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Affordable UAS Manufacturing; From Home

The rise of unmanned aerial systems (UAS) in the previous 10 years has revolutionized the aviation industry in more ways than one. It has allowed companies to find creative solutions to previously unsolved problems. It has also opened a new hobbyist side of UAS. Companies such as DJI and Parrot have created various UAS lines for the average consumer. The issue many people have with these products is the cost factor. Entry-level UAS costs around $300 but is also very limited in functionality and proprietary; they can only use parts manufactured by the parent company. While some people may want to take the safe route of staying with a single company, another market wants to have the freedom of interchangeable parts and repairability. A new route many people are seeking is implementing 3D printing with UAS flight, which can be very cost-effective in the long run.

The first is to consider why 3D printing a UAS is practicable. The most considerable appeal of 3D-printed UAS is their customizability and repairability. Several designs online allow the user to create a UAS that meets their specifications. For some people who want to make a racing drone, several designs online are lightweight and designed for certain classes of competitive racing or smaller and lightweight quadcopters for use within the house (*Firefly Pro - fully 3D printed racing drone*). If there is no design online that is to someone's liking, they can create a

UAS frame with some computer-aided design learning. The versatility to customize parts is a massive draw to the world of 3D-printed UAS. The other appeal of 3D printing parts is the ability to repair broken or defective parts. If someone decides to purchase a proprietary manufactured UAS, costs can rise very quickly and can create a total financial loss for the aircraft (*Buy camera drones - DJI store*). If there is a part that needs to be repaired for a 3D-printed UAS, the reprint costs can vary from a couple of cents to, at most, a couple of dollars. For example, the average roll of filament is $20 for a 1kg roll, around 2 cents per gram to print (*Overture PLA 3D printing filament*).

The next step for 3D printed UAS is arguably the biggest part of the process: choosing the 3D printer to use. While this seems like an inefficient purchase, seeing that some printers cost more than other entry-level UASs, it is important to determine the use factor of the printer. While purchasing a $500 printer won’t make much sense financially, it is important to know your mission with 3D printing UAS parts. If it is in furtherance of a business and there is use for it over the years, it could be seen as more practical than a hobbyist using it to get into the world of UAS. There are several factors in choosing the right 3D printer, the biggest being the build plate size. There are two main build plate sizes on the market: standard and mini. The mini build plate will be more affordable for most consumers but will limit the user on the size of parts they’re able to print. If the goal is the most affordable but quality printer, the best purchase for affordability would be the Bambu Lab A1 Mini, which retails for $200 online (*Bambu lab A1 Mini 3D printer*). It is a quality printer that can print fast and consistently, with its only drawback being the smaller build plate size, but it should be able to handle most prints.

After obtaining a 3D printer, the next choice is what filament to use. Polylactic acid (PLA) and polyethylene terephthalate glycol (PETG) are the most common beginner filaments. PLA filament is derived from renewable sources, like corn and cane sugar, and is more ecologically sustainable than most plastics. It is considered the most beginner-friendly filament due to its ease of use and print reliability. Still, it is drawn back on its brittleness and weakness, which lack substantial internal support. PETG is derived from oil-based sources and is considered an upgrade from PLA, which has better strength in almost every category. While this inherently seems like a net positive, it comes with some more challenging prints, higher temperatures required to print, and is prone to warping if not handled correctly (*Pla vs PETG - which filament is right for me?*). Another type of PLA, PLA Air, is considerably lighter than the original PLA, created explicitly for aerial applications such as UAS. While there are tradeoffs, it is entirely up to the builder or designer to determine the best filament for their purpose.

Arguably, the most critical part of any UAS is the electronics. Several parts to a UAS make it fly. They are starting with communicating with the UAS, the transmitter, and the receiver. Most smaller UAS receivers will have an electronic speed controller (ESC) for all four motors built in. Similarly, ESCs are considered carburetors; they regulate the motor’s power to give a specific output. The receiver receives the input the operator provides via the controller/transmitter. These can usually be bought online for more advanced versions at $15 to $50. The transmitter should be purchased in conjunction with the receiver to ensure compatibility.

The motors are the aircraft's powerhouse and vary depending on the designer's and mission's power requirements. Most motors will have standard mounting, so some interchangeability depends on motor size and mounting. Remember that motors positioned diagonally must rotate in the same direction, but ones adjacent to another must rotate opposite. Ensure that the propellers are to the specifications of the motors as well. Almost all UAS will use some form of a LiPo battery, and whenever you decide on a receiver, ensure that the battery is compatible. Otherwise, you risk overloading the board and risk causing a fire.

The assembly portion of the UAS should be straightforward for most people. The tools required vary from aircraft to aircraft, but most people can expect to use some screwdriver and soldering iron. Make sure other tools, such as a knife and contact adhesive, are readily available, as minor adjustments may be required. After assembling the UAS, the next step would be to install the required software on the board. The best open-source software for programming a quadcopter would be “BetaFlight,” as this has a large community and can help program and configure any UAS to specification. Use other online guides to help you through this process, as it can get relatively complicated for the uninitiated.

Overall, building your own UAS can be tedious but fun and rewarding. There is already a community out there that has thrived on building off each other’s work and ideas and is continuing to evolve. With more advancements in 3D printing technology and electronics shrinking in size, the possibilities for the future of homemade UAS production are endless.

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