Article Review: Experiencing Cultural Heritage Sites Using 3D Modeling for the Visually Impaired

Along with the difficulties of everyday life, visually impaired individuals also struggle with comprehending the world around them. Visiting museums and landmarks are often sub-par experiences for visually impaired individuals. 3D modeling of historic sites and landmarks has become more popular with the development of 3D printers. These models allow an individual to interact with the site and interpret the tactile feel of the model. In order to complete these models, Unmanned Aerial Vehicles (UVA) capture high resolution images of the sites. Then photo modeling software converts the images into 3D models with accurate scaled down characteristics such as distance, object size, and terrain. Before 3D printing was accessible, 3D models were very expensive and time consuming. The combination of these three technologies continues to enhance the experience of historical landmarks and museums for visually impaired individuals.

In this article, a 3D model of the historic site of the Curium amphitheatre was created. First, a UVA took over 300 hundred photos of the site. In order to insure the entire area was covered without irrelevant areas being captured, a predetermined path was created using GPS points. Then, those photos were rendered into a 3D model using Agsisoft Photoscan. The software compiled all of the photos together into a single model using geometric algorithms. After the model was printed using PLA plastic, it was displayed at the Curium museum. The model was effective in creating a tactile feel for the site. Along with Braille captions, the patrons were able to interact with the model, allowing them to create a sense of spacial awareness for the amphitheater. The technology of the UVA is not invasive, and using a 3D model is relatively inexpensive. The UVA itself and the software use to create the model is where most of the cost comes from.

The information and technology discussed in this article is not directly related to Staff of Gandalf, but it provides insight to the importance of tactile feel within the visually impaired community. Blind people often use their other senses to make up for their lack of vision. Their sense of touch is a major method used to interpret their surroundings. Further on down the road, the Staff of Gandalf will be equipped with a haptic panel that can form a 3D image of the obstacle in front of the user. This specific imaging allows the user to more practically interpret their surroundings. The process of rendering a 2D image into a 3D model could help in the development of this panel. The staff could have a camera attached to it, and using a software like Agisoft Photoscan, could turn the images into a 3D model that could be output by the pin array.

Article Review: Application of Ultrasonic Sensors in Road Surface Condition Distinction Methods

Unforeseen differences in terrain is a major cause of slip and fall accidents for elderly and visually impaired individuals. Wet surfaces cause unexpected instability, and rocky terrain provides an unstable surface to walk on. Movement support systems like wheelchairs and walking canes help with mobility, but they can malfunction when they come in contact with a puddle or lawn. Ultrasonic sensors are commonly used to measure the distance of an object by determining the speed at which the sound wave is echoed back. Instead, if the intensity of the echoed wave is measured, the type of surface can be detected. Many Electronic Transport Aids are equipped with moisture sensors that can detect water, but these are only effective if the device is already submerged in water. With this new system of detection, water can be avoided all together.

This article discusses the results of an experiment where different road conditions were tested using ultrasonic sensors. Four different textures were tested: assault, grass, puddles, and soil. The sensors were all placed at the same distance from the surfaces. A 40 Hz wave was sent out from the sensor, and the frequency of the returning wave was measured. If the frequency returned was weaker than the original signal, then the surface is rough. Based off of the data collected, a trend was able to be detected and used to identify which of the four surfaces was being tested. The puddles had the highest voltage return, then asphalt, followed by grass and soil. Two equations for thresholds were determined to identify whether or not the surface was asphalt. If the frequency was above threshold 2, and below threshold 1, the surface is asphalt. The equations are exponentially dependent on the distance away an object is. Using the sensors and the corresponding equations, an effective method of surface detection was generated.

In future prototypes of Staff of Gandalf, surface detection technology could prove to be very useful. Being able to alert the user of a wet surface or sudden change in terrain could help prevent slip or falls. The staff is already equipped with ultrasonic sensors, so adding more sensors would be relatively easy. The tricky part would be to make the microcontroller detect a change in frequency rather than distance. Because every surface absorbs a small amount of sound, the frequency returned will always be lower. Determining the correct thresholds for specific surfaces such as carpet, tile, and sidewalks will be a vital part of the research. This technology could also be be beneficial for the auto industry. If the system could predict ice, or a car running off the road, it could send that information to the car’s computer and the proper safety actions could be taken. There is a lot of possibility of use for this technology, but at the current state of the prototype this would be a bit too ambitious for the team.

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