

## Overview

### Our Motivation

- Validate and increase knowledge of the microscopic 3D scanning system by exploring novel applications.
- Determine if structured light 3D scanning can be used for fingerprinting.
- Investigate a potential threat of misusing technologies like 3D scanning and 3D printing for criminal activities.

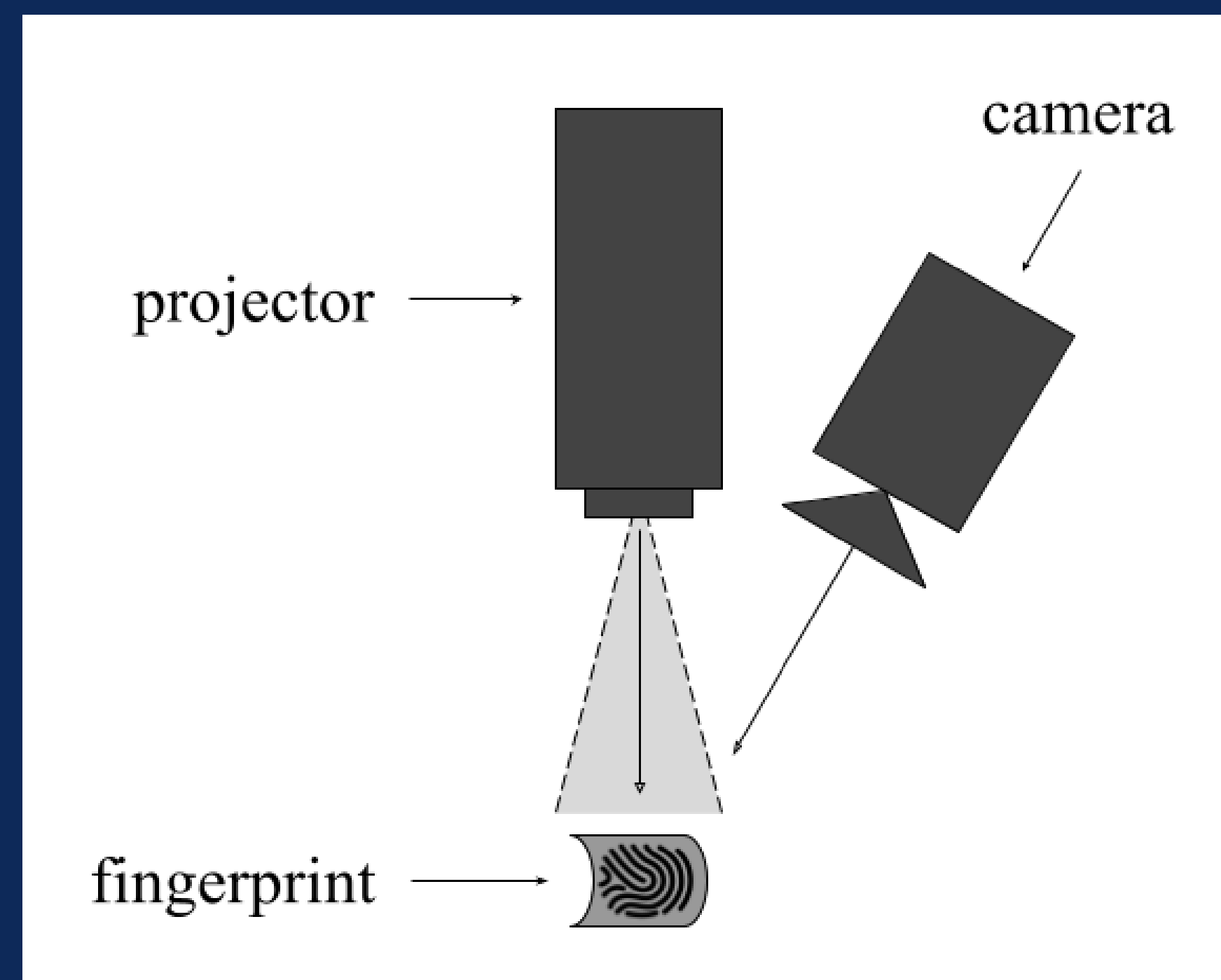


Figure 1. An SLS system

### Structured Light 3D Scanning (SLS)

- SLS uses one camera and one projector (Figure 1).
- Most SLS systems can't capture microscopic details.
- We use a telecentric lens to improve accuracy when scanning microscopic objects [1].

