GNSS Simulation in Virtual Word for Trimble Inc

Jacob Kyle Klemick
Ara Institute of Canterbury
Jacob.klemick@outlook.com

Dr Bernard Otinpong
(Supervisor)
Ara Institute of Canterbury
bernard.otinpong@ara.ac.nz

Dr David Weir
Ara Institute of Canterbury
david.weir@ara.ac.nz

ABSTRACT

This paper outlines the development of GNSS simulation features for Trimble Virtual World, a digital twin environment used for site training. The project main objective was to enhance simulating GNSS by implementing an accuracy/degradation system when under obstructions and visualising satellite-to-receiver signals. The project itself used an Agile, Scrum methodology to guide the development process.

Keywords, Geospatial, Game Engines, GNSS, Surveying, Scrum, Digital Twin

1. INTRODUCTION

Trimble Inc. is an American industrial technology company that provides solutions for agriculture, transportation, geospatial, and construction (Trimble Inc., 2024 a) Trimble has been operating since 1978 and is involved in developing both hardware and operates internationally in 34 countries. Trimble Navigation NZ Ltd is the branch operating in New Zealand, focusing on the development of Trimble Access, Virtual World, and the DA2 receiver.

This project is a joint work-integrated learning initiative between Ara Institute of Canterbury, Trimble Navigation NZ Ltd, and an Ara Institute of Canterbury student. This paper provides a project overview of the implementation and development of GNSS simulation features in Trimble Virtual World.

Figure 1

GNSS Simulation in Trimble Virtual Worlds Poster

This quality-assured poster paper appeared at the 15th Annual Conference of Computing and Information Technology Research and Education New Zealand (CITRENZ2024) and the 37th Annual Conference of the National Advisory Committee on Computing Qualifications, Dunedin, NZ, October 2nd-4th.
DOI: will be supplied ahead of camera ready.

2. PROJECT BACKGROUND

Trimble Virtual World is a digital twin environment used for site training (Trimble Inc, 2022). It allows users to simulate site training with other field application such as Trimble Access, Siteworks, without the need to be physically onsite. Virtual World currently provides basic GNSS simulation but aims to further expand this feature set to mimic more real-life conditions users would encounter. A list of requirements had already been identified through discovery sessions with key stakeholders and the product owner.

Project requirements:

- Enhancing the current GNSS feature set in Virtual World.
- Simulating accuracy degradation when the player is under buildings or obstructions.
- Visualising GNSS signals from satellite to receiver
- Updating the emulated receiver when connected to various field applications.

3. DEVELOPMENT PROCESS

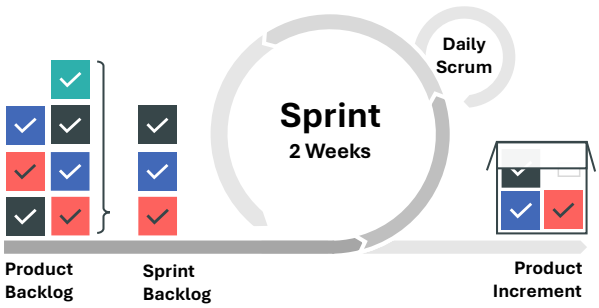
This section will cover the risk management, quality assurance, and methodology processes used in the project.

3.1 Scrum

Scrum was the main methodology used throughout the project, with aspects of Kanban and Scrum for One incorporated. The use of Scrum allowed for an incremental software development cycle, where every two weeks a build was developed and shared with the product owner, enabling a constant feedback loop.(Sliger, 2011). Management of the project was done using Jira.

Figure 2

High Level of Scrum Framework Overview



3.2 Risk Management

Risk management was handled using the Microsoft Risk Management Framework (MSRF) (Robin, et al., 2002) .MSRF was chosen because it provides guidance on conducting risk management in small projects and offers a quantitative approach to analyzing risks. Risk management activities were conducted weekly.

3.3 Quality Assurance

Quality Assurance was handled using aspects of the Virginia Tech Project Quality Assurance framework (Virginia Polytechnic Institute and State University, n.d.) .This framework was employed to identify, maintain, and record deliverables. QA activities were conducted on a weekly to fortnightly basis throughout the project.

4. OUTCOMES

- Developed a Line-of-Sight System to simulate GNSS signal interference.
- Simulated accuracy degradation when the player is under buildings or obstructions.
- Visualised GNSS signals from satellite to receiver. Implement Dilution of Precision metrics.
- Develop a quest around the use and learning of GNSS technologies.
- Constellation information updates in various field applications when connected
- Develop quests to that teach users on GNSS technologies

Figure 3

GNSS Simulation Features

Figure 4

GNSS Learner Quest in Virtual World

5. FUTURE WORK

Other requirements and deliverables were identified throughout the project but were out of scope; these have been further investigated and is potential future developments.

- Provide real-time and forecast satellite constellations through the use of Orbital Mean Motion data.
- Develop heat map visualisations of GNSS signal strength across a virtual work site.
- Expand the current features to simulate virtual reference stations and different types of Total station setups.

6. CONCLUSION

The outcome of this project was to enhance GNSS simulation features within Trimble Virtual World, a simulated digital twin environment used for training in land surveying equipment. These developed features bridge the gap between real-world and digital environments.

7. ACKNOWLEDGMENTS

- *Stuart Ralston*
- *Ken Fortune*
- *Sam Fortune*

8. REFERENCES

Robin, A., Preedy, D., Campbell, D., Paschino, E., Hargrave, L., Born, M., . . . Getchell, S. (2002). Microsoft Solutions Framework. *MSF Risk Management Discipline*(1.1). Retrieved from http://www.uml.org.cn/softwareprocess/MSFRiskManagementDisciplinev.1.1.pdf

Sliger, M. (2011). *Agile project management with Scrum*. Retrieved from www.pmi.org: https://www.pmi.org/learning/library/agile-project-management-scrum-6269

Trimble Inc. (2022). *Introducing Trimble Virtual World*. Retrieved from virtualworld.trimble.com: https://virtualworld.trimble.com/

Trimble Inc. (2024 a). *Our story*. Retrieved from www.trimble.com: https://www.trimble.com/en/about

Trimble Inc. (2024 b). *Locations*. Retrieved from www.trimble.com: https://www.trimble.com/en/locations

Virginia Polytechnic Institute and State University. (n.d.). *Project Quality Assurance*. Retrieved from it.vt.edu: https://it.vt.edu/projects/project_management/qualityassurance.html