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Introduction to Small Unmanned Aircraft Systems

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History of GIS

At its core, GIS or Geographic Information System is a tool utilized by many professionals to blend elements of cartography and data science. The rise of the digital age saw many technological advancements, although a lesser-known advancement, GIS software is undoubtedly a significant contributor. According to Jessica Aguirre, for the Smithsonian Magazine, Roger Tomlinson is widely credited for creating the first Geographic Information System. Throughout the years since its creation, Geographic Information Systems have gotten more complex and allowed people around the globe to spatially conceptualize the world better. (Aguirre, 2014) As geographic information system technology advanced, so did its adoption. Laura Tate wrote an article for Geospatial World where she highlights what the "second phase" of GIS development was like. "The second phase of development in GIS history occurred throughout the 1970s, and by the 1980s the concept progressed as national agencies adopted it, and invested parties began determining best practice." (Tate, 2018) This second wave of GIS development cemented the utilization of GIS technology. Currently, GIS is so prevalent, and most people interact with an aspect of GIS every day.

Importance of data

Data is the most pivotal component of any GIS project. Without relevant and accurate data, even the most experienced GIS analyst is going to have trouble. Caitlin Dempsey wrote about the importance of data in her article for GIS Lounge. “Data is the core of any GIS. There are two primary types of data that are used in GIS: vector and raster data.” She continued, “There are many different ways that GIS data can be collected. Heads up digitizing (the process of tracing GIS data directly on the screen), LiDAR, drones, GPS, and satellites.” (Dempsey, 2019) In the past aerial imagery was most often captured through photos taken from manned aerial vehicles. While this is an effective technique, the rise of unmanned aerial systems made gathering aerial imagery much more practical. Devon Humphrey, in an interview with Matthew DeMeritt for Esri, elaborated on the benefits of UAVs. He said, “Due to the unique flight characteristics of UAVs, the imagery is sharper and offers some unique advantages. Drones fly very low compared to manned aircraft.” He continued by saying, “Turnaround time is a few hours, instead of days, weeks, or months in the case of traditional delivery times.” (DeMeritt, 2019) UAVs have many benefits over traditional methods, which will be elaborated on later. But the ability for UAVs to capture accurate data is their strongest asset.

Drones and GIS

UAV technology is proving to be a vital tool that should be a part of any GIS worker’s toolkit. As previously stated, aerial imagery captured by a drone has many benefits over traditional aerial imagery gathered by plane or helicopter. However, UAVs are also often much cheaper than their alternatives. An article for Landpoint talked about the benefits of UAVs for GIS. “The difference is that UAVs provide a quicker, less expensive, and more hassle-free way togather data that GIS mapping services require. (Souter, 2017). These are not the only benefits that UAVs can have in GIS. For professional work, drones are often equipped with sensors that

allow for more in-depth data collection. For example, drones are being heavily utilized in the precision agriculture field. These drones are equipped with LiDAR, thermal, NDVI, and multispectral technology. When the data gathered by drones are used in conjunction with GIS software, the resulting product is revolutionary. In an article for Drone Zon, Fintan Corrigan wrote about the effects that multispectral cameras can have on farming yield. "Multispectral images are a very effective tool for evaluating soil productivity and analyzing plant health.

Viewing the health of soil and crops with the naked eye is very limited and is reactionary. Multispectral sensor technology allows the farmer to see further than the naked eye." (Corrigan, 2020) The impact of drones in precision agriculture is already vast, and it is only in its infantile stage. The impact of this technology, when used in conjunction with GIS technologies, will only continue to grow in the precision agriculture industry, as well as a variety of others.

Software

There is a lot of different software that has been developed to allow more accessibility to gather data through drone flights. Some examples of these programs are, DroneDeploy, Pix4d, OpenDroneMap, and many more. DroneDeploy is often seen as the most user-friendly of the bunch but is still incredibly powerful. Whether you are a hobbyist, or a professional DroneDeploy can be very useful. In an article for Forbes, Amit Chowdhry wrote about DroneDeploy. "DroneDeploy is a company that builds cloud-based software for drone mapping, making it possible to create aerial maps and 3D models with a single click. DroneDeploy's software automates drone flight and makes it easy to capture aerial data with a mobile app." (Chowdhry, 2017) This is just one example of a drone mapping software that is leading the charge in drone-captured aerial imagery. These applications are being implemented in a variety of industries such as agriculture, mining, archaeology, surveying, and more. The ease of use

combined with the extremely valuable data gathered has made these applications vital to some of the success of these industries.

Limitations

Unfortunately, there are some limitations to drone-captured imagery. The first limitation is battery life. Battery technology has not yet reached a point that would allow UAV flights to reach optimal levels (at least at a commercially viable price-point). However, emerging technologies such as hydrogen fuel cells may alleviate this issue. In an article for the EE Times, Maurizio Di Paolo Emilio talked about the benefits that hydrogen fuel cell-powered drones could have. “The increased flight time, coupled with rapid refueling, opens a wide range of new business possibilities for companies using drones for offshore platform inspection, search and rescue operations, high-quality aerial photography, precision agriculture, deliveries and more.” (Emilio, 2021) Although hydrogen fuel cell-powered drones may not ultimately be the answer to the current flight time limitations, it is a promising and developing technology. The second limitation many UAV operators run into is FAA restrictions. The FAA currently restricts UAV flying to visual line of sight only (VLOS). This is problematic as many GIS projects require large amounts of data over large areas. Because the FAA has the restriction, it greatly increases the amount of time this data gathering takes. The future does not look bleak, however. Accordingto Jed Pressgrove, in an article for Government Technology, the FAA seems to be aware of this issue. He said, “The FAA released the BVLOS (beyond visual line of sight) waiver guide for first responders last week during its annual Unmanned Aircraft Systems Symposium. If the waiver is granted to an organization, BVLOS flights must comply with a variety of spatial regulations and only be performed when necessary.” (Pessgrove, 2020) This is a *slightly* more relaxed approach than the FAA has previously taken on this topic. And although

this is not exactly the news many commercial drone operators were hoping to hear, it is undoubtedly a step in the right direction.

Conclusions

UAVs are becoming an essential component of GIS development. In an article for Mapware, Jeff Brooks said it best. He said, “The ability of GIS to display complex geospatial information in a meaningful way, and UAVs’ ability to collect the requisite data quickly and inexpensively, make these two technologies an outstanding combination.” (Brooks, 2019) Brooks perfectly describes what makes GIS and UAV technology so great. They complement each other and when used in conjunction create a more polished final product. The use of UAVs for GIS purposes is slowly rising with the introduction of new technology. The adoption of UAVs must continue to grow for the betterment of GIS as a whole.

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