Design and Fabrication of V6 Solenoid Engine

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***Abstract*— In this work, the development of a revolutionary contribution to the field of electric motor technology known as a V6 Solenoid Engine is detailed. The project incorporates a methodical approach beginning with a comprehensive literature research to collect insights about the designs of electric motors, safety requirements, and technologies that are currently in use. During the beginning stages, we conceptualised numerous engine designs and evaluated them based on their practicability, performance, and level of safety. After determining which of the designs had the greatest likelihood of success, we moved on to the phase of exhaustive elaboration. This phase encompassed the electrical system, the solenoid mechanism, the integration of the battery, and the utilisation of a lightweight base.**

The subsequent development of a prototype provided concrete insights, which enabled testing and modification based on real-world conditions. The process of optimisation was directed by performance criteria, particularly acceleration and top speed, as well as thorough safety tests. The final design uses a V6 layout, which makes the most efficient use of space while still maximising power output. The dimensions of the individual components, the kinds of materials used, and the impact on the environment were among the primary areas of concentration, with the end goal of making the engine suitable for use in modern electric propulsion systems. Not only does this initiative enhance the design and fabrication processes in electric motor technology, but it also brings attention to cost-effectiveness and environmental concerns. The V6 Solenoid Engine that was developed as a result is a demonstration of inventive engineering that provides an environmentally friendly and effective alternative to existing electric propulsion systems.

Keywords*— *Electric Motors; Solenoid Engine; V6 Configuration; Prototype Testing; Sustainable Design; Electric Propulsion; Performance Optimization; Safety Standards; Environmental Impact; Engineering Innovation.

I. INTRODUCTION

The introduction of electric propulsion systems has signaled a fundamental shift in the landscape of engine technology. This has resulted in the development of innovations that provide a challenge to the established paradigms of internal combustion. A revolutionary contribution to the field of electric motor technology, the V6 Solenoid Engine is presented here, along with its design and manufacture, in this particular piece of research. The rising demand for eco-friendly and fuel-effective alternatives to traditional engines served as the impetus for the development of this project. This was especially true in light of the shifting landscape of available energy sources and rising worries over the state of the environment.

Even though it has been around for a while, the idea of a solenoid engine has only seen limited implementation in actual propulsion systems. Solenoids are, at their most basic level, electromagnetic devices that are capable of transforming linear motion into linear motion generated by electrical energy [1]. By applying this idea, the V6 Solenoid Engine intends to convert the linear motion of solenoids into rotating motion, analogous to that of a conventional internal combustion engine but without the emissions and inefficiencies that are typically associated with such an engine.

This project started off with an exhaustive examination of the relevant prior literature, which laid the groundwork for the future phases of design and development [2]. The evaluation covered all of the known technologies for electric engines and focused on the complexities of their designs, as well as the operational principles and safety procedures associated with them. This first phase was essential in determining where there were holes in the existing technology and where there were potential for innovation.

Following the completion of the study phase, a number of different design concepts were suggested and each was examined in terms of its practicability, performance potential, and potential risks. The criteria for selection were stringent, and as a result, it was guaranteed that the winning design would not only satisfy but also beyond the existing standards for the efficiency and sustainability of electric motors [3]. Fig. 1 shows IC engine components.

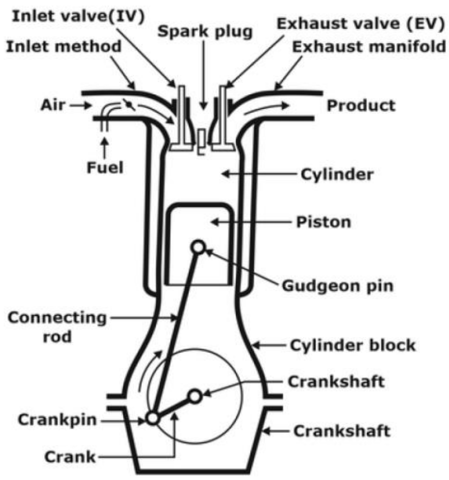

Fig. 1 IC Engine Components

During the process of detailed design, the main components of the engine, such as its electrical system, solenoid mechanism, battery layout, and lightweight structural base, were developed. The performance, the safety, and the ability to manufacture these components were all given a great deal of focus during the optimization process [4]. The electrical system in particular was developed to properly control power distribution to the solenoids, and the choice of a lightweight base material was made with the intention of improving the engine's overall efficiency as well as its manoeuvrability.

