Suspended Rotary System for Improved Object Accessibility in 3D Scanning

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***Abstract*— Three-dimensional (3D) scanning is commonly used for object digitization, reverse engineering, and quality control. However, conventional rotary turntables often limit access to object surfaces and create occluded regions that reduce the completeness of scanned models. This paper presents a low-cost suspended rotary system designed to improve object accessibility during 3D scanning. The proposed device rotates a suspended object using a geared DC motor controlled by an ESP32 microcontroller with Bluetooth Low Energy communication. The system was manufactured using 3D-printed components and evaluated with a structured-light 3D scanner. Experimental results show improved access to object surfaces and reduced occlusions compared to conventional turntable-based scanning setups. The proposed solution provides a practical and affordable accessory for laboratory-scale 3D scanning applications.**

Keywords*— *3D scanning, suspended rotary system, object manipulation, scan accessibility, occlusion reduction

I. Introduction

3D scanning is widely used for object digitization, reverse engineering, quality inspection, and additive manufacturing. Although modern scanners provide high accuracy, the completeness of acquired data is often limited by object geometry and scanning conditions. One of the most common problems is the occurrence of occluded regions, which cannot be captured due to restricted visibility from the scanner's viewpoint.

To simplify data acquisition, scanned objects are frequently placed on rotary turntables. While this arrangement enables automated rotation and scanning from multiple angles, it also obstructs surfaces in contact with the supporting platform. As a result, additional scans, object repositioning, and manual post-processing are often required to obtain a complete 3D model.

This paper presents a suspended rotary system designed to improve object accessibility during 3D scanning. The proposed device rotates an object suspended on thin filaments, minimizing surface obstruction and reducing scanning occlusions.

II. Design, Construction and Control of the Suspended Rotary System

The mechanical design consists of a stationary inner cylinder and a rotating outer cylinder. The inner cylinder houses the electronic components, while the outer cylinder carries the suspension mechanism and rotates around the stationary core. Rotation is provided by a geared DC motor driving an integrated 3D-printed gear ring. An axial bearing ensures smooth motion and reduces friction between the rotating and stationary parts.

All structural components were 3D printed to achieve low weight and sufficient mechanical strength. The object to be scanned is suspended below the device using thin transparent filaments attached to a rotating cylinder. This arrangement minimizes interference with the scanning process while providing access to surfaces that would otherwise be blocked by the supporting platform.

The electronic system is powered through a USB-C interface with a Power Delivery trigger module providing 12 V for the motor drive. An ESP32 microcontroller manages both motor control and wireless communication. Rotational speed is controlled using pulse-width modulation (PWM), enabling smooth adjustment according to scanning requirements. Wireless control is implemented using Bluetooth Low Energy (BLE). A custom graphical user interface developed in Python allows users to establish a BLE connection and adjust rotational speed in real time.

III. Conclusion

This paper presents a suspended rotary system developed to improve object accessibility during 3D scanning. By suspending the scanned object on thin filaments instead of placing it on a conventional turntable, the proposed solution reduces surface obstructions and allows access from a wider range of viewing angles.

Experimental testing confirmed the feasibility of the proposed approach and its ability to reduce scanning obstructions, especially on surfaces that are typically hidden by support platforms.

The results indicate that the suspended rotary system represents a simple and low-cost accessory for laboratory 3D scanning applications. Future work will focus on improving the rotation accuracy and evaluating the system using quantitative measures of scan completeness and reconstruction quality.

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