

Verification and Validation Report: PCD:  
Partially Covered Detection of Obscured  
People using Point Cloud Data

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# 1 Revision History

Date	Version	Notes
Date 1	1.0	Notes
Date 2	1.1	Notes

## 2 Symbols, Abbreviations and Acronyms

symbol	description
T	Test

[symbols, abbreviations or acronyms – you can reference the SRS tables if needed —SS]

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This document outlines the results and analysis of executing our VnV plan. Included below is a brief summary of each Functional, Non-functional, and Unit test, along with a description of their expected vs actual results. Provided with these results is the insight gained on the system that each tests highlights. "N/I" will be used for tests that have not yet been implemented.

## **3 Functional Requirements Evaluation**

### **3.1 Human Detection Testing**

The following section covers the functional tests related to human detection given different coverage levels.

### **3.2 Offline Processing**

The following section covers the functional tests related to the offline processing of files.

### **3.3 Body Pose Variation Handling**

The following section covers the functional tests related to human detection give a dynamic set of poses.

### **3.4 Integration with Kinect Sensor**

The following section covers the functional tests related to the connection and data transfer of the Kinect Sensor.

### **3.5 Location Prediction Test**

The following section covers the functional tests related to predicting the location of obscured segments.

## **4 Non-Functional Requirements Evaluation**

### **4.1 Realtime Processing**

The following section covers the non-functional tests related to performance metrics.

### **4.2 Reliability**

The following section covers the non-functional tests related to reliability requirements.

### **4.3 Accuracy**

The following section covers the non-functional tests related to accuracy requirements.

## 5 Unit Testing

ID	Type	Input	Expected Result	Actual Result	Pass/Fail
UT1	Automated	Sample PCL Point Cloud	The RGB values, Depth Values, and Cloud Size are mapped correctly between file types.	The RGB values, Depth Values, and Cloud Size are mapped correctly between file types.	Pass
<b>Description:</b> ConvertPCLtoOpenCV: Converts a PCL Point Cloud to OpenCV Mat type for point cloud analysis using OpenCV. A pass means that the function correctly maps the Point Cloud values to OpenCV Mat type. The unit test passed successfully, verifying that the mapped values matched between the two types.					
UT2	Automated	OpenCV Mat, Min Depth, Max Depth	Returns an OpenCV Mat Type that includes only points within the desired depth range.	Returns an OpenCV Mat Type that includes only points within the desired depth range.	Pass
<b>Description:</b> segmentDepth: This function takes an OpenCV Mat cloud and removes points outside the specified depth range. A pass indicates that only points within the given depth range remain in the returned Mat. The unit test passed, confirming correct depth segmentation.					

## 6 Changes Due to Testing

[This section should highlight how feedback from the users and from the supervisor (when one exists) shaped the final product. In particular the feedback from the Rev 0 demo to the supervisor (or to potential users) should be highlighted. —SS]

## 7 Automated Testing

The only automated testing present is the Unit Tests, which are run using CTest and GTest Suites.

## 8 Trace to Requirements and Modules

See section G.4 in the [SRS report](#) for more information on the requirements. See section 7 in the [Module Guide](#) for more information on the modules.

Table 1: Module and Requirement Tracing

Test ID	Requirement ID	Modules
FT11	F411	M5, M6, M7, M8, M9
FT12	F411	M5, M6, M7, M8, M9
FT13	F411	M5, M6, M7, M8, M9
FT14	F411	M5, M6, M7, M8, M9
FT15	F411	M5, M6, M7, M8, M9
FT16	F411	M5, M6, M7, M8, M9
FT17	F411	M5, M6, M7, M8, M9
FT18	F411	M5, M6, M7, M8, M9
FT21	F412	M7, M11
FT22	F412	M7, M11
FT23	F412	M7, M11
FT24	F412	M7, M11
FT31	F413	M4, M5, M6, M8, M9, M10, M11
FT32	F413	M4, M5, M6, M8, M9, M10, M11
FT41	F414	M4, M5, M6, M8, M9
FT42	F414	M4, M5, M6, M8, M9
FT43	F414	M4, M5, M6, M8, M9
FT51	F415	M1, M2
FT52	F415	M1, M2
NFT11	NF431	M1, M2, M9
NFT12	NF432	M5, M6, M7, M9
NFT13	NF433	M5, M6, M7



## 9 Code Coverage Metrics

The automated unit testing achieves 6% line coverage. This is checked using CTest and OpenCPPCoverage Suites to acquire coverage results.

