Different Flexibilities of 3D Scanners and Their Impact on Distinctive Applications: An Analysis

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ABSTRACT

3D scanners are supporting technology which offers a higher level of flexibility to create designs for ergonomic tooling, biocompatible surgical guides, and realistic prototypes and parts. Flexibility helps to reduce lead time, weight, cost, and product development time. Scanning technologies are in tandem with support software that helps a designer to (re)design products at a cheaper and faster rate. There is a need to understand different types of flexibilities and associated application of 3D scanner. In this article, we have conducted an extensive review of the available literature for identifying various flexibilities of 3D scanners and its applications. This research categorises 3D scanner flexibility and applications into five major types. From design to final quality inspection, these flexibilities play a significant role in industries and sectors to achieve optimum performance. Ranking of these flexibilities and their impact on different applications are accomplished using the analytical hierarchical process (AHP) with the help of expert opinion. The ranking of five significant flexibilities by using 3D scanners, undertaken through the AHP technique shows that scanning provides object flexibility at a higher level. The impacts of different flexibilities on applications are also weighted, and it shows that all flexibilities are enough to achieve application individually. This digital technology is helpful to create the customised product which is also helpful to achieve goals of Industry 4.0. It facilitates the customisation and has a significant impact on the design applications. This study provides an understanding of the 3D scanner in the context of flexibilities by identifying the different flexibilities it offers when used for different applications. Findings may assist developing a decision support system for the selection of 3D scanners for the different applications.

KEYWORDS

3D Scanner, Analytical Hierarchical Process (AHP), Applications, Customization, Flexibility, Industry 4.0

1. INTRODUCTION

Automation industry is focusing on improving productivity, product assembly quality with lower cost. Flexibility is a significant factor which effects automation system and reduces human efforts. 3D Scanners are used to create a high level of flexibility that analyses the real-world object (Haleem

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& Javaid, 2018). It collects data from the object and then constructs a 3D model which has various applications in medical, industrial design, reverse engineering, inspections and entertainment industry such as the production of video games and movies (Wojciechowski & Suszynski, 2017).

3D Scanners play a vital role in increasing productivity and enhance product development capability. This digital representation is helpful for advanced manufacturing methods (Craveiro et al., 2017; Javaid & Haleem, 2019). Different types of 3D Scanners are available for scanning of various products, and by using these 3D scanning technologies, one can achieve higher levels of accuracy even up to 1μm (Omar et al., 2011; Sun et al., 2012). It converts the 3D physical model into a digital 3D model and makes changes in design using the software. This digital data is then further exported in 3D printing technologies as an input file for printing ( Lerch et al., 2017). 3D scanner enhances digital manufacturing system and plays a useful role in Industry 4.0 (Bag et al., 2018; Zheng et al., 2018; Telukdarie et al., 2018).

After scanning the product associated modification in design is done through designing software, over the scanned data file, thereby creating flexibility in manufacturing. It reduces the time of research and development (Javaid & Haleem, 2017). This technology fulfils the requirement of product innovation which is concerned with product design as per the required specification of the customer. The application of new technologies now facilitates advancement which was previously faced by manufacturers (Li et al., 2018). Scanning output of customised products is used to create a 3D physical product according to the specific demand of the customer. By using 3D scanners, there is a saving of time in the product development cycle, enhancement in design and quality of the final product (Javaid et al., 2015; Kumar et al., 2016; Khani et al., 2017).

By achieving different flexibilities through the 3D scanners in today’s manufacturing field, the customised parts are easy to produce. During the direct manufacturing of the finished product, it achieves a higher level of efficiency. Scanning of the external surface of any products with the help of this technology and changes thereon are smooth and, the same is made as per the required dimension, shape, size which was not possible by other traditional technologies/process ( Dias et al., 2017).

In the current scenario, smart manufacturing is essential for making advancement in the manufacturing field. 3D scanner enhances smart manufacturing capability by using rapid manufacturing tools that give efficiency and innovation to modern industry. It creates designing of different products which are suitable for modelling and inspection and adopted for regeneration or modification of equipment using reverse engineering techniques. It undertakes the considerations of ergonomics factors such as grip comfort and wrist strain by the application of this technology (Haleem et al., 2016; Peruzzini & Stjepandic, 2017; Peruzzini et al., 2017).

2. LITERATURE REVIEW

This section provides the relevant literature on 3D scanners with the research status on flexibilities of 3D scanners. Further, this section tries to identify various types of flexibilities and applications of 3D scanner. The relevant details are provided in following subsections.

2.1 An Overview of 3D Scanner

This sub section provides the basic understanding of the 3D scanner, types of scanning and methods of 3D scanning. Further, the benefits of the 3D scanner are discussed in the context of the manufacturing.

2.2.1 Types of Scanning

- Contact scanning: In contact type scanning method, it is essential to have the mechanical contact with the object, which is to be scanned; For Example - measuring arms and coordinate measuring machines (CMM) (Toth & Zivcak, 2014).
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