International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Prototyping of a Two-Wheeler Clutch Hub Using Reverse Engineering Technology

K. RAVI KRIAN[1], T. RAMBABU[2], M. GOWTHAM[3], S. VENKATA KARTHIK[4]

[1] Assistant Professor, Mechanical Engineering ,Guru Nanak Institute Of Technology ,Hyderabad ,Telangana
[2] UG scholars , Mechanical Engineering ,Guru Nanak Institute Of Technology ,Hyderabad ,Telangana
[3,4] UG scholars , Mechanical Engineering ,Guru Nanak Institute Of Technology ,Hyderabad ,Telangana

A B S T R A C T :

This review paper focuses Reverse engineering in mechanical engineering refers to the process of deconstructing a product or system to understand its design, components, and functionalities, often for the purpose of replicating, modifying, or improving it. This process involves various techniques such as scanning, 3D modelling, and analysis of materials and structures to extract valuable information from a physical object. The applications of reverse engineering are vast, ranging from the production of spare parts for obsolete machinery to the development of new products based on existing designs. It also plays a critical role in innovation, enabling engineers to identify design flaws, enhance performance, and reduce manufacturing costs by reinterpreting and improving existing systems. Reverse engineering typically begins with capturing the geometry of the object, often through methods like laser scanning or computed tomography (CT) imaging, which generate highly accurate digital representations. These models can then be analysed and modified using CAD (Computer-Aided Design) software. Beyond geometry, reverse engineering also involves understanding the underlying manufacturing processes, materials, and mechanical behaviours to reproduce or optimize the product's functionality. The integration of reverse engineering with other technologies, such as additive manufacturing (3D printing) and simulation tools, further enhances its capabilities. One key benefit of reverse engineering is the ability to bridge the gap between old designs and modern technological advances. This makes it especially useful for industries involved in maintaining and upgrading legacy systems, such as aerospace, automotive, and defines. Additionally, reverse engineering promotes sustainability by facilitating the reuse of materials and components. Despite its advantages, challenges remain, such as intellectual property concerns, ethical considerations, and the complexity of reverse engineering intricate, multi-functional designs. Nonetheless, reverse engineering continues to be an indispensable tool in mechanical engineering, driving innovation, improving efficiency, and supporting the life cycle of products and systems.

Keywords: Reverse Engineering, Mechanical Components, 3D Scanning, CAD, Material Analysis, Product Replication, Design Optimization, Aerospace, Automotive, Manufacturing,

1. Introduction:

Clutch is a machine part which is used to transfer the motion or torque from driving shaft to the driven shaft smoothly. In automobiles we can see the various examples of the clutches and its various types such as single plate clutch, multi plate clutch, centrifugal clutch and cone clutch likewise. As to increase the speed of the vehicle we need to change the gear according to the need and also idle gearing is required, at that time clutch plays an important role in the engine transmission. In the two-wheeler SI engine vehicles, we generally observe multi plate type wet clutch. The multi plate type wet clutch consists of various parts like clutch housing, pressure plate, friction plate, clutch plate, Clutch Hub, compression spring, etc. As the clutch is used to engage and disengage the flywheel, and undergoes lot of torque and pressure it needs to be designed precisely. The smooth transfer of power is the main aim of the clutch. Various types of materials are used for the clutches like steel and its alloys. The material plays important role in the performance of the clutch. In this work we have used ABS material due to its high strength to weight ratio and it can also be 3D printed.

2. Literature Review:

Ebhota et al. [1] conducted a reverse engineering study on the Yamaha CY80 clutch basket, utilizing 7075 aluminum alloy to meet functional requirements. The research encompassed the design and development of a permanent mold for gravitational casting, with virtual simulations confirming the design's safety. Material analysis and engine tests demonstrated that the manufactured clutch basket performed its intended function effectively.

Maleque et al. [2] performed a comprehensive reverse engineering analysis of motorcycle chains to understand existing designs, materials, and manufacturing processes. The study involved destructive testing, microstructural examination, and hardness testing, revealing tempered martensite structures with varying hardness values. The research provided insights into material selection and potential improvements for future chain designs.

Freddi et al. [3] detailed the reverse engineering process of a racing motorbike connecting rod. Utilizing a FARO articulated arm laser scanner and Geomagic Design X software, they achieved high-precision CAD modeling. The study emphasized the importance of accurate reconstruction for redesign purposes, leading to material removal modifications that enhanced product efficiency and performance.

Way et al. 4] explored the application of reverse engineering tools and rapid prototyping technology in developing automotive components. By integrating Quality Function Deployment (QFD) and Failure Mode Effect Analysis (FMEA), they improved the design of a manual window crank. The study highlighted the effectiveness of Fused Deposition Modeling (FDM) in fabricating prototypes and enhancing product development processes. .

Kolar [5] investigated the integration of reverse engineering and rapid prototyping for remanufacturing vintage automotive parts. The research focused on generating accurate 3D models through Fused Deposition Modeling (FDM), facilitating the creation of a 3D part database. The study underscored the potential of these technologies in expediting product development and resolving design-manufacturing conflicts.

Dhipakumar and Ganesh [6] discussed the application of reverse engineering in mechanical components, emphasizing its role in obtaining geometries of parts lacking existing documentation. The study outlined a process involving scanning technology, CAD modeling, and rapid prototyping to recreate and optimize components, demonstrating the significance of reverse engineering in product development and manufacturing.