## Methods

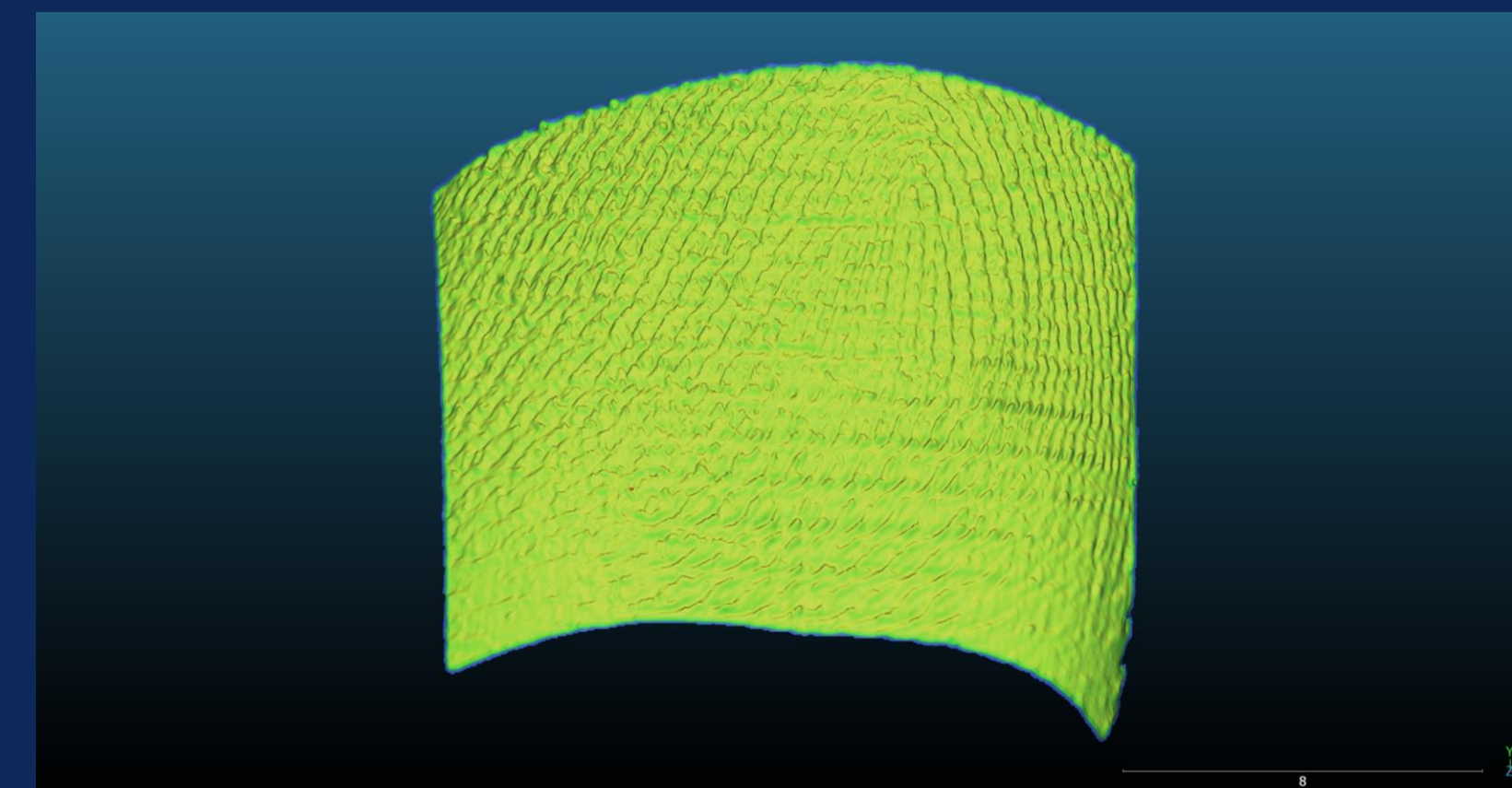
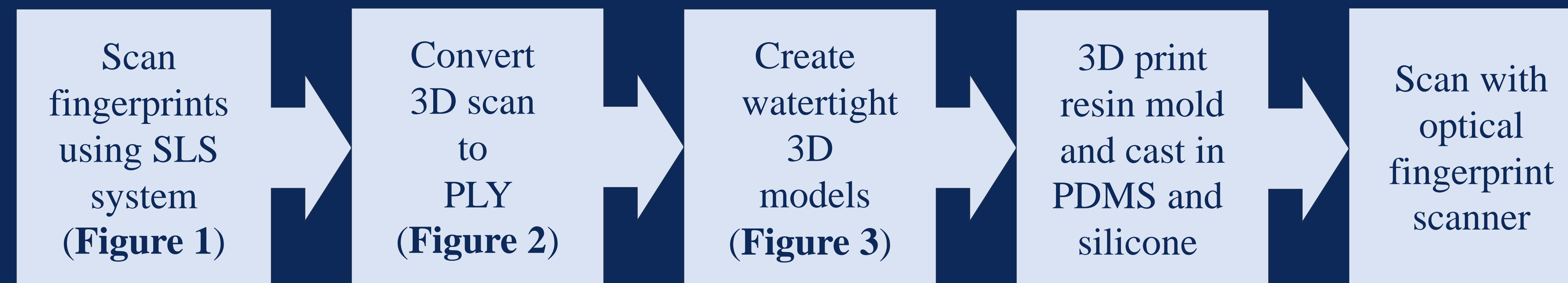


