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LATEST TECHNOLOGIES HANDHELD 3D SCANNING AND PHOTOMODELLING THE EYESMAP TABLET

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Abstract

In this presentation we are focusing on the latest technologies for 3D scanning and photomodelling. As the needs for better land survey and better digitalisation of the real word, such as buildings, archeological sites, nature, etc., grew larger and with the implementation of new technologies, many innovative devices have been created as to ensure the best result for real world 3D surveying. This is the case of the device presented in this project, the EyesMap tablet. Implemented by Ecapture, this handheld device gives its user the freedom of use and a full solution in just one device. EyesMap ensures full data processing, by acquisitioning data using the embedded cameras and also using the embedded depth sensor and direct processing of such data on its own EeysMap Software. EyesMap is the 3D modelling solution available to your fingertips.

Key words*: photomodelling, 3D SCANNING, EyesMap.*

INTRODUCTION

Surveying or land surveying is the technique, profession, and science of determining the terrestrial or three-dimensional position of points and the distances and angles between them. Surveyors work with elements of geometry, trigonometry, regression analysis, physics, engineering, metrology, programming languages and the law. They use equipment like total stations, robotic total stations, GPS receivers, retroreflectors, 3D scanners, radios, handheld tablets, digital levels, drones, GIS and surveying software.

Surveying has been an element in the development of the human environment since the beginning of recorded history. The planning and execution of most forms of construction require it. It is also used in transport, communications, mapping, and the definition of legal boundaries for land ownership. It is an important tool for research in many other scientific disciplines.

Surveying instruments have characteristics that make them suitable for certain uses. Theodolites and levels are often used by constructors rather than surveyors in first world countries. The constructor can perform simple survey tasks using a relatively cheap instrument. Total stations are workhorses for many professional surveyors because they are versatile and reliable in all conditions. The productivity improvements from a GPS on large scale surveys makes them popular for major infrastructure or data gathering projects. One-person robotic-guided total stations allow surveyors to measure without extra workers to aim the telescope or record data. A fast but expensive way to measure large areas is with a helicopter, using a GPS to record the location of the helicopter and a laser scanner to measure the ground.

Figure 1. Surveying equipment: optical theodolite, robotical total station, optical level, RTK GPS base station

MATERIALS AND METHODS

As the needs for better land survey and better digitalisation of the real word, such as buildings, archeological sites, nature, etc., grew larger and with the implementation of new technologies, many innovative devices have been created as to ensure the best result for real world 3D surveying.

A 3D scanner is a device that analyses a real-world object or environment to collect data on its shape and possibly its appearance (e.g. colour). The collected data can then be used to construct digital three-dimensional models.

Figure 2. Lidar scanner that can be used for creating 3D models for buildings

Many different technologies can be used to build these 3D-scanning devices; each technology comes with its own limitations, advantages and costs. Many limitations in the kind of objects that can be digitised are still present, for example, optical technologies encounter many difficulties with shiny, mirroring or transparent objects. For example, industrial computed tomography scanning can be used to construct digital 3D models, applying non-destructive testing.

Collected 3D data is useful for a wide variety of applications. These devices are used extensively by the entertainment industry in the production of movies and video games. Other common applications of this technology include industrial design, orthotics and prosthetics, reverse and prototyping, quality control/inspection and documentation of cultural artefacts.

Handheld laser scanners create a 3D image through the triangulation mechanism: a laser dot or line is projected onto an object from a hand-held device and a sensor measures the distance to the surface. Data is collected in relation to an internal coordinate system and therefore to collect data where the scanner is in motion the position of the scanner must be determined. The position can be determined by the scanner using reference features on the surface being scanned or by using an external tracking method. External tracking often takes the form of a laser tracker (to provide the sensor position) with integrated camera (to determine the orientation of the scanner) or a photogrammetric solution using 3 or more cameras providing the complete Six degrees of freedom of the scanner. Both techniques tend to use infrared light-emitting diodes attached to the scanner which are seen by the cameras through filters providing resilience to ambient lighting.

As needs for 3D modelling changed in the past years, new solutions have been implemented for 3D scanning and photomodelling. But also as the technology went on developing, the devices became each time harder to use and handle. It became a general problem for 3D modelling in general.

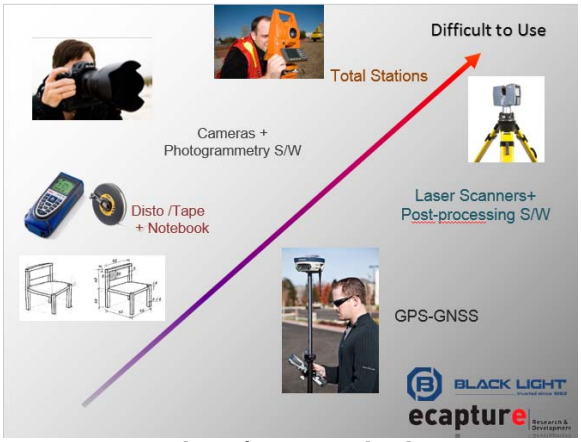

Figure 3. Chart of surveying development and its difficulty of use

This was the starting point for 3D modelling expert companies to begin designing and implementing new solutions that can offer its users an easy to use, light weight device, as also a full data processing directly on the field without needing an external computer and other software.
This is the case of the handheld tablet designed and offered by Ecapture called EyesMap.

