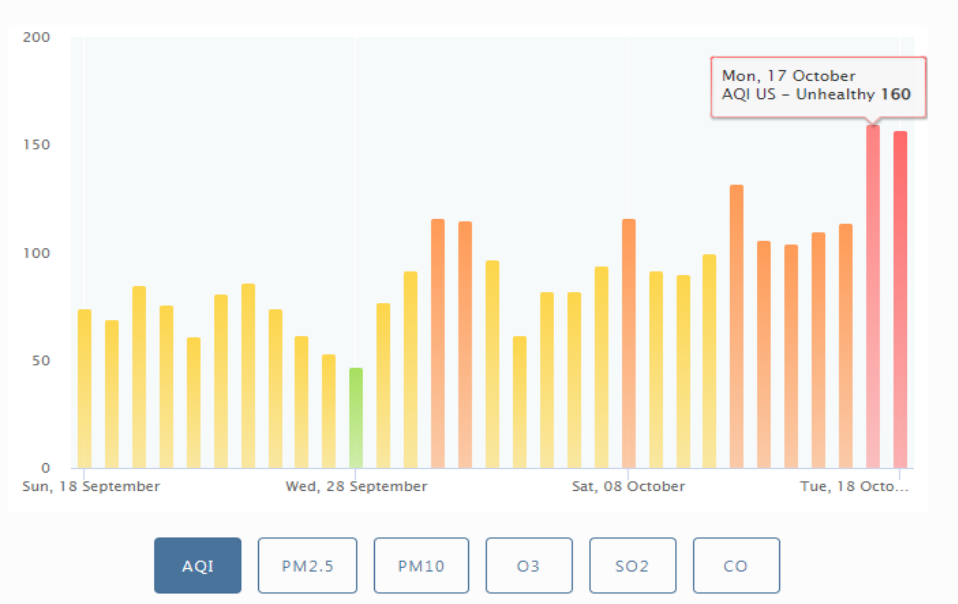

Fig. 5. Monthly air quality in Tashkent [4]

Analysis

Due to climate changes, less rainy days are observed in Uzbekistan. And this year, the rainy season mostly coincides with the spring season. Due to the loss of moisture in the summer, the environment becomes drier and pollination increases. Therefore, the new technologies of unmanned water misting drones to help increase rainfall can help eliminate pollination.

The number of days in a month with rain, snow and hail in Tashkent is attached below.

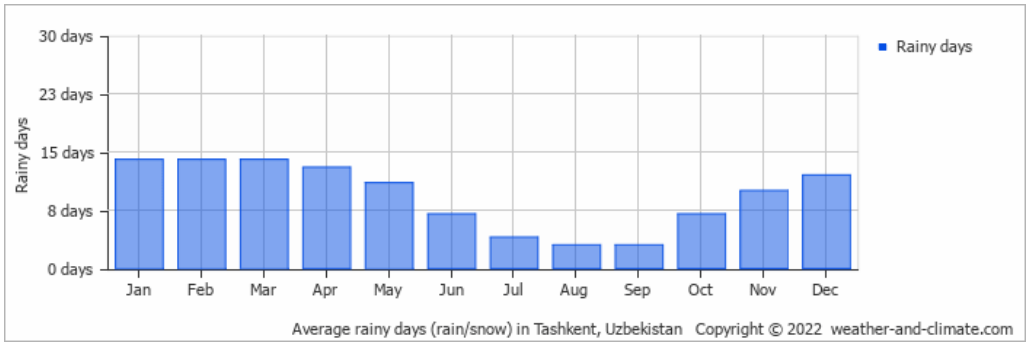

Fig. 6. Average monthly number of rainy days in Tashkent [4]

On average, March is the rainiest with 14 days of rain/snow. On average, August is the driest month with 3 rainy days. The average annual amount of rainy days is: 108 [4].

The last month of the autumn, November, is another mild month in Tashkent, Uzbekistan, with an average temperature ranging between max 14.9°C (58.8°F) and min 4.1°C (39.4°F). In Tashkent, the average high-temperature in November drops from an agreeable 21.8°C (71.2°F) in October to a moderate 14.9°C (58.8°F) [6].

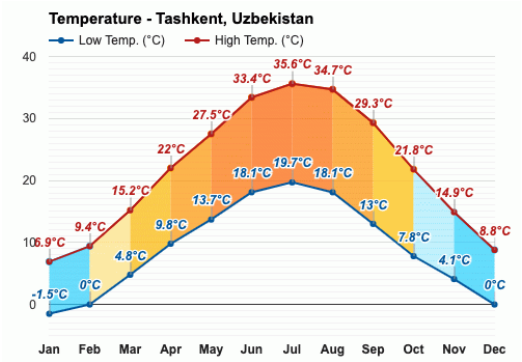

Fig. 7. Average temperature in Tashkent [6]

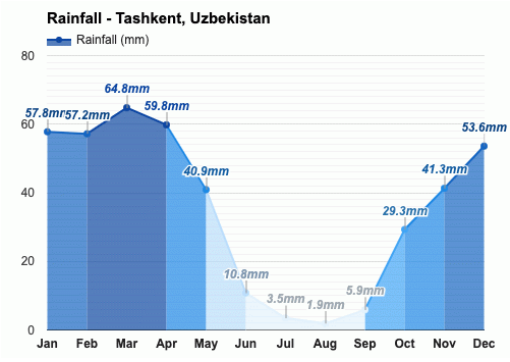

Fig. . Average rainfall in Tashkent [6]

Currently, many university researchers are using drones in the agricultural industry. But mainly it can climb short distances and not high altitudes.

The proposed drone configuration is listed in the table below.

Table 2

Main technical specifications of foggy drones:

Flight duration:	9-10 minutes
Range:	7-8 km.
Tank capacity:	15 l.
Beam diagonal:	170 cm.
Maximum takeoff weight:	36 kg.
Battery capacity:	29,000 mAh.
Operating temperature range:	+ 40 °C
Flight altitude	120-150 m.
Spraying strip width:	4-6 m.
Spraying speed:	2-5 m/s.
Transport flight case:	Yes
Set weight:	36-40 kg.

The productivity of the drone when spraying is up to 16.2 hectares per hour. Spray diameter - 9 meters. The performance of the nozzles can reach an intensity of 8 liters per minute. The intensity of the solution supply is regulated by 8 solenoid valves. The drone detects the remaining material in the tank in real time and automatically returns to refuel.

With the help of an omnidirectional lidar and two cameras, the drone tracks the terrain and repeats it at a constant height above objects. Lidar and LED lighting of the camera allow you to work at night. The spherical radar system recognizes obstacles and the surrounding area in all weather conditions and viewing angles, regardless of the presence of dust and light interference. Automatic collision avoidance and adaptive flight features help keep you safe while you work.

The number of guaranteed battery charge cycles is 1000. The charge time is 10 minutes. The battery is not afraid of overheating, so you can start charging immediately after replacing it. Two batteries with a capacity of 29,000 mAh are sufficient for continuous operation.

3. Conclusion

The proposed unmanned water misting drones will help the sky to open and clear in the Tashkent region. Based on this theory and modeling, dust particles settled in the environment are washed away by artificial rain, on the other hand, it creates cool conditions during hot summer days.

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