Figure 2. PLY mesh of fingerprint

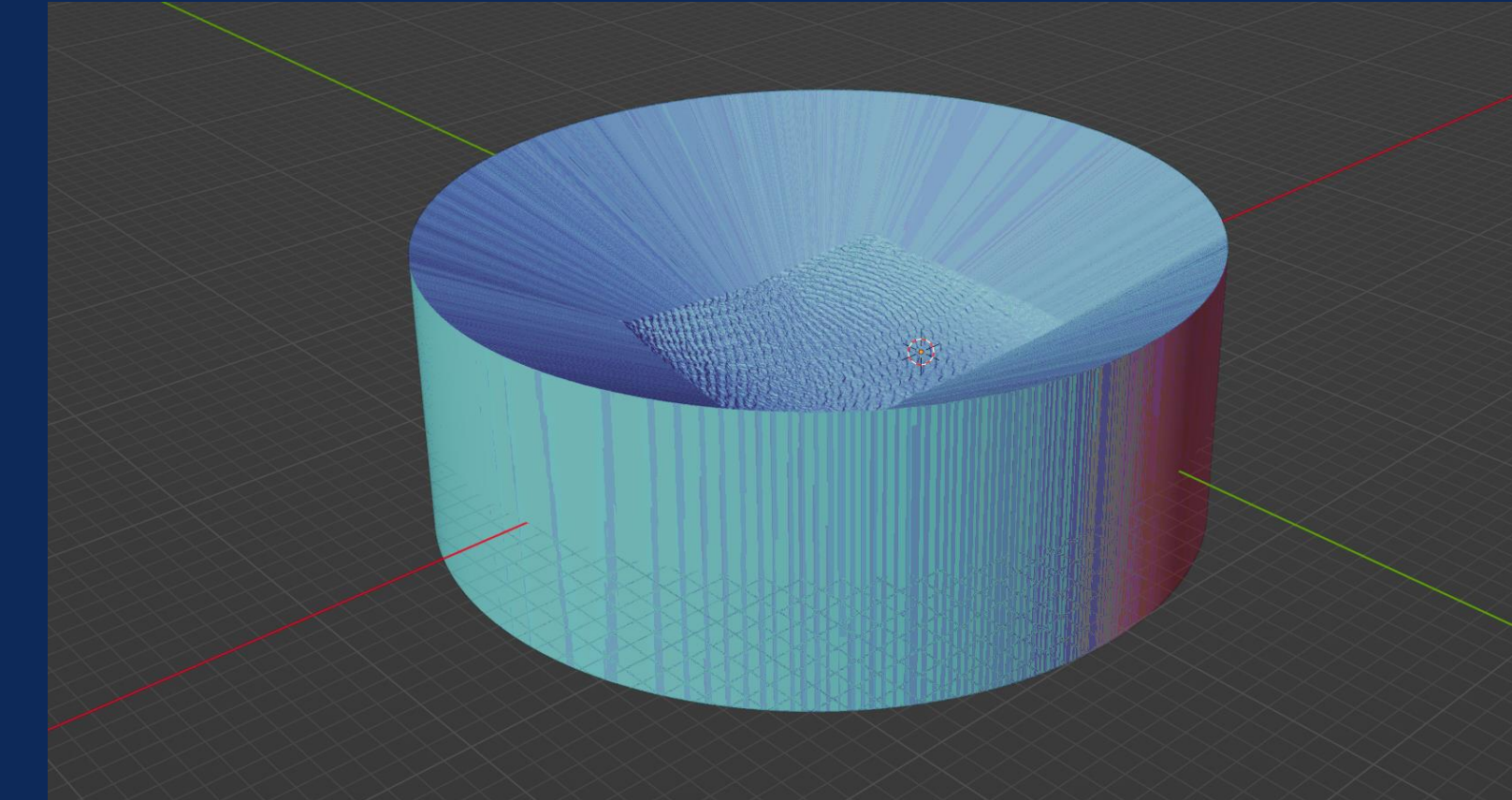


Figure 3. 3D model of fingerprint mold

## Results

- Fingerprint models were successfully created using 3D scanning and replication pipeline.
- Silicone and PDMS fingerprints were recognized by optical fingerprint scanner (Figure 4).
- Fingerprint phantoms were capable of matching actual fingerprints (Figure 5).