The creation of a physical prototype was an essential step in the process of completing the project. This prototype was used as a testbed for the theoretical concepts, which allowed for real-world assessment and further refinement [5]. Testing of performance, which included acceleration and top speed evaluations, as well as thorough safety checks, played an essential part in the process of iterative optimisation.

The ultimate design of the V6 Solenoid Engine is an example of a design that successfully combines innovative ideas with real-world considerations. The V6 configuration, which is well-known for its compactness and balanced distribution of power, was modified to fulfil the one-of-a-kind demands of an electric solenoid system. The choice of materials and the dimensions of the components were made with great care in order to guarantee the engine's longevity and effectiveness while simultaneously reducing its negative influence on the environment [6].

To summarise, the planning and execution of the V6 Solenoid Engine represent a substantial advance in the field of electric motor technology. This project contributes a viable and sustainable alternative to conventional propulsion systems by combining extensive study, inventive design, and practical testing. The consequences of this go far beyond merely being a technical success, and they herald the beginning of a new age in engineering solutions that are environmentally friendly and energy efficient.

II. RELATED WORK

Electric propulsion system development has been the focus of a substantial amount of research and invention in recent years, particularly in the context of the search for environmentally friendly and resource-conserving alternatives to internal combustion engines. The foundation has been built by earlier work in this sector for subsequent developments such as the V6 Solenoid Engine, which draws upon a variety of electromechanical system design ideas as well as electric motor design principles.

The investigation of different propulsion mechanisms that are based on solenoids has been one of the more fundamental components of this research. Previous research has shown that it is possible to generate linear motion by utilising solenoids, which are simply coils that become electromagnets when an electric current is passed through them [1]. These research have concentrated their attention primarily on the transformation of electrical energy into mechanical motion, which is a fundamental concept underlying the workings of a V6 solenoid engine. However, the majority of this early work was restricted to theoretical applications or applications on a small scale, and there was less of an emphasis placed on integrating solenoids into more complicated propulsion systems.

In the past, one prominent area of research was on improving the performance of electric motors in a variety of contexts. Work is being done to improve the electric motors' efficiency and power output, as well as to reduce their size and weight for better integration into automobiles and other mobile applications [2]. This work includes the development of new technologies. These studies have been very helpful in understanding the restrictions and possibilities in the design of electric motors, particularly in regards to the amount of energy that is consumed and the amount of efficiency that is produced.

Previous research has placed a significant emphasis on developing safety standards and regulations, which is particularly important when considering the high-voltage nature of electric propulsion systems. Particularly in the context of high-capacity lithium-ion batteries used in electric vehicles [3,] a significant amount of effort has been put into the development of safety protocols and design considerations to avoid dangers such as electric shock and thermal runaway. [4] These efforts have proven fruitful. This study has been essential in ensuring that emerging technologies for electric propulsion, such as the V6 Solenoid Engine, conform to high safety regulations.

Environmental concerns were similarly prioritised during the early stages of research conducted in this area. Studies have been conducted to investigate the effects that electric motors have on the environment, particularly in contrast to the effects of internal combustion engines. This includes research aimed at lowering emissions, increasing energy efficiency, and making better use of environmentally friendly materials in the design of motors [4]. In light of worries over global climate change, these environmental considerations have taken on an increasingly crucial role, propelling advancements towards more environmentally friendly propulsion systems.

In addition, earlier research has investigated the economic implications of electric propulsion systems, particularly with regard to the costs of manufacturing and the marketability of the products. This study has included evaluations of the costs of materials, the processes of manufacturing, and consumer acceptance, all of which are key aspects in the successfully implementing and adopting new technologies such as the V6 Solenoid Engine [5].

