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Condition Assessment of End-of-Use Products for Remanufacturing

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College of Engineering

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Opportunity and Significance

As a result of remanufactures encountering high uncertainties in component quality, advanced technology such as 3D scanning serves as a vital component used to reduce inspection and assessment to eliminate error and make remanufacturing and reprocessing more efficient. Often manufacturers spend more money, energy, and time fixing human error as it relates to quality checks and schematic calculation error that cannot be detected by the human eye. Therefore, the goal of my project is to use the automated 3D laser scanner using a (Capnut) as a test object to detect surface defects, corrosion and calculation error through offline quality inspection. Potentially reducing labor time and cost for both consumers and manufacturers.

Technical Objectives

- **Use schematic design and calculation to create 3D model** – By using schematic design I was able to use its calculations to draw the (Capnut) using AutoCAD software. Having the (Capnut) drawn as a 3D model is critically important for data acquisition and analysis.
- **Create a fixture to secure the 3D model** – A fixture is vital for securing a zero position to ensure consistent scans.
- **Design a trajectory path for automated scanning –** Use compatible 3D software for the purposes of converting programming data over to (TP) Teach Pendent controller which operates the Fanuc robot and the automated laser scanner.

Related Work and State of Practice

The below diagram displays the various processes of sustainable remanufacturing. Sustainable remanufacturing is a global concern which addresses ecological, economical and socio-political needs of the human race as well as considering the availability of natural resources and the ecosystems for future generations. As a participant of the (REU) Sustainable Remanufacturing program, I was afforded the opportunity to ascertain knowledge and skills that propel sustainability efforts. Initially the goal of my project as a (REU) participant was to gather point clouds of the (Capnut) and compare it with the 3D model. However, I have now extended that study into figuring out the kinematics of the robot to create a better trajectory for the (Capnut), which will aide in further research efforts to have consistent data that allows a better comparisons between a 3D model and an actual object in this case the (Capnut).

Technical Approach, Accomplishments and Results

Figure 1

This figure represents the setup design for scanning. Table is placed in a specific location known to Roboguide software to create the trajectory.

Figure 2

This figure represents the simulation robot created to program automated scan paths and using the dimension of the part from the blueprint and the physical location seen in figure 1.

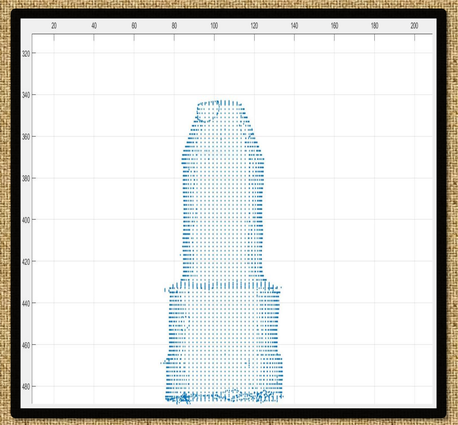

Figure 3

This figure represents the computed point clouds in MATLAB, it is the dimensional information of the scanned part which shows all the data points for clearer analysis and modification purposes.

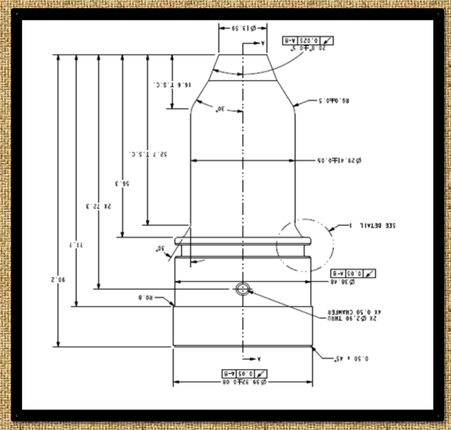

Figure 4

This figure represents the schematic design and dimension used to draw a 3D model that will is used to program the trajectory and automate the scanning process.

Next Steps for Development and Test

In the future by standardizing the scanning procedures and controlling the variations in the scans this technology can be widely used in the industry. For example, industry currently uses this form of technology, however, it is not consistent or reliable due to obstruction and inconsistency as it relates to scan paths and parameters. Controlling these factors and knowing its causes by conducting research can help both academics and industry. This extended research will provide causes and effects of the change in parameters and controlling the noise variations. In conclusion, it is most essential that academia in the near future focus on ways to study different parameters and the affect on scan quality.

COE Undergraduate Research Experience

Working as an undergraduate researcher in alongside Ph.D. student Mojahed, under the leadership of Dr. Jeremy Rickli gave me a wealth of knowledge and experience that I could not possibly gain inside a classroom. Dr. Rickli's research consisted of a three part framework for condition assessment, material deposition, and reprocessing. As a result of his cutting edge research Ph.D. student Mojahed and I were able to use previous methodologies and concepts to study and find solutions to remanufacturing processes and quality checks. My research will be able to help Dr. Rickli and Ph.D. student Mojahed have consistent data to improve condition assessment processes and collect feasible scans for accurate analysis.

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