A comprehensive review on materialistic and sustainable approach for drone sanitizations

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Abstract. Military, law enforcement, surveillance, leisure, scientific, and research have benefited from drones. Recent decades have seen considerable advances in aerial robot structure, working method, flying features, and navigation control, notably small UAVs and drones. Their use in civilized places needs regulation. Early covid products delivery and sanitization involved drones. This thorough analysis of UAV applications in numerous domains from respected journals and scientific reports during the past decade. Summary of UAV-based sanitization research inputs. This review helps inexperienced researchers evaluate studies. This concise review of materialistic and sustainable drone sanitization literature is useful for novice researchers and practitioners.

Keywords: UAV's; Sustainable Material; Sanitization; Materials; Nozzle; Covid 19

1 Introduction

Unmanned aerial vehicles (UAVs) are usually referred to as "drones." These UAVs are capable of flying in the same ways that conventional aircraft (aeroplanes flown by pilots) are. Drones, unlike airplanes, do not always need a human pilot (the Autopilot mode is similar). The industry calls an unmanned aerial vehicle's space position a "Platform". The term "Payload." refers to the hardware or embedded systems. Attaching payloads to drone platforms expands their uses and improves their performance [1-3]. As the name indicates they eliminate the operators from the boards and permit new mode of exercises. However, Ballistic, cruise and artillery missiles, torpedoes and satellites vehicles with similar characteristics cannot be considered as drones [4,37,38]. The technology advancement aspects with fabrication, celestial navigation, higher bandwidth, remote control capabilities and power backup makes easy accessibility of drone where human presence is terrible or hazardous [5,6].

Basically Drones can be classified on the basis of different platform, mission and parameters. Researcher classified the drones' based upon characteristics, such as size, flight endurance, and capabilities. In their drones' classifications, they classified them as MAVs (Micro or Miniature Air Vehicles), NAVs (Nano Air Vehicles), VTOL (Vertical Take-Off & Landing) and drones on the bases of altitude and endurance like LASE (Low Altitude, Short-Endurance), LALE (Low Altitude, Long Endurance), MALE (Medium Altitude, Long Endurance), and HALE (High Altitude, Long Endurance) [7]. Researchers classified drones on the basis of weight as nano, micro, mini, small, tactical, HALE/MALE/strike drones [8-11]. Investigator suggested drones classification based on their flying range also [12-14]. A similar study identified six subcategories: near range, short range, medium range, long range, endurance, and medium altitude long endurance [15,16]. Operational purpose, fabrication material, complexity, and control system cost can also categorise drones [16]. Today, technology drives researchers to create UAVs for vertical takeoff, landing, and hovering [17-18]. Researchers classed drones as single, coaxial, tandem, and quad-rotor. UAV wings separate rotating and stationary wings [19-20].

The engine type of a drone classifies it, along with other parameters. Example: gasoline engine and electric motor. The bio-inspired flying vehicles with recoil propulsion are atypical UAVs like FESTO AirJelly. This helium-filled ballonet drone has a central electric driving unit and clever adaptive mechanism [21-22, 36]. Drones consist of five varieties based on their operation: UGV (unmanned ground vehicles), UAV (unmanned aerial vehicles), USV (unmanned surface vehicles), UUV (unmanned underwater vehicles), and USC (unmanned space crafts). Ariel vehicles can be remote-guided or autonomous [23]. Researchers also classed the unmanned aerial vehicle by working platform as HAP [24] and LAP [25]. Table1[23] lists three UAV classifications according to U.S. report.

Table 1. Category of UAV with examples

S.No	Category	Mini	Tactical	Strategic
1	Altitude	Low	Low to medium	Medium to high
2	Endurance	Short (about an hour)	Medium (up to several hours)	Long (from hours to day)
3	Range	Close range	Limited to line of sight	Long range
4	Example	Raven	Shadow	Global Hawk

Table 2: Specifications of private UAV[19]

	Fixed Wing UAV			Rotatory wing UAV		
Name of pvt. UAV	eBee	UX5	maveric	hantom2	eXom	Inspire1
Weight (Kg)	0.69	2.20	1.16	1.24	1.80	2.94
Wingspan (cm)	96.0	100.00	74.9	35.0	56.0	55.9
Flight time (min)	50	45	45-60	25	22	18
Cruse Speed (Km/h)	40-90	80	34-101	54	28.8-43.2	79.2

Features of a system based on drones Here, we'll explain the major pieces and how they work both individually and in conjunction with one another. The drone frame is the most reliable part because it supports all other parts. Depending on product weight, a carbon frame may be better than a plastic one. The drone's flight depends on the motor's torque. The "pusher prop" counterbalances torque to stabilize the drone. Brushless motors are quieter and more efficient. Brushless motors last longer. Your boat's propellers and motors need weatherproofing and high-velocity air. An ESC circuit adjusts and controls a motor's rotational speed and direction. The flight controller, also known as the ground control system (GSC) or ground cockpit, controls the drone's movements from takeoff until landing. The gyroscope and front propeller ensure stable flight in all directions. The boom is long enough to make certain changes while in flight. Signals also coordinate payloads. This is the UAV operation control centre.