OpenCPPCoverage Result:

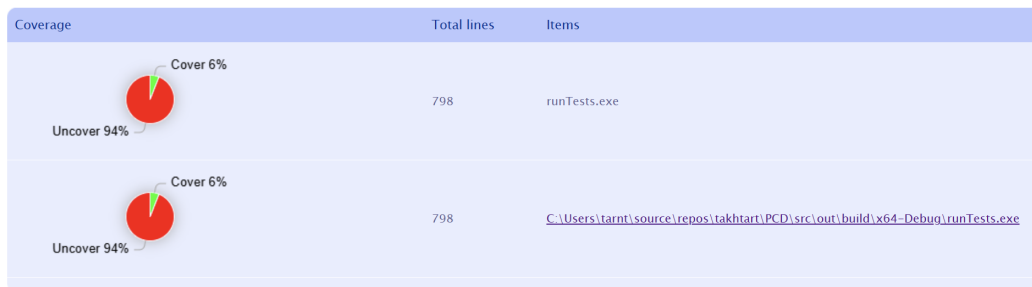


Figure 1: OpenCPPCoverage Result

## References

## Appendix — Reflection

The information in this section will be used to evaluate the team members on the graduate attribute of Reflection.

1. What went well while writing this deliverable?

When writing this deliverable, the sections that were very smooth were the ones that stemmed directly from the VnV plan. Those sections that went exactly as planned as the VnV Plan were very easy to translate to this report.

2. What pain points did you experience during this deliverable, and how did you resolve them?

A slight pain point that we did run into had to do with a change we received from Dr. Bone after Rev0. He proposed a change clarifying his vision for the project. This change caused one of our requirements to be completely reworked, changing the associated tests as well. We resolved this by simply moving back and rewriting the requirement, planned tests, and report tests that related to this requirement.

3. Which parts of this document stemmed from speaking to your client(s) or a proxy (e.g. your peers)? Which ones were not, and why?

The parts of the document that stemmed from speaking to our supervisor were the ones relating to the requirement mentioned in the above question. The rest of the requirements we generated previously based on the initial specification from Dr. Bone, which he checked and approved. The only new tests, that weren't described in the VnV Plan, were those related to the new reworked requirement stemming from Dr. Bone's feedback.

4. In what ways was the Verification and Validation (VnV) Plan different from the activities that were actually conducted for VnV? If there were differences, what changes required the modification in the plan? Why did these changes occur? Would you be able to anticipate these changes in future projects? If there weren't any differences, how was your team able to clearly predict a feasible amount of effort and the

right tasks needed to build the evidence that demonstrates the required quality? (It is expected that most teams will have had to deviate from their original VnV Plan.)

Aside from the changes mentioned in the previous question, we had to slightly tweak some of the test procedures initially proposed in the VnV Plan. In the beginning we weren't set on what method we were using for human detection and ended up trying a few different ways. The test procedures were initially written without any specific method in mind. Later on, after many meetings with Dr. Bone, we settled on a method that mainly uses skin point detection and region growing. Because of this method some of the test procedures didn't really make sense, namely any one that caused the person to maneuver into a position that hid all skin from the camera. The changes that this required was simply to move back to the VnV plan and tweak the procedure in such a way that kept the original intent of the test but made it feasible to test with our method of detection. Regarding these issues, I don't think we would be able to predict roadblocks like this in the future. The nature of these issues stem from explorations during development and would be difficult to account for prior.