In a nutshell, the work that has been done in the subject of electric propulsion systems in the past has been varied and multidisciplinary. This work has included issues pertaining to the areas of technology, safety, the environment, and economics. These research have collectively contributed to the progress of electric motor technologies, thereby laying the groundwork for revolutionary inventions such as the V6 Solenoid Engine, which stands as a witness to the continued evolution in this dynamic and important sector of engineering.

III. PROPOSED WORK

The implementation plan for the V6 Solenoid Engine project is a meticulously crafted process that emphasizes both the technical sophistication and the innovative design aspects of the engine. This multi-stage approach not only ensures a thorough development process but also allows for detailed attention to each component and design feature. Fig. 2 shows the methodology.

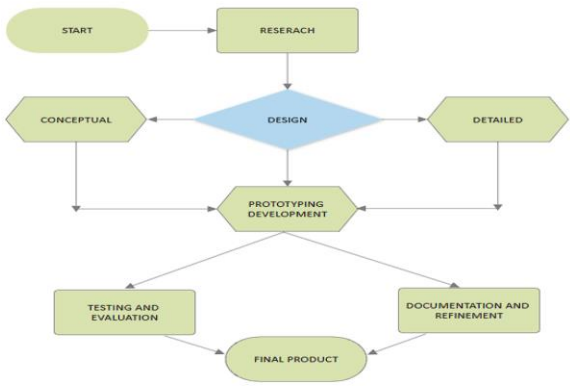

Fig. 2 Methodology

The project commences with an extensive research phase, where a comprehensive literature review is conducted. This stage is pivotal in gathering crucial information about existing electric engine designs, their components, and the prevailing safety standards and regulations. The objective is to build a solid foundation of knowledge that will guide the design and development of the solenoid engine.

Based on the research findings, the conceptual design phase involves developing multiple design concepts for the electric engine. Each concept is meticulously crafted, considering factors such as performance capabilities, safety features, cost implications, and manufacturability. This stage is crucial for evaluating different design approaches and selecting the most feasible and efficient one.

The selected design concept is then translated into a detailed design. This phase is where the technical nuances of the engine come to the forefront. Key components such as the electrical system, solenoid, battery, and frame are designed with precision.

The electrical system is a critical component, designed to efficiently manage power distribution to the solenoids, which are the heart of the engine.

The solenoid design is pivotal in this engine, as it converts electrical energy into mechanical motion. The solenoid consists of a coil of wire wound around a metal core, which becomes magnetized when electric current flows through it, thereby creating motion.

The battery system is optimized for energy efficiency and longevity, ensuring that the engine can operate effectively for extended periods.

The frame design, using lightweight materials such as wood, contributes to the engine's overall efficiency and maneuverability. Fig. 3 shows the circuit diagram for pulse generation.

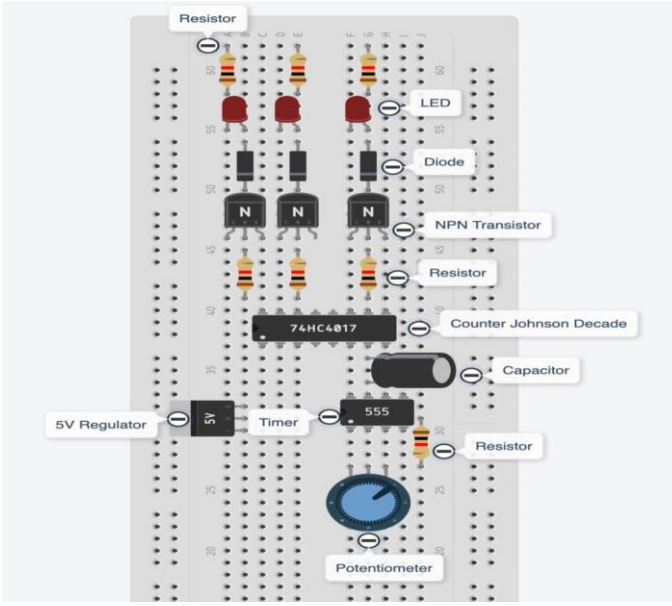

Fig. 3 Circuit Diagram

In this phase, the detailed design is brought to life through the development of a physical prototype. This prototype is a crucial step in testing the practical viability of the design. It allows for the identification and rectification of any design or functional flaws.