With a magnetometer and GPS, you can also determine your latitude, longitude, altitude, and magnetic heading. To boost power supply performance, you need an efficient motor. Remote pilots can effectively use antennas to get a first-person view of the line of sight. Remotely operating a drone requires only a transceiver and five channels. Drone remote controls must comply. A key component is "Payload," which is the equipment the drone can carry to boost performance. This could be a camera or sensors. The camera will take X, Y, and Z images for object detection, photogrammetry, and collision avoidance. Telemetry allows real-time data monitoring and display on handheld devices.

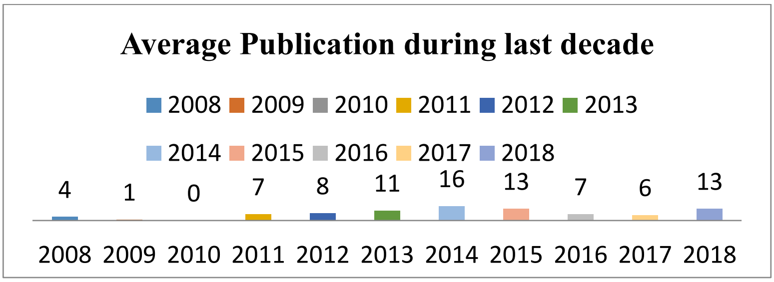

Fig. 1. Research publication during last decade on AEC domain [22]

2 Tank materials

The tank material is vital for disinfection drone design. Remember to use corrosion-resistant materials for the tank. Sprayer tanks are polyethylene, stainless steel, and fibreglass. Sanitizers corrode materials. Do not use incompatible parts. Avoid aluminum, galvanized steel, and steel tanks. Some chemicals can react with these materials, lowering tank sanitizer efficacy and producing rust or corrosion. Keep tanks clean to protect pump and nozzles from corrosion, scale, dirt, and other impurities. Nozzle contamination can reduce chemical flow, affecting spray patterns and application rates. Particles can clog strainers, reducing spray flow. Clean water cleanse the tank after sanitizing. Select a tank with a bottom drain hole for thorough drainage. A sump-bottom tank is best. Interior inspection, cleaning, and maintenance require a big top opening. To add enough pesticide, determine the tank capacity. The sides of most modern tanks show capacity. Include a tank fluid level sight gauge if not translucent. A bottom shut-off valve should close the sight gauge if it breaks. Marking plastic and fiberglass tanks. Make sure the sprayer is level while checking tank gallons. Mismeasured pesticide volume can lead to poor insect management, crop damage, and greater pesticide expenses.

For this project, polyethylene is the best tank material because it's inexpensive, available, and lightweight. Polyethylene tank is safe because it does not transfer chemicals to cleaned things and is air-compatible. Its light weight and swap ability lessen the drone's overload risk. Since these materials are commonly available, the drone works better.

Table 3: Application area of UAV with example [17]

S.No.	Application area	Examples
1	Structural and infrastructure inspection	• Building inspection, • Bridge inspection • Other inspections (roads, photovoltaic cells, dams, retaining walls, microwave tower
2	Transportation	• Landslide monitoring and mapping • Earthwork • Traffic surveillance
3	Cultural heritage conservation	• Historic preservation and reconstruction • Monitoring historic monuments • 3D modeling of heritage buildings • Landscape preservation
4	City and urban planning	• Land policy monitoring • Cadastral surveying • City and building modeling • Cartography updating
5	Progress monitoring	• Construction progress monitoring • Tracking material on complex jobsite
6	Post-disaster assessment	• Assessing damages (including structural) of cities/buildings after disastrous events
7	Construction safety	• Construction safety inspection • Monitoring safety hazards of equipment in construction sites

3 Future Aspects of Drone Technology

UAVs have many uses and are of interest worldwide, thus the commercial and civilian drone markets are increasing rapidly. Businessmen, manufacturers, investors, and service providers can benefit from the new drone trend. [24] Researchers have estimated UAV market value. As seen in Figure 2, the market value exceeds $127 billion. Civil and agriculture industries will dominate UAV market value with $45 billion and $34 billion, respectively. According to the Association for Unmanned Vehicle Systems International, unmanned aircraft will provide over 100,000 jobs by 2025 [21].