Figure 4. Images of actual and replica fingerprint scans

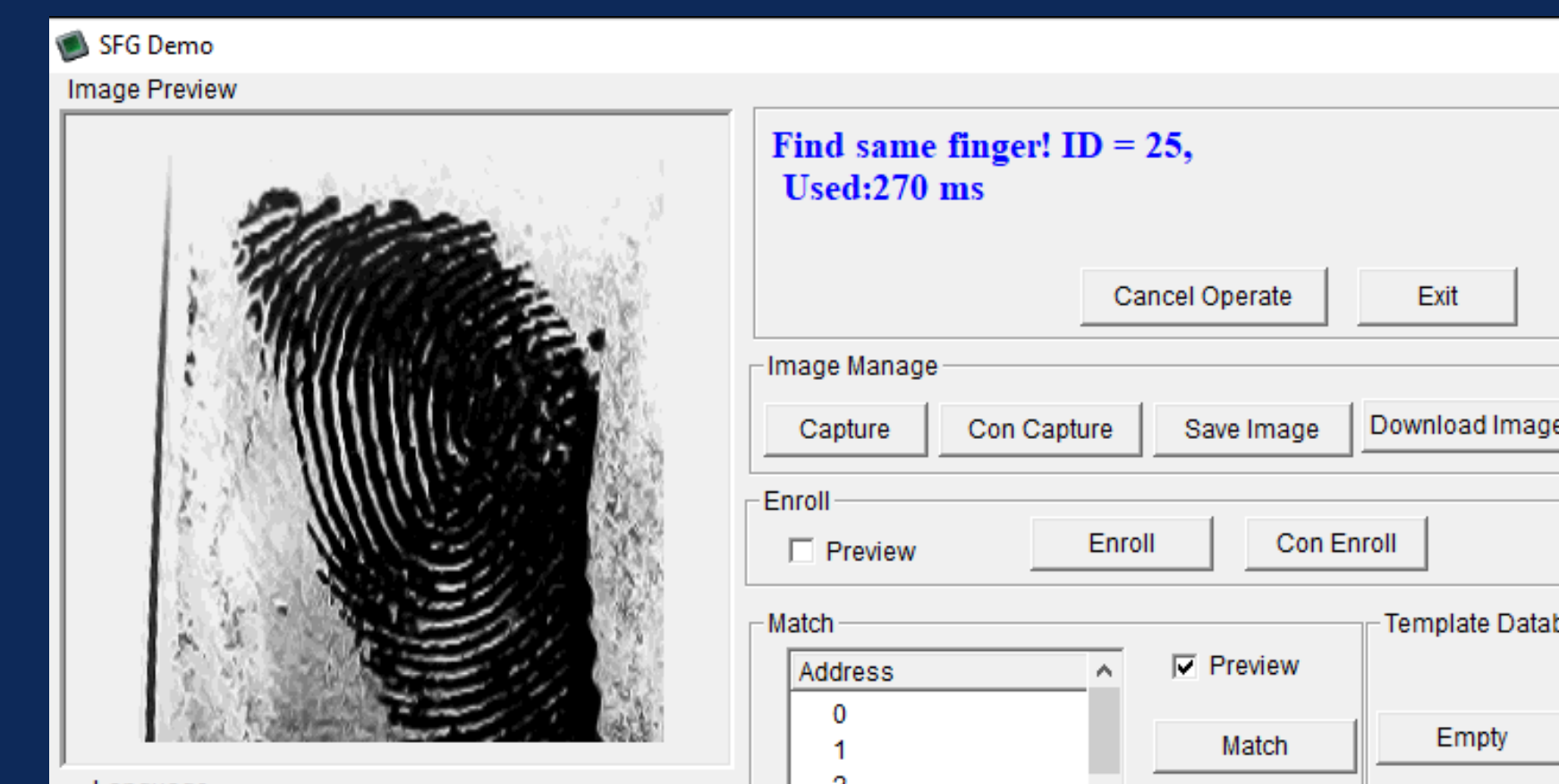


Figure 5. A successfully spoofed fingerprint reading

## Discussion

### Implications

- Potential for contactless fingerprint phantom spoofing with our method.
- Positive applications include better fingerprinting of atypical fingerprints.
- Spoofing may allow for criminal activity.

### Limitations

- When testing PDMS and silicone against an optical scanner, approximate tissue optical properties of the fingerprint "phantom" can affect the clarity of ridge resolution [2].
- Motion artifacts can occur when scanning [3].

### Future Work

- Examine potential for detecting spoofed fingerprints using methods such as BSIF [4].
- Test method on a broader demographic range.

## References

- [1] B. Li and S. Zhang, "Flexible calibration method for microscopic structured light system using telecentric lens," *Opt. Express, OE*, vol. 23, no. 20, pp. 25795–25803, Oct. 2015, doi: 10.1364/OE.23.025795.
- [2] C. W. Schultz, J. X. H. Wong, and H.-Z. Yu, "Fabrication of 3D Fingerprint Phantoms via Unconventional Polycarbonate Molding," *Sci. Rep.*, vol. 8, no. 1, Art. no. 1, Jun. 2018, doi: 10.1038/s41598-018-27885-1.
- [3] J. Wilm, O. V. Olesen, R. R. Paulsen, and R. Larsen, "Correction of Motion Artifacts for Real-Time Structured Light," in *Image Analysis*, R. R. Paulsen and K. S. Pedersen, Eds., in *Lecture Notes in Computer Science*. Cham: Springer International Publishing, 2015, pp. 142–151. doi: 10.1007/978-3-319-19665-7\_12.
- [4] A. Rattani, Z. Akhtar and G. Foresti, "A Preliminary Study on Identifying Fabrication Material From Fake Fingerprint Images," 2015 IEEE Symposium Series on Computational Intelligence, Cape Town, South Africa, 2015, pp. 362-366, doi: 10.1109/SSCI.2015.61.