Design and Fabrication of Engine Oil Extractor for Mechanics

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Abstract. The fabrication of a portable engine oil extractor addresses the challenges faced by mechanics in automotive workshops, where conventional oil draining methods are time-consuming, labour-intensive, and pose safety risks. Traditional techniques require lifting vehicles, removing drain plugs, and working under the car, which increases the likelihood of injuries and physical strain. Additionally, modern oil extraction machines available in the market are often expensive and bulky, making them inaccessible for small-scale workshops. This project aims to design and fabricate a cost-effective, lightweight, and portable engine oil extractor that simplifies the oil changing process, reduces operational time, and enhances workplace safety. The proposed design integrates an electric oil extractor pump powered by a 12 V car battery, housed within a compact frame constructed from hollow mild steel and aluminium sheet plates for durability and corrosion resistance. The extractor uses a semi-automatic system that requires minimal human effort, enabling oil removal through the dipstick tube without dismantling engine components. The frame is equipped with castor wheels and a luggage-style handle for easy mobility, while safety features such as secure hose connections and proper sealing prevent oil spillage during operation. The fabrication process involves cutting, welding, grinding, drilling, and riveting techniques, ensuring structural integrity and ease of assembly. Performance testing demonstrated that the portable extractor significantly reduces oil extraction time compared to manual hand pumps, achieving faster flow rates and improved efficiency. Cost analysis revealed that the total fabrication cost of RM366.50 is substantially lower than commercial alternatives, which range from RM638.00 to over RM3,000.00. This affordability makes the product suitable for small workshops and individual users, promoting wider adoption of modern maintenance practices. Furthermore, the design emphasizes ergonomics and portability, reducing physical strain on mechanics and optimizing workshop space. Future improvements may include integrating a stainless-steel filter on the inlet hose to prevent debris entry, upgrading the battery to higher wattage for faster operation, and incorporating digital monitoring systems for enhanced functionality. Addi-

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tionally, the extractor can be adapted as an emergency kit for personal use, enabling convenient oil changes in remote locations. Overall, this innovation aligns with TVET and Industry 4.0 principles by combining mechanical design with practical automation, delivering a product that enhances efficiency, safety, and cost-effectiveness in automotive maintenance.

Keywords: Oil extraction, fabrication, maintenance, oil drain, design.

1 Introduction

The rapid advancement of technology under Industrial Revolution 4.0 (IR 4.0) has transformed industrial practices by emphasizing innovation, efficiency, automation, and improved human-machine interaction [1-3]. In the automotive service sector, these advancements have encouraged the development of tools and systems that enhance productivity while reducing physical workload and safety risks [3, 4]. Within this context, the Portable Engine Oil Extractor is proposed as an innovative mechanical solution aimed at improving the efficiency and ergonomics of engine oil servicing operations in automotive workshops.

At present, many automotive workshops in Kuching and throughout the Sarawak region continue to rely on conventional engine oil extraction techniques, such as draining oil through the sump plug or using manual hand pumps [5]. These traditional methods are generally time-consuming and labor-intensive, requiring vehicles to be lifted using ramps or jacks. Moreover, mechanics are often required to work underneath suspended vehicles, which increases the risk of occupational injuries and long-term musculoskeletal strain [5, 6]. Although modern oil extraction equipment is commercially available, such systems are frequently associated with high acquisition costs, large physical dimensions, and limited portability, making them unsuitable for small-scale or independently operated workshops [7, 8].

Financial limitations remain a significant barrier preventing many mechanics from adopting advanced oil extraction technologies [9]. Consequently, manual tools continue to be widely used despite their inefficiency and the physical strain they impose [10]. Repetitive tasks such as jacking vehicles, removing drain plugs, handling oil containers, and reassembling engine components significantly extend servicing time and increase fatigue [10, 11]. Prolonged exposure to these working conditions can lead to health issues, including chronic back pain, which negatively affects productivity and service quality in automotive workshops [11].

To address these challenges, this research focuses on the design and fabrication of a portable, electrically powered, compact, and lightweight engine oil extractor. The proposed system is intended to minimize manual effort, enhance operator safety, and reduce servicing time during engine oil replacement [12]. Its semi-automatic operation allows mechanics to extract engine oil efficiently without the need for vehicle lifting or extensive physical exertion, thereby reducing occupational risk [13]. Furthermore, the portable design and low-cost components make the system accessible and practical for small and medium-sized workshops where space and financial resources are often limited [14].

Nevertheless, certain limitations are acknowledged in the proposed design. The main structural frame is fabricated from mild steel, which may be susceptible to corrosion when exposed to moisture or harsh environmental conditions over extended periods [15]. In addition, as a semi-automated system, proper operation still depends on user involvement [16]. Potential challenges during fabrication, such as welding defects (including cracks or porosity), dimensional inaccuracies, or errors during the riveting process, may affect structural integrity, component alignment, and overall durability if not carefully controlled [17, 18].

Engine oil extractors are commercially available in a wide range of designs to meet both professional and individual user demands. These products are widely used by automotive mechanics and private vehicle owners worldwide [19]. Each design undergoes a systematic development process involving conceptual design, material selection, and fabrication techniques to ensure functionality, durability, and cost effectiveness [20]. Common manufacturing processes include filleting, extrusion, rotational forming, and riveting, which are employed sequentially until the intended design specifications are achieved [21].