The prototype undergoes rigorous testing to evaluate its performance and safety. These tests include acceleration and top speed assessments, along with comprehensive safety checks. This phase is essential for ensuring that the engine operates safely and meets all performance expectations.

Following testing, the design is refined and optimized based on the feedback received. This iterative process is vital for enhancing the engine's performance and safety features.

The final phase involves preparing detailed documentation of the entire design and manufacturing process. This documentation includes all research data, design concepts, prototypes, and testing results, along with recommendations for future improvements.

Throughout these phases, technical components such as transformers, solenoids, and various electrical elements play a significant role.

The transformer is crucial for transferring electrical energy between circuits, operating on the principle of electromagnetic induction.

The solenoids, around which the engine's design is centered, are responsible for the conversion of electrical energy into mechanical motion.

The circuit design, which includes diodes, capacitors, a 5V regulator, and other components, is critical for controlling the flow of electricity and ensuring the efficient operation of the engine.

The project effectively proves that it is possible to develop and manufacture an ecologically friendly, high-performance electric engine. In addition, the electric engine is safe to operate.

This accomplishment would not have been possible without a methodical strategy that began with an exhaustive literature review in order to gain an understanding of the many designs, components, safety standards, and regulations currently in place for electric engines. This research helped to shape the creation of various different concepts for the design of electric engines, with a particular emphasis on performance, safety, affordability, and the ability to be manufactured.

Following an analysis of these ideas for their applicability, level of performance, and level of risk, the most promising design was chosen for further development. During this stage, improvements were made to the electrical system, the solenoid, the battery, and the frame, with a focus on improving the product's overall performance while also making it safer and simpler to produce. Following the completion of this thorough design, a physical prototype of the electric engine was subsequently developed.

This prototype was put through a battery of demanding testing to evaluate its capabilities and ensure that it is safe to use. These tests included evaluations of its acceleration, top speed, noise, stability, and safety. The results of the tests were promising and showed that the electric engine worked well in terms of acceleration and top speed. In addition, it was discovered that the engine had a negligible effect on the surrounding environment, as seen by its low levels of pollutants and decreased carbon footprint. The frame of the engine was constructed out of lightweight materials such as wood or composites, which substantially contributed to the engine's speed and its manoeuvrability.

In terms of the technical analysis, the project made use of SolidWorks, a potent computer-aided design (CAD) programme, for the development and analysis of the design. This was done in order to meet all of the technological requirements. In addition to providing tools for the design of mechanical components, electrical systems, and other types of components, SolidWorks made it easier to create detailed 3D models and assemblies. The integrated data management features of the programme made it possible for the team to effectively collaborate on the project.

An additional analysis was carried out with the help of the ANSYS software, which made it possible to undertake an in-depth investigation of the structural, thermal, and fluid flow behaviours of the design. This simulation feature in SolidWorks was extremely helpful in locating any problems in the design, improving the designs in terms of their strength and efficiency, and reducing the amount of time and effort spent creating physical prototypes. The use of computational fluid dynamics (CFD), finite element analysis (FEA), and thermal analysis provided vital insights into how the product operates under a variety of settings, which ensured improved performance and reliability.

In general, the project emphasises the potential of new software tools in the design and analysis of complex electric engines. This paves the way for innovative, safe, and environmentally friendly solutions to be developed in the field of electric propulsion systems.

IV. RESULTS

The results from the finite element analysis (FEA) of the V6 Solenoid Engine project provide insightful data regarding the behavior of different materials under specific conditions. This analysis is crucial for determining the suitability of materials for various components of the engine, like the base board and the camshaft, under operational stresses and strains.

