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|  | **Sofia University „St. Kliment Ohridski”**  Faculty of Mathematics and Informatics  *Department of Computer Informatics* |  |

**MASTER’S THESIS**

„Scan-y: 3D Scanning System with Structured Light for Reconstruction”

(Summary)

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Master's programme: **Embedded Systems**

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# Summary

This master's thesis describes realisation of a 3D scanner with structured light for reconstruction. The main approaches to 3D scanning are reviewed, including their principle of operation, advantages, disadvantages and application areas. A comparative analysis of the functions and architecture of samples that were implemented with the most commonly used scanning methods was made. When looking at the samples, the choice of the Scan-y implementation is justified.

Reconstruction of an object provides computer-readable information about the object's 3D structure. Unlike passive methods that use natural light to obtain spatial data for the scene, structured light uses a projector as its own source. The projector is used to project pre-generated patterns that uniquely encode each point in the scene. The main method of scanning in Scan-y is through Gray code pattern. Patterns are alternating black and white stripes that are either horizontal or vertical. The advantages of Gray code over other scanning methods is that it does not depend on the available natural light and illuminates the entire scene simultaneously, which significantly reduces the number of iterations required. A potential place for errors to occur is where there is a transition from white to black stripe or vice versa. Gray code is an improved version of the Binary pattern, because in it each subsequent value differs by one bit from the previous one. This reduces the number of transitions and improves the result accordingly. A disadvantage of this method is that it cannot be used in a dynamic environment.

Section 3 "Project description of Scan-y" describes the implementation of the system. A description of the implemented algorithm for obtaining spatial data is made. The individual components of the scanner -block Sensors, system and block Actuators and the interfaces between them - have been examined. Raspberry Pi 3 was used for control platform and Python programming language. A Camera Pi camera, which is designed for use with Raspberry Pi, was chosen to capture the scene. The Raspberry Pi has all the necessary libraries installed and makes it possible to use the camera easily. The turntable is implemented with a Nema 17 bipolar stepper motor and a Pololu A4988 control driver.

The system is tested according to previously created test plans. Testing consists of unit tests, software and software-hardware integration tests. Appendices 2 to 5 describe the test plans divided by modules – Projector, Turntable, Templates and Camera. For some of the tests, only a few parameter values are shown because the number of combinations of different parameter values is large. The problems of the system and the opportunities for improving the services are analysed.

The last part of the document contains a Glossary and the literature used. The glossary contains descriptions of key terms and abbreviations used in the document.