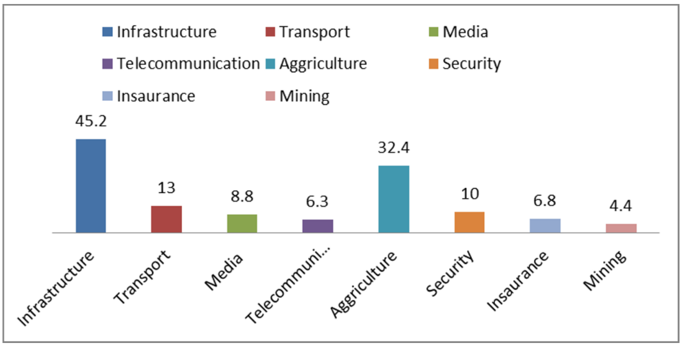

Fig. 2. Predicted value of UAV solution in key industries (billions) [19]

4 Drone in sanitizations

Sanitization was excellent with drones at covid 19 [21-25].Several studies support this. Scientific papers will make the COVID-19 epidemic more professional. Kumar et al. [15] examined drone-based disinfectant spraying networks. This investigation sprayed a two-kilometer-radius, ten-minute zone without circumstances data. Alsamhi et al. [16] presented a decentralized drone framework. This study also covered drone disinfectant spraying without details. Khan and colleagues [17], Singla [18] say researchers use drones to sterilize and spray disinfectant. In recent studies, a 16-litre drone disinfected 100,000 square meters. According to this knowledge, there is no standard drone disinfection technique, and tank design, size, and nozzle type must be selected to maximize mission success. However, widespread disinfectant use endangers urban animals and people regardless of technology. Dangers may affect both populations. Khan et al. [17] cited material selection-related human difficulties, while Nabi et al. [24] listed several bad urban environment circumstances. These studies indicated that drone sanitization required proper nozzle, tank, and operating mechanism selection.

Fig.3. Application of drones for sanitization during COVID-19 pandemic (Singla 2020)

4.1 Tank Materials

Disinfection drone design relies heavily on the tank material. Make sure you use rust-proof metal while constructing the tank. Polyethylene plastic, stainless steel, and fiberglass are currently used for sprayer tanks. Sanitizers can cause corrosion in some materials. Always be sure your parts are going to work together before you buy them. Never use plastic, aluminum, or galvanized steel tanks. As a result of chemical reactions, the tank's sanitizer may lose its effectiveness, and the tank may rust or corrode. Keep tanks clean to prevent corrosion, scale, dirt, and other impurities from causing damage to the pump and nozzles. Chemical flow can be impeded by contamination in the nozzle, leading to undesirable spray patterns and application rates. Pick a container that has a hole in the bottom for complete water removal. A sump in the bottom of a tank is preferable to any alternative. The top access must be generous in size to facilitate inspection, cleaning, and maintenance within. Insecticide dosing requires knowledge about the tank's capacity. Capacity indicators can be seen on the sides of most contemporary tanks. Include a sight gauge for the fluid level in the tank if it is not transparent.

This review paper concludes that polyethylene is the best material for tanks since it is inexpensive, widely available, and relatively lightweight. Due to its compatibility with the environment and its lack of chemical transmission into disinfected products, polyethylene tanks are risk-free. Since it's lightweight and replaceable, it helps keep the drone from getting too top heavy. Since these components are easily accessible, the drone's performance will improve. In Table 4 we see a variety of tank materials.

Table 4. Comparative Analysis of Tank Materials

S. No.	**Material Used**	**Capacity (L)**	**Shape**	**Color**	**Temperature (°C)**	**Pressure (Bar)**	**Weight (Kg)**	**Application**	**Advantages**	**Disadvantages**
1	Aluminum	2	Cube	Black	148	1.5	1.2	Car Water Pump	Resistant to UV radiation Good conductor of electricity	More rare and more expensive than steel
2	Plastic	2.34	Cuboid	Translucent	80	1.18	0.198	Water Storage	Plastic is strong,good and cheap to produce Plastic is one of the unbreaka	Plastic is a nonrewnable resources
3	Fiberglass	2	Cylindrical	Translucent	93	2.4	0.270	Store chemical	Light weigh,long spans available with a seprate stuctural frame High	Poor ventilation Uv senstitive unless
4	Polypropylene	2	Cylindrical	Milky White	121	1.2	0.110	Kitchenware	More easily repaired from damage Relatively inexpensive	High flammability Susceptible to oxidatio
5	High density polythene	2	Cylindrical	White	173	1.9	0.230	HDPE water bottle	Recyclable, eco-friendly material No flame used for joining, with	Sensitive to stress cracking Poor weathering
6	Carbon fiber	2	Cylinder	Black	200	2.7	0.068	Light wt. (car parts)	High stiffness and strength Lightweight Corrosion resistanc	High Cost Not suitable for alcohol
7	Glass	2	Bowl Shaped	Transparent	149	1.93	1.6	Aquarium	Transparency Dustpro of UV Stable Sustainable Material	High Cost Brittleness Heat Transpar
8	Copper	2	Cylindrical	Opaque	60	5.39	1.2	Water Dispenser	Copper is a naturally corrosion resistant metal Malleability and	Highly Reactive Cost more than plastic