The static analysis performed on the base board, made of plywood, under varied loads of 50N and 100N revealed important information about the material's stress distribution and deformation characteristics.

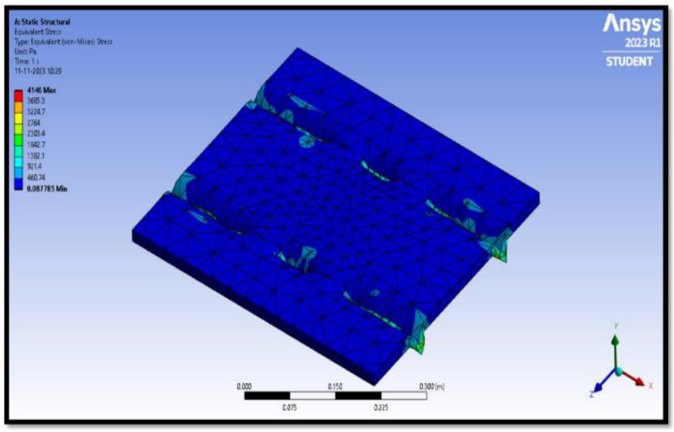

Fig. 4 50N Load Base Board

When a load of 50N was applied, the analysis showed specific patterns of Von Mises stress distribution. These stress values are critical for understanding how the plywood base board will behave under operational conditions.
With an increased load of 100N, the Von Mises stress distribution changes, indicating how the material responds to higher stress levels. Additionally, the directional deformation analysis at this load provides insights into the material's flexibility and resilience under increased force.
The material properties of plywood, with its layered structure, offer a combination of strength and flexibility, making it suitable for the base board application in the electric engine.

The camshaft, a crucial component in the engine, was analyzed using three different materials: grey cast iron, aluminum alloy, and structural steel. The analysis involved several steps:

Model Preparation: A detailed 3D model of the camshaft was created using SolidWorks. This model is essential for accurate FEA.

Material Properties: The properties of the materials, including elasticity, Poisson's ratio, and density, were inputted into ANSYS for analysis.

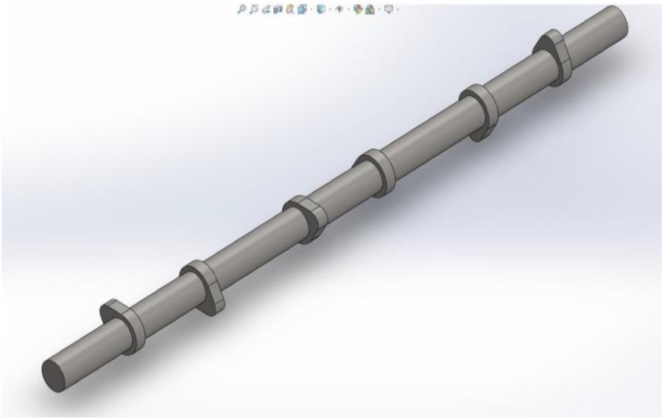

Fig. 4 Camshaft Model

Mesh Generation: Meshing the model is a vital step in FEA, impacting the accuracy of results. The size of the mesh elements affects the precision of the analysis.

Boundary Conditions: Proper constraints were applied to the camshaft model, considering it as a rotating member in the engine. The load of the turning moment was specifically applied for this analysis.

Solution Phase: This phase involved analyzing the total deformation, equivalent stress, and equivalent strain of the camshaft model under simulated operational conditions.

Post-Processing: The final step included examining various graphs representing different factors, providing a clear understanding of potential material failure.

