3D Mapping and Surveying using Unmanned Aerial Vehicle

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***Abstract*—Surveying is one of the important aspects of any civil engineering project, traditional survey and inspection methods involve a lot of labor and time, also the equipment used is heavy and requires specialist knowledge. But with the help of UAVs (Unmanned Aerial Vehicles) the time and effort for surveying or inspecting large areas and structures will reduce exponentially. This is achieved with the help of sensors such as Cameras, Lidars, Sonars, thermal cameras etc. that are attached to the UAV. Since most UAVs fly with the help of GPS satellites, coordinates of these places will be easily obtained. Software like Drone deploy, Pix4D, Precision Mapper etc. help in creating accurate and usable survey data. With the help of such systems 3D models of land and assets can be made. UAV technology is thenext big thing in the world of survey.**

Keywords—3-D Mapping,Unmanned Aerial Vehicle

I. INTRODUCTION

UAVs are the next advancement of technology in the field of civil. It is simple, easy to use, portable, time consumption is less, better coverage etc. Studies state that UAVs can bring up more development not only in civil but also in many other fields.

UAVs are the best alternative in the area of surveying in civil. It is used in different areas like remote sensing, search and rescue operations, monitoring and surveillance, fire fighting etc. UAVs provides safer access to assets which are dangerous, hazardous or difficult to access like high voltage power line and towers. Thus, it helps in reducing the effort taken in manual surveying. These are remotely controlled aircrafts, thus making this unmanned. Manual surveying requires many laborers and also it is time consuming.Aerial surveying conserves the natural ecosystems. This way of surveying is applied by flying a drone (UAV) at a particular orconstant height and speed.

UAVs consists of a camera, sensors and copter wings. It captures the aerial view with help of downward-facing camera and the sensors. This helps to survey large area or route. The camera will take the photographs of the ground area, to be surveyed, several times from different angles and every single image is tagged with the coordinates.

Photogrammetry is a software that combines the images taken using the drones that contain the same point on the ground from different vantage points to yield detailed 2D and 3D mapping. It also can create geo-referenced orthomosaics, altitude or elevation models, or 3D models of the area. These maps can also be used to know the information like surface area, volume, distances etc. Drones fly at high and low altitudes so that it can capture a high-resolution photograph with high accuracy data. It is less expensive as well as faster. It is five times faster than land-based methods and also with lesser number of workers. With one flight of drone, it captures thousands of photographs which can be represented in the formats like orthomosaic, point cloud, DTM, DSM, contour lines etc. The produced map or point of 3D model contains 3D geo-data in each pixel.

Aerial mapping allows drones to survey anywhere. No limitations are there. In the most difficult areas as well the drones provide best accuracy in the map. The photographs taken are uploaded in the photogrammetry software(drone- deploy). After compilation the map is produced as 3D construction which show the required values like area, surface area, volume, elevation etc. Compared to traditional monitoring techniques using sensors drones enable more data collection with accuracy. By the invention of drone surveying the development in many areas became more faster than before

A. Aim

- To compare conventional surveying and 3D

mapping with photogrammetry-Validation of software
- To compare past data that was collected when the college was surveyed against the new 3D model that isgoing to be made

B. Comparison to be done
- Time taken to survey and map any civil structure
- Future uses of the data obtained.
- Usability of data obtained

C. UAVs are classified based on the payload:

TABLE 1:CLASSIFICATION OF UAV

Nano Drones	250gm
Micro Drones	250gm to 2kg
Small Drones	2kg to 25kg
Medium Drones	25kg to 150kg
Large Drones	Above 150kg

II. LITERATURE REVIEW

Unmanned Aircraft System Applications in Construction by Mark C.Tatum et.al Use of photographs taken from various angles to create 3D maps and models of existing structures.

CLASSIFICATION OF AERIAL PHOTOGRAMMETRIC 3D POINT CLOUDS by

C. Becker et.al

The scope of the presented work is the performance evaluation of a UAV system that was built to rapidly and autonomously acquire mobile three-dimensional (3D) mapping data.
A novel program for photogrammetric flight planning and its execution for the generation of 3D point clouds from digital mobile images is explained and a performance model for estimating the position error was developed and tested.

