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Scanning indoor environments with Microsoft HoloLens 2 for interactive generation of floor plans

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Abstract:

Nowadays, 3D scanning is used in a wide range of fields, including relief and indoors mapping. However, the tools used in the scanning process may present drawbacks, regarding size, mobility, weight, real time data visualization, etc. Moreover, for the subsequent processing of the data, specialized staff and great amount of time are needed, increasing project complexity and cost, and thus restricting the use of these technologies. On the other hand, Mixed Reality devices have experienced a remarkable growth in later years, due to their nearly infinite uses. To address the former situation, the use of Mixed Reality device HoloLens 2 as a scanning tool is proposed, in order to achieve an intuitive, fast, and versatile experience. Furthermore, marker placement with the device is also proposed to help with data post-processing.

In order to accomplish this objective, three main sections are differentiated: data extraction, development environment and the creation of the scanning application. For the first section, Microsoft provides a tool, called "Windows Device Portal" (Microsoft Learn, 2024 b), that can be used with HoloLens 2 to visualize and extract information from the device. With this tool, some points were clarified: the scan is automatic, only a portion of the data near the device is loaded and different scanned environments can be stored and loaded automatically.

The second and third points are closely related: the familiarization with the application's development environment and the creation of the program itself. The main recommendations in the documentation were Unity along with the MRTK library, developed by Microsoft (Microsoft Learn, 2024 a), thus these two were chosen to develop the program. This allowed to detect hand actions and show basic objects with ease. Consequently, different markers were created to use within the app. One of them can be shot at the user's will, resulting in the addition of a tag to the mesh from a given list. Position markers were also developed, recording, with a configurable frequency, the user's position and orientation while scanning. The main control and the settings are accessible via a navigation menu located next to the user's wrist. Figure 1 illustrates how the application looks while in use.

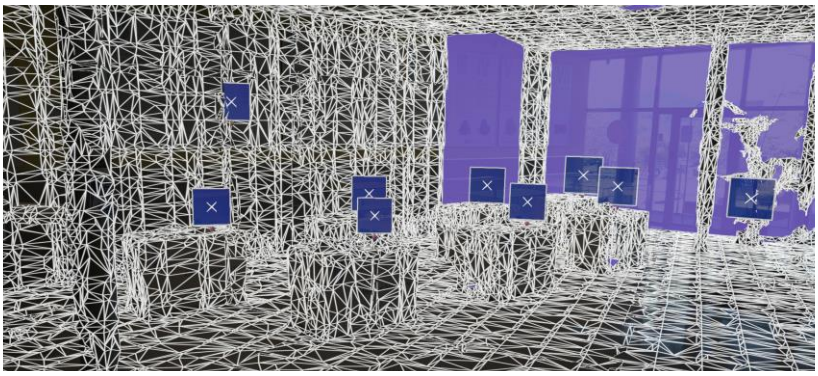

Figure 1: application view with tag markers added. Note: colors (especially black) are less intense when seen from the device, allowing a clearer view of the real world.

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The developed application was tested in two case studies: two adjacent classrooms and the first floor of the School of Mining and Energy Engineering (University of Vigo), measuring around 330m^2 and 200m^2 respectively. This space includes multiple areas of interest to test the app, such as reflecting surfaces, windows, stairs, multiple objects, etc. The scan was completed in less than an hour in both cases, and tag markers were placed during the scanning, later allowing to differentiate the different areas. Figure 2 illustrates the obtained results.

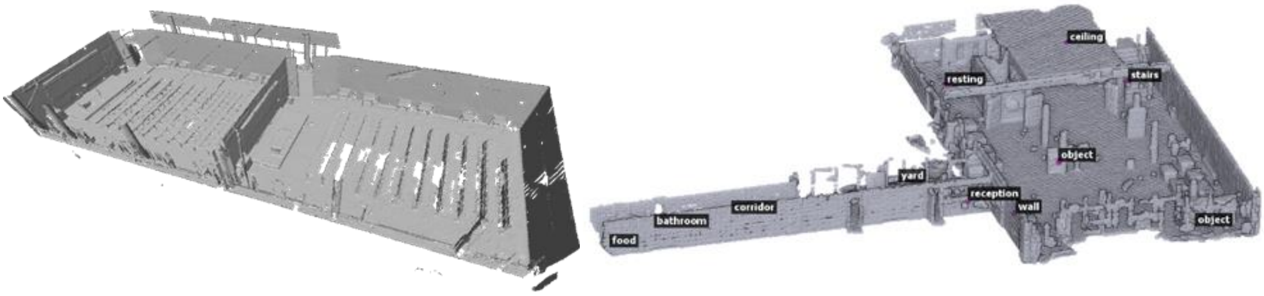

Figure 2: adjacent classrooms (left) and first floor (right) case studies. For the first floor, some tags are shown.

Moreover, for the classrooms case study, the obtained point cloud was compared to a previous scan performed with a Faro Focus3D X 330 TLS. As Figure 3 shows, most of the HoloLens 2 scan presents a deviation under 5cm in reference to the TLS. Greater distances belong mainly to occlusions or non-scanned areas in any of the two point clouds.

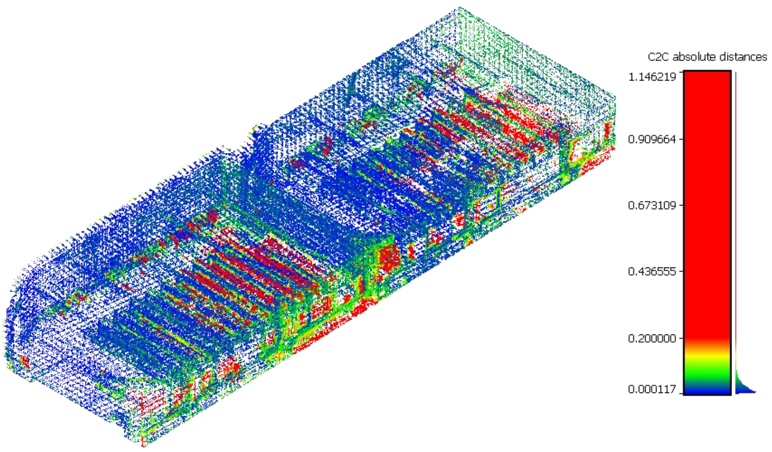

Figure 3: distance map between HoloLens 2 and Faro TLS point clouds

With these results, it is clearly stated that the developed application can be used to obtain a valid 3D scan, allowing further processing such as segmentation, mapping, data visualization and presentation, etc. The tag markers help to accomplish this purpose, since they are added by the user in-situ, allowing a more direct and precise classification.

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