Table 1 Camshaft Analysis Result

MATERIALS	TOTAL	STRESS	STRAIN
GREY CAST IRON	0.37421 mm	16.81 MPa	0.00015299
ALUMINIUM ALLOY	0.57680 mm	16.79 MPa	0.00023683
STRUCTURAL STEEL	0.20543 mm	16.82 MPa	0.00007750

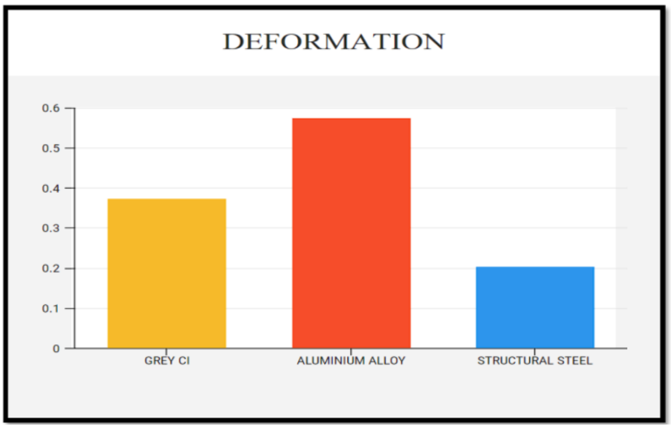

Fig. 5 Deformation Graph

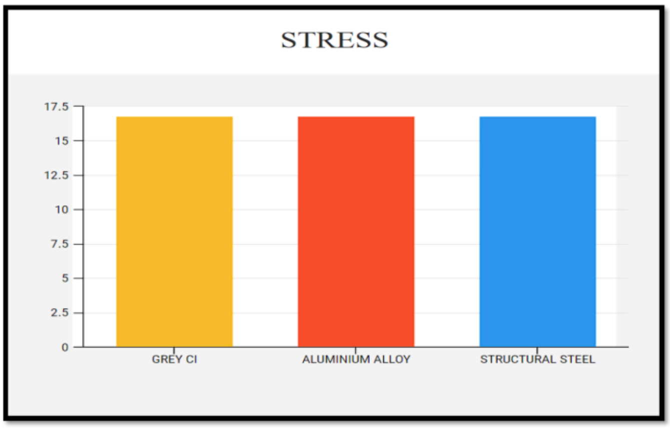

Fig. 6 Stress Graph

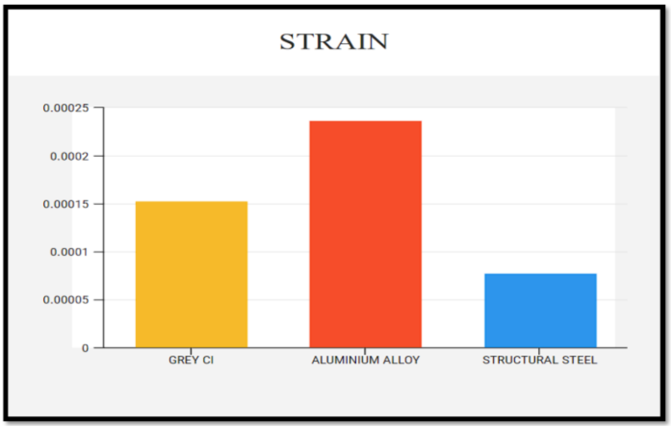

Fig. 7 Strain Graph

The results from fig. 4, 5, 6 of the analysis revealed the following:

Grey Cast Iron: Exhibited a total deformation of 0.37421 mm, a stress of 16.81 MPa, and a strain of 0.00015299.
Aluminium Alloy: Showed the highest total deformation at 0.57680 mm, a stress of 16.79 MPa, and a strain of 0.00023683.
Structural Steel: Demonstrated the least deformation at 0.20543 mm, but the highest stress value at 16.82 MPa and a strain of 0.00007750.
The conclusion drawn from these results indicates that aluminum alloy experiences the highest deformation among the materials, suggesting its lower suitability for applications where rigidity is crucial. Grey cast iron and structural steel show less deformation, with structural steel exhibiting the highest stress capacity. This analysis guides material selection for the camshaft based on the specific requirements of stress resistance, deformation, and overall durability in the operational context of the V6 Solenoid Engine.

