Computing Insight UK 2019
5 – 6 December 2019

Inspecting Bridges using Imaging, Virtual Reality and AI

"Instead of Office Going to the Bridge, Bridges are Coming to the Office."

MANCHESTER 1824
The University of Manchester

1. Aims and Objectives

Develop digital twins of infrastructure and automate bridge inspection using the concepts of **"Smart Cities."**

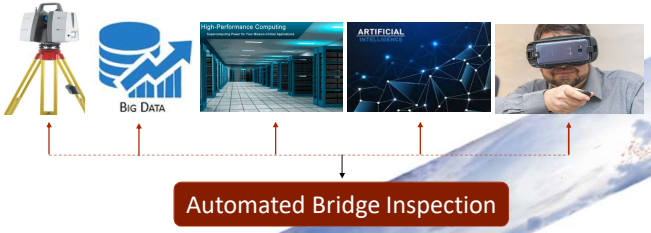

Fig 1. Cutting edge technology used for automated inspection

Use AI and extreme scale computing to detect structural features.
Develop data sub sampling algorithms to reduce the memory foot print.

2. Introduction

Due to rapid urbanization and need of optimised infrastructural maintenance, there is a growing trend of what is called **"Smart Cities."**

Fig 2. Reasons for the need of infrastructural assessment

Smart City in described in three key words known as 3I's
"**Instrumented, Interconnected and Intelligent City.**"

3. Motivation of Study

Principle Inspection/Visual Inspection is the primary technique for assessing the serviceability and performance of bridge structure. Following are the difficulties faced by engineers in inspecting bridges


Interpretation of results


Accessibility to critical areas


Poor Lightening


Safety of inspectors

Fig 3. Limitations of conventional inspection technique

Fig 4. Digital twins of a bridge using 3D scanner

4. Methodology of Proposed Workflow

The Mancunian Way is chosen the case study. The flowchart below summarizes all the major step required. The bridge and field experimental setup is shown in *figure 6* and *figure 7*. Blue annotates the stations and yellow annotates the targets.

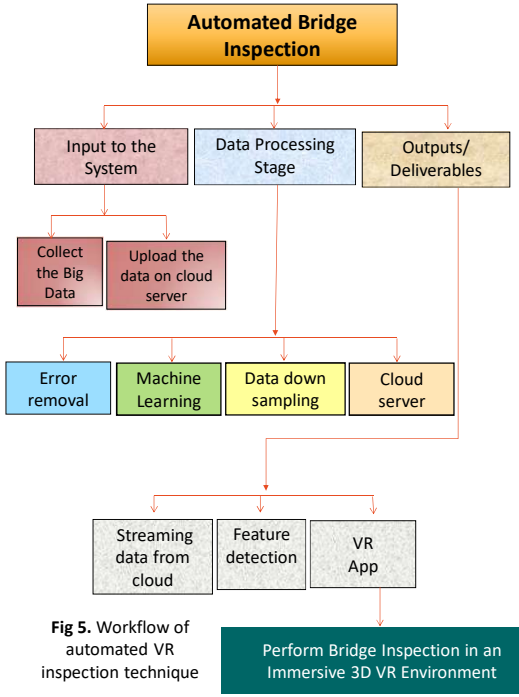

Fig 5. Workflow of automated VR inspection technique

Fig 6. Photograph of the Mancunian Way

Fig 7. Experimental setup

5. Results and Discussion

Results from bridge inspection in VR are demonstrated in *figure 8.*

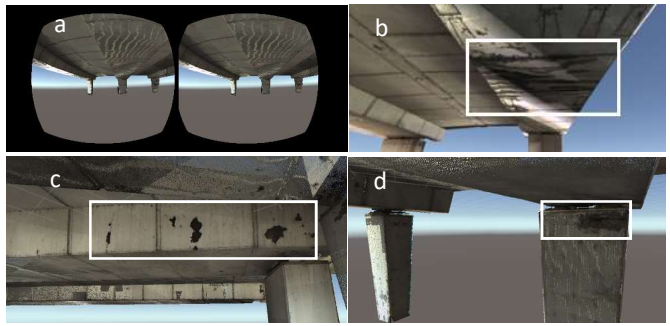

Fig 8. Bridge inspection in the VR. Features shown are: a) stereoscopic view; b) spalling on girders; c) thermal cracks on the beams; d) spalling in piers

Critical comparison between Principle Inspection in VR and conventional method of Inspection is shown in *table 1*.

Comparison Criteria	Conventional Inspection	VR Inspection
Accessibility to critical areas	Difficult	All areas are accessible
Ease of Data collection	Subjective	Effective
Consistency in findings	Low	Consistent
Interpretation of results	Based on experience	Repeatable
Safety of inspector	Needs improvement	Excellent
Time (Disruption)	Depends on the scale of inspection	Less
Documentation	Needs improvement	Excellent
Cost per inspection	Costly	Cheaper in long term

Table 1. Critical comparison of the conventional inspection technique and the VR inspection technique

6. Conclusion and Future Work

The new approach promises to be highly effective in terms of interpretation of results, accessibility to critical areas and safety of inspectors and time consumption.
In the next stage, AI, extreme scale computing and cloud computing will be used to detect and quantify cracks, reduced material strength and other irregularities.
Validation test on different bridges will be performed to verify the accuracy and efficiency of the framework.

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For further details, visit the article or scan the QR Code
Omer *et al* (2019), *Use of Gaming Technology to Bring Bridge Inspection to the Office*, Journal of Structure and Infrastructural Engineering

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