Unmanned Aerial Vehicles (UAVs): A Survey on Civil Applications and Key Research Challenges HAZIM SHAKHATREH 1 et.al The use of unmanned aerial vehicles (UAVs) is growing rapidly across many civil application domains, including real-time monitoring, providing wireless coverage, remote sensing, search and rescue, delivery of goods, security and surveillance, precision agriculture, and civil infrastructure inspection. Smart UAVs are the next big revolution in the UAV technology promising to provide new opportunities in different applications, especially in civil infrastructure in terms of reduced risks and lower cost.

III. METHODOLOGY

Survey can be done with a drone and a camera attached to it. The images are taken in 70:30 overlap or 80:20 overlap
i.e. 70% of the new photo should have 30% of the previous photo. Comparing this with traditional survey methods, it is found that the same data can be obtained in a much lesser time with the same accuracy; this brings a huge reduction in time, cost and workload of specialists who do the survey.
With a drone ,surveying can be done in two ways mainly; it can be done using automated flight paths that is certain photogrammetry software with the help of Google Maps can create flight paths for a drone and once this flight path is uploaded into the drone the drone automatically follows the flight path while taking high resolution photo, The other way is to manually fly the drone over the area that is to be surveyed and the asset To be 3D mapped
Automated drone survey: This is done by selecting the area that is going to be surveyed on Google Maps after selecting the area to be surveyed the software automatically creates a flight path this flight path can be set to user specifications as well the flight path is generally done in a cross hatched pattern to get maximum satisfying 3 di maps. Once the flight path is uploaded into the drone the drone automatically takes off and covers the flight route with extreme accuracy in case off low battery the drone lands where it took off or lands at its home point where the battery can be swapped for a new one. As the drone flies the flight path it takes for high resolution photos and after completion of the flight path these photos can be uploaded Do any photogrammetry software.
Manual drone survey: Done by flying the drone manually over different parts of the land that is to be survey in most cases the drone is initially flown over the land while the cameras face downward and at a fixed altitude the photos are taken. And then the drone is flown at lower altitudes while the camera is pointed at an angle do the subject. The drone is then flown in circles around the asset at different altitudes to get maximum coverage and after these photos are taken they are uploaded into a photogrammetry software where further processing is done.
Photogrammetry software: A photogrammetry software uses photographs and location data to create orthomosaic models 3D map and models etc. the software users the location data that comes with an image and with this data it creates accurate maps within this software we can measure various volumetric parameters. The maps and models made using the software can be directly exported into CAD software, The exported file can be used do plan and render future projects before it has even started in the real world.

A. Some Common Errors
- Poor ground control placement or layout.
- Images with high ISO
- Coordinates for the known point are not enteredcorrectly
- Poor flight layout and settings that yield blurry

orthomosaics.

- High amount of data for the computer
- Stitching issues
- Systematic errors due to the camera issues

IV. OUTPUT

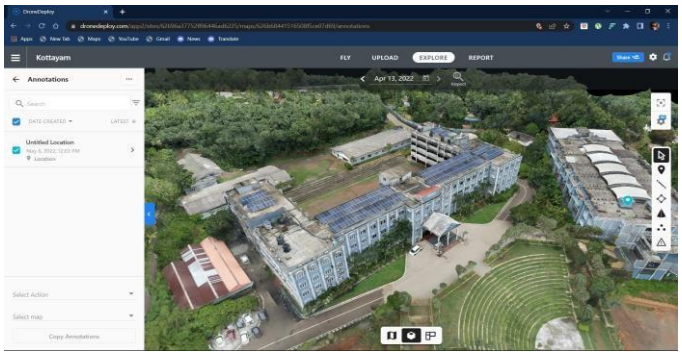

FIG 1. EXAMPLE OF A 3D MAP

A .Validation of software

TABLE 2: COMPARISON OF AREA

Method of survey	Area obtained
Conventional survey using tape	444 sq.m
Survey using Unmanned aerial Vehicle	400.76 sq m

V CONCLUSION

Surveying is one of the important aspects of any civil project. Traditional survey and inspection methods involve a lot of labor and time. With the help of UAVs (Unmanned Aerial Vehicles) a.k.a Drones, the time and effort for surveying or inspecting large areas and structures will reduce exponentially. UAV can help us survey and create 3D models of far away places that are dangerous and inaccessible. It also helps in inspecting old abandoned structures, bridges, mines etc.

The software drone deploy is validated by selecting a small portion and area is calculated and compared with area obtained using conventional surveying technique.

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