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9	Titanium	2	Cylindrical	Grey	386	36	1	Fuel Tanks	Corrosion Resistant Excellent biocompatibility Ductile Fatigue Resistance Low Young's	Notch sensitivity Poor wear characteristics Relative

4.2 Nozzles

Researchers have provided a number of parameters which effect the life of base materials dealing with slurry suspensions [26-35, 39-42]. Components of drone like nozzle are the best examples for such studies. Nozzles are important in drone sanitization because they mark a target zone to spray either COVID-19 sanitizer or pesticide or fertilizer for agriculture. Nozzles control output flow while maintaining internal and external factors such liquid volume, viscosity, and nozzle shape and size. Nozzle turns blended fluid into desired-shaped and inter-droplet space droplets. Nozzle design prefers brass, plastic, nylon, stainless steel, hardened stainless steel, and ceramic. The most popular nozzle is brass, which is cheaper but wears out faster. Harder metal or material nozzles wear less despite their higher cost. Their use is expensive. When exposed to high-quality chemicals, nylon nozzles swell, making them economical and wear-resistant.

The most typical problems experienced during the actual application procedure are streaks and a clogged nozzle. To avoid streaking, it is essential that the sanitizing liquid be consistent so that it is distributed uniformly throughout all nozzles. Each nozzle on a sprayer must be filled with the same quantity of disinfectant solution. If there is a discrepancy between the amounts of sanitizer liquid supplied by neighbouring nozzles, streaks may appear. There must also be consistent monitoring of the flow rates of each nozzle in relation to the other nozzles. There is roughly a 10% discharge tolerance for a nozzle. if the number of discharges is too high or too low to attain this threshold, adjust the nozzle accordingly. One of the most common and annoying problems with sprayers is a nozzle that becomes clogged. Using the appropriate strainers and filters in the appropriate locations helps alleviate this issue while simultaneously decreasing nozzle wear. The sprayer system's nozzle comprises primarily of three strainers: tank fill strainers, line strainers, and nozzle screens. PVC nozzles were selected because they are readily available and resistant to corrosion. The PVC nozzle has the greatest advantage as compared to others since it allows for a constant and steady stream of liquid (water or chemical). The selected material also reduced flow and frictional resistance in the fluid

Table 5. Nozzle materials with their advantages and disadvantages

S. No.	Material Used	Advantages	Disadvantages
1	Stainless Steel	• Low coefficient of friction • Increase resistance of low alloy steel	• Poor fatigue and corrosion resistance • Distortions due to high temperature
2	Polypropylene	• Increases with rate of temperature	• Only for continuous domain • Difficult to converge

3	ABS Plastic	• Light and strong • Excellent chemical resistance	• Poor mechanical strength • Subject to heat deformation
4	Brass	• Brass nozzles have better thermal conductivity.	• Brass nozzles are cheaper and easier to machine and have better thermal properties.
5	PVC	• They permit high smooth and undiminished flow of water	• They possess higher coefficient of expansion as compared to the cast- iron or galvanized iron pipes.
6	Copper	• No chemical reaction occur during processing.	• Limited service temperature performance.
7	Plastic	• Thermosets generally form stronger durable chemical bonds.	• Constant pressure required during curing. which can cause mechanicals stresses.
8	Aluminum	• Corrosion resistant • low maintenance light weight • flexibility	• Lower strength than steel • less flexibility on bolt circles • limited mounting heights
9	PVDF	• PVDF material suitable for harsh environmental conditions. • Temperature compatibility of PVDF material up to 140° C.	• PVDF is easy to dissolve in several organic • Solvents like N-methyl-2-pyrrolidone (NMP), N,N-dimethylformamide(DMF),N,N-dimethylacetamide (DMAc), acetone and Tetrahydrofuran (THF)
10	Bronze	• The brass nozzles are the standard nozzles as they are the most affordable.	• Lower strength than steel • less flexibility on bolt circles
11	ABS Plastic	• low cost • easily available	• Inflexible to variations

5 Conclusion

The literature on materialistic drone sanitization applications yielded the following findings. In recent decades, aerial robots, especially smaller UAVs and drones, have advanced in structure, operating methods, flying features, and navigation control. This is drone-specific. This applies especially to UAVs with modest payloads. Their prevalence in wealthy nations necessitates distribution control. Many industries, including product delivery and cleaning, use drones despite early commercialization. This paper analyses UAV utilization throughout the previous decade using data from multiple scholarly sources. Sanitation researchers used

UAVs to gather key points. This study assists experienced and rookie researchers. This article is appealing to novice and seasoned researchers because it condenses the vast literature on materialist drone sanitation.

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