V. CONCLUSION

The V6 Solenoid Engine project is a significant improvement in the realm of engine technology. The project's primary focus is on improving fuel economy and reducing the engine's negative impact on the environment. This project effectively exhibits a unique approach to the design of an engine that varies from the conventional paradigm of a combustion engine. It addresses critical challenges relating to fuel consumption, power losses, and the utilisation of batteries.

One of the most important aspects of this project is the installation of an electrical switching circuit in place of the mechanical switches that are traditionally utilised in magnetic engines. This modification in strategy plays a critical part in lowering the creation of heat and friction, which are two of the primary contributors to the inefficiency of conventional engines. The V6 Solenoid Engine is not only able to function in a more effective manner as a result of the elimination of these mechanical components, but it also contributes to a reduction in the amount of influence it has on the environment.

The complexity that is generally associated with mechanical solenoid switching is simplified thanks to the electronic switching circuit. This simplification not only improves the engine's reliability and durability but also makes it possible to exert greater control over the engine's workings, which is a significant benefit. Because of this, the engine is able to operate at a better degree of efficiency as well as performance, both of which are essential in the engineering applications of today.

In addition, one of its most notable qualities is that the engine has a low impact on the environment. The elimination of fuel and combustion processes in the design denotes a shift towards more environmentally friendly methods of producing energy. The V6 Solenoid Engine is a forward-thinking solution in the field of environmentally aware technology as it aligns with worldwide initiatives to reduce carbon emissions and reliance on fossil fuels. This is one of the reasons why this approach is so important.

In conclusion, the V6 Solenoid Engine project represents a breakthrough shift in the design of engines, mixing efficiency, environmental responsibility, and inventive engineering into a single package. It establishes a new standard for future advancements in engine technology, so paving the path for propulsion systems that are more environmentally friendly and energy efficient. The accomplishment of this project illustrates the potential for further innovation in this sector, which provides a positive perspective for the future of engine technologies that are kind to the environment and efficient in their operation.

REFERENCES

[1] Suresh, Brahadeesh. (2021). SOLENOID ENGINE. 10.13140/RG.2.2.32973.56803.

[2] Chandra, Raghuveer. (2020). Design and analysis of V6 engine.ijrct

[3] Anamika Tiwari, Anurag Singh, Deepak Agarwal, Ajay Kumar Verma, "Design and Fabrication of 4-Stroke Solenoid Engine", International Research Journal of Engineering and Technology (IRJET), Volume-6, Issue-12, December 2019.

[4] Pratik Kumar Sinha, "High Torque Solenoid Coil Engine", International Academy of Engineering and Medical Research (IAEMR), Volume-2, Issue-3 March -2017.

[5] Prashant kumar tiwari "Design and development of solenoid engine ", International Journal of Emerging Technologies and Innovative Research (www.jetir.org | UGC and issn Approved), ISSN:2349-5162, Vol.8, Issue 5, page no. ppe458-e464, May-2021, Available at : http://www.jetir.org/papers/JETIR2105601.pdf

[6] Sanket Sandeep More, Shaikh Md Aameel Iqbal Hassan2, Rutvik Rajaram Patil3, Pushpak Mahesh Shewale4. "Design and fabrication of single cylinder solenoid engine" VIVA-Tech International Journal for Research and Innovation Volume 1, Issue 4 (2021) G146-G152.

[7] Wikipediaoriginal: https://en.wikipedia.org/wiki/Solenoid

[8] Rahul Bhatia, Vishal Jariwala, Akash Jariwala, Abhishek Alkari, Prof. Hiral Chauhan "Experimental Working model of V8 solenoid engine" IJCRT Volume 9, Issue 4 April 2021 | ISSN: 2320-2882

[9] Md Modassar Akhtar, Santosh Kumar Tripathy, Ekula Prasant Kumar, Suryakanta Biswal, Sourabh Kumar, Himanshu Shekhar Dash "SOLENOID ENGINE" © April 2017 IJSDR | Volume 2, Issue 4, ISSN: 2455-2631