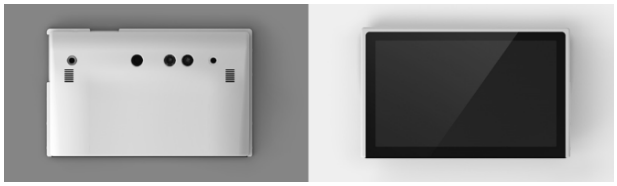
Figure 4. Ecapture EyesMap 3D scanning tablet

Using this device, the users can obtain points, distances and surfaces measured by just touching the screen using their fingertips.

The EyesMap embedded software allows its users to create 3D models using the following possibilities:
- 3D Photomodelling: a powerful automatic 3D point cloud generator for small, medium and large objects. This tool generates point clouds using multiple overlapping images. This images can be done with any external camera, but also with the embedded stereo cameras.

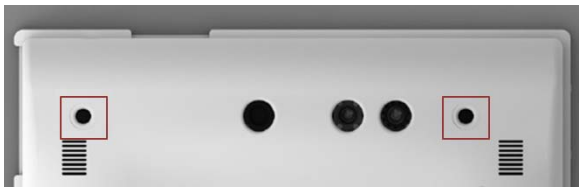
Figure 5. The EyesMap stereo cameras

This tool uses the principle of triangulation which means that it will create a point in 3D through two or more homologous points (2D) in different images. The point is calculated through crossing lines in the space (using the calibration and orientation data).

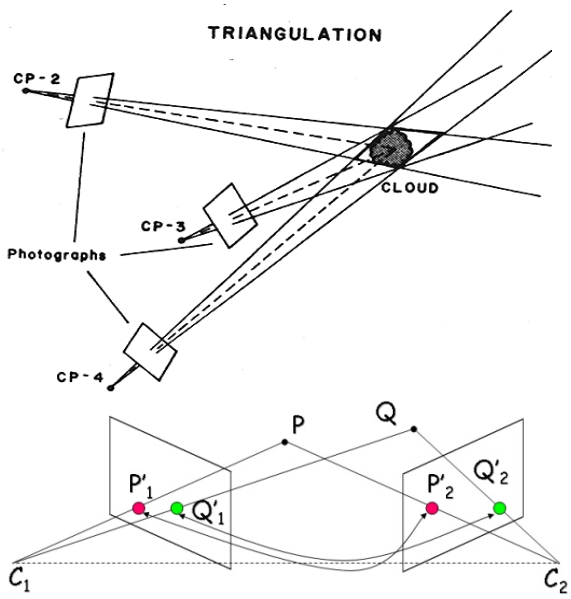

Figure 6. Triangulation method

- 3D Depth Sensor: Real time short range scanner. The depth sensor scanner is an easy and fast way to capture scenes indoors at short range distances (< 4m).
The user can get a 3D points cloud of the scene while moving (the entire object can be bigger than 4 meter). This tool is useful for: indoor scanning, (outdoors without direct sunlight), road accidents or crime reconstructions, industry motor engines or machines and so on.

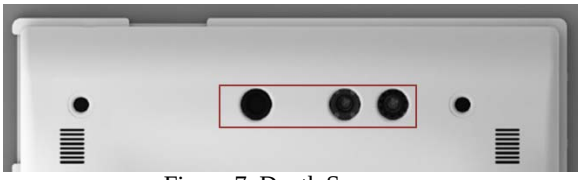
Figure 7. Depth Sensor

- Orthophoto: Automatic true orthophoto generator. Using this tool, true orthophotos can be easily generated automatically using images.

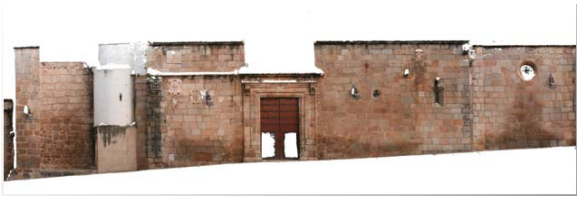

Figure 8. Orthophoto generated using images

- Georeference: this tool will georeferenced your data using GPS-GNSS GPS, GLONASS, GALILEO, QZSS, COMPASS & SBAS L1 Ideal for GIS applications. It can achieve sub-meter real time coordinates accuracy, or even better after post processing.

RESULTS AND DISCUSSIONS

Thanks to its easy to use design, the handheld tablet EyesMap can be used in a wide rage of applications, such as:

- Architecture / heritage. The EyesMap tablet can create 2D/3D facades and interiors, 3D/Orthophoto captures and it can be used for the process of buildings renovation, building change of use/destination.
- Archeology. The EyesMap tablet can create small objects 3D documentation, 2D/3D profiles of archeological sites, detailed full colored site documentation, GPS georeferencing.
- Road accidents reconstruction. The EyesMap tablet can create 3D reconstruction of road accidents, insurance 3D documentation, and instrument certification.
- CSI / Insurance: The EyesMap tablet can be useful for Crime Scene Investigations, Insurance investigation, home and labour accidents certification / traceability.
- Interior design.
- Industry. The EyesMap tablet can be useful for automotive industry, petrochemical industry, reverse engineering, as-built documentation.
- 3D video gaming / Entertainment industry. The EyesMap tablet can be useful for capturing virtual reality.
- Biology / Geology. The EyesMap tablet can create detailed 3D small animals capturing.

CONCLUSIONS

The digitalisation of real-world objects is of vital importance in various application domains. This is the main reason why devices as the EyesMap tablet is becoming an important tool in the 3D scanning and photomodelling market.

The general tendencies of 3D scannig experts is to create or the require devices that cand offer high quality results without forgeting about the need for ergonomic and easy to use designs. As result, this will be the main cause and effect for the implementation for new designs to go on and keep being developed in the need for reaching perfect digitalisation.

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