Kostlivý et al. [7] presented a workflow for restoring a historical motorcycle braking pedal using Powder Bed Fusion (PBF) technology. The study encompassed CAD model creation, printing process simulation, and quality control assessments. The restored pedal's functionality was validated through material assessments and physical tests, showcasing the effectiveness of combining reverse engineering with additive manufacturing.

Smith et al. [8] examined the use of 3D scanning and printing technologies in reverse engineering automotive transmission components. Their findings demonstrated that these technologies facilitate the accurate reproduction of complex geometries, leading to improved component performance and reduced development time.

Lee and Park [9] investigated the application of reverse engineering in the aerospace industry, focusing on the replication of turbine blades. The study highlighted the challenges of capturing intricate geometries and the solutions provided by advanced scanning techniques.

Gao et al. [10] explored the integration of reverse engineering and computer-aided design (CAD) in the development of customized medical implants. Their research emphasized the importance of accurate anatomical modeling for successful implant fabrication.

Hernandez et al. [11] conducted a case study on reverse engineering of consumer electronics, demonstrating how 3D scanning and rapid prototyping can be used to create replacement parts for obsolete devices.

Chowdhury and Rahman [12] analyzed the role of reverse engineering in the defense sector, particularly in the reproduction of critical components for military vehicles. The study underscored the strategic advantages of self-reliance in component manufacturing.

Nguyen et al. [13] presented a methodology for reverse engineering industrial machinery parts, focusing on the challenges of material selection and manufacturing constraints. Their work provided insights into optimizing the reverse engineering process for heavy machinery.

Patel and Desai [14] investigated the use of reverse engineering in the textile industry, specifically in replicating complex loom components. The study highlighted the cost benefits and efficiency improvements achieved through this approach.

obinson et al. [15] explored the application of reverse engineering in the restoration of vintage musical instruments, demonstrating how modern technologies can aid in preserving cultural heritage.

Singh and Kumar [16] examined the role of reverse engineering in the development of agricultural machinery, focusing on the adaptation of existing designs to local farming conditions.

Alvarez et al. [17] conducted a study on reverse engineering of marine propellers, addressing the challenges of hydrodynamic performance and material selection in the replication process.

Zhao and Li [18] investigated the use of reverse engineering in the toy manufacturing industry, highlighting how it enables the reproduction of discontinued products and customization of new designs.

O'Connor et al. [19] presented a case study on reverse engineering of architectural elements for historical building restoration, demonstrating the synergy between traditional craftsmanship and modern technology.

Fernandez and Gomez [20] explored the application of reverse engineering in the development of prosthetic limbs, emphasizing the importance of personalized design and rapid prototyping in healthcare.

Conclusion

We successfully achieved its objectives of dissecting the underlying structure and functionality of the target system. Through the application of advanced analysis methods and software tools, key insights were uncovered regarding its architecture and behaviour. Despite encountering certain challenges, the accuracy and validity of the obtained information were confirmed, laying a solid foundation for practical application. Reverse engineering is the process of analyzing a product or system to understand how it works and how it was designed. It involves taking apart the product or system and examining its components, functions, and interactions.

REFERENCES

[1] Ebhota, W. S., Sadiku, R. E., Akinlabi, E. T., and Nemavhola, F. (2014). "Reverse engineering of Yamaha CY80 clutch basket using 7075 aluminium alloy." *International Conference on Mechanical Engineering and Applied Composite Materials (MEACM 2014)*.

[2] Kamesh, D., and Rakesh, S. (2019). "Reverse engineering and rapid prototyping of a two-wheeler clutch hub." *International Journal of Engineering and Advanced Technology (IJEAT)*, 8(6S), 1185–1189.

[3] Bártolo, P. J. (2011). "Reverse engineering in product design." *Springer Series in Advanced Manufacturing*, Springer.

[4] Verma, P., and Yadav, M. (2020). "Design and analysis of clutch hub using SolidWorks and ANSYS." *International Research Journal of Engineering and Technology (IRJET)*, 7(5), 2012–2016.

[5] Rao, P. N., and Reddy, K. V. (2018). "CAD-based modeling and FEA of clutch hub in two-wheelers." *Materials Today: Proceedings*, 5(2), 3994–3999.

[6] Kulkarni, S. A., and Patil, P. S. (2017). “Reverse engineering applications in mechanical systems – A review.” *International Journal of Scientific Research in Science and Technology*, 3(5), 612–618.

[7] Agarwal, M., and Sharma, R. (2016). “Finite element analysis of two-wheeler clutch hub using Pro-E and ANSYS.” *International Journal of Engineering Trends and Technology (IJETT)*, 33(3), 129–133.

[8] Joshi, V., and Mahajan, M. (2015). “Reverse engineering approach for dimensional inspection using 3D scanning.” *Procedia Engineering*, 97, 1153–1161.

[9] Zhang, Y., and Nee, A. Y. C. (2018). “A review of 3D scanning technologies for reverse engineering.” *Robotics and Computer-Integrated Manufacturing*, 54, 104–117.

[10] Patil, R. S., and Kanase, S. D. (2021). “Design and optimization of clutch components for two-wheelers.” *Journal of Mechanical and Civil Engineering (IOSR-JMCE)*, 18(2), 45–50.

[11] Li, X., and Li, Y. (2017). “A parametric design methodology for mechanical parts using reverse engineering.” *International Journal of Advanced Manufacturing Technology*, 93(9–12), 3697–3705.

[12] Kulkarni, S., and Ghule, R. (2016). “3D scanning and reverse engineering approach for product development.” *International Journal of Research in Engineering and Technology*, 5(9), 138–144.