

Mixed Reality Interface Of Geospatial Data Towards Efficient, Effective, And Reliable Bridge Inspection

Liujun LI, Genda CHEN

42% of the bridges across the United States are at least 50 years old, and 7.5% in the National Bridge Inventory are considered structurally deficient. Their deterioration is expected to accelerate at an unprecedented rate in the years to come. Biennial inspection of these deteriorated bridges thus becomes more critical and heavier than ever before. The current practice with visual inspection requires the presence of a crew of two inspectors at any bridge site with one for inspection and paperwork and the other for photographing of bridge deterioration and areas of concern. In recent years, inspectors in some states are equipped with mobile tablets (with a flat-screen interface) to aid them in a 3D model-based data entry application. However, the 3D model markup and rendering is inaccurate and cannot be easily manipulated for the field inspector to record and visualize defects and element level data (e.g., defect location). In this study, a Mixed Reality (MR) interface with Microsoft's augmented reality (AR) headset is proposed and developed with Mixed Reality Toolkit (MRTK) to revolutionize the 3D data collection, storage, retrieval, and analysis (or general cloud-based data management) of an entire bridge through wireless communication. MR allows inspectors to recognize its surroundings and allow digital contents to interact with the real bridge in three dimensions. The MR interface provides an inspector with intraoperative hands-free access to complex data, real environment, and bi-directional communication. Based on the spatial anchoring function of AR headset, the inspector can create a spatial anchor at the intersection point between the real bridge and a digital task and then place a bridge hologram at the origin of that anchor's coordinate system for future revisit and bridge inspection. The MR bridge environment imports a high-resolution 3D reconstructed and georeferenced bridge model at 5cm/pixel from a Laser scanner and stores and visualizes the meta data such as past inspection report and photos of defects including size, shape, and location. The region of interest (ROI) defects can be compared and annotated as needed by retrieving the historical inspection data and adding the current inspection data. A database is established to automate the bridge inspection and reporting process according to 2019 AASHTO Bridge Element Inspection Manual. Therefore, the bridge element field inspection efficiency and accuracy can be dramatically improved with the developed MR interface. The proposed MR approach will accelerate the use of MR devices, such as HoloLens 2, in the bridge element inspection field to improve the quality of visual inspection and bridge asset condition statement for preventative maintenance workflow. The developed MR interface can assist in aspects of bridge inspection education, communication, or operative planning as the pace of MR related technological development will evolve rapidly in the coming years.