Material selection is a critical aspect of engine oil extractor design, as it directly influences product cost, structural durability, safety, and aesthetic quality [22]. Materials such as mild steel, plastic, glass, and stainless steel are commonly used, depending on application requirements and budget constraints [23]. The primary purpose of these products is to facilitate engine servicing operations by enabling efficient and safe oil extraction [24].

Engine oil extractors available on the market can generally be categorized into three main types: manual, pneumatic, and electric [25]. Each type differs in terms of structural design, material composition, operating mechanism, and hose configuration [26]. Manual oil extractors are typically manufactured from plastic materials and feature a cylindrical storage container integrated with a hand-operated pumping mechanism [27]. Their relatively large storage capacity allows for the collection of significant volumes of engine oil, while the use of plastic materials improves safety in workshop environments by reducing the risk of corrosion and electrical hazards [28].

Despite these advantages, manual engine oil extractors have notable limitations. Their operation relies entirely on human effort, which significantly increases servicing time and contributes to operator fatigue. Prolonged use may lead to physical exhaustion, particularly during frequent oil replacement tasks, thereby reducing overall workshop efficiency. These limitations highlight the need for more ergonomic and efficient alternatives to conventional manual oil extraction systems.

Pneumatic engine oil extractors are typically manufactured using metallic materials, which significantly enhance their structural strength and operational stability. These systems are commonly equipped with a transparent collection bowl, allowing users to visually monitor the oil condition and fluid level, thereby indicating when the container is full. In addition, rubber castor rollers are installed at the base of the unit to improve mobility, making the equipment easier to reposition within the workshop and more convenient to store when not in use. However, pneumatic oil extractors generally have a large physical footprint due to their reliance on external air compressors. The requirement for compressed air not only increases equipment size but also demands additional storage space, limiting their practicality in small or space constrained workshops.

In contrast, electrical engine oil extractors are designed with compact dimensions to enhance portability and user convenience. These devices are often described as small-sized and lightweight, making them suitable for mobile applications and field servicing. Typically, the internal components are constructed from plastic materials to reduce overall weight, while the outer casing is made from metal to provide adequate protection and durability. This combination of materials ensures ease of handling without compromising mechanical integrity. The compact design allows the extractor to be easily transported and used in various locations. Electrical oil extractors operate using an external power source supplied through positive and negative electrical connections, enabling efficient oil extraction without the need for manual force or pneumatic systems.

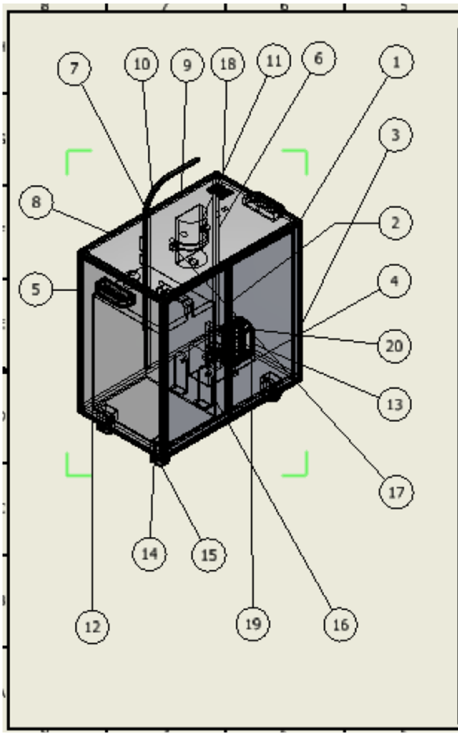
Despite these constraints, the proposed portable engine oil extractor represents a cost-effective, ergonomic, and safer alternative to conventional oil extraction methods. The system has strong potential to improve workshop efficiency while reducing physical strain and operational risks, particularly in resource-limited automotive service environments.

The design and implementation of a portable engine oil extractor is expected to significantly reduce engine oil servicing time while improving mechanic ergonomics by minimizing physical strain and fatigue. The compact and mobile design will enhance workshop space efficiency and ease of movement, enabling safer, more efficient, and more convenient oil extraction compared to conventional methods.

2 Methodology

The methodology of this study focuses primarily on the computer-aided design (CAD) and fabrication processes of the portable engine oil extractor. Autodesk Inventor was used as the main design software to develop precise three-dimensional models and detailed engineering drawings of the system. The use of CAD software ensured dimensional accuracy, facilitated component assembly analysis (Fig. 1), and minimized fabrication errors prior to physical construction. To achieve the project objectives, a comprehensive review of existing engine oil extractor designs and fabrication methods was conducted. This review guided the selection of suitable materials, structural configuration, and manufacturing techniques. Emphasis was placed on producing a design that is robust, compact, and practical for workshop use.

Several standard metal fabrication techniques were applied during the construction of the prototype, including the cutting, welding, grinding, drilling, and riveting processes. These processes were carried out sequentially to ensure proper alignment, structural integrity, and operational reliability. Initially, structural components were prepared by cutting hollow mild steel sections using a hacksaw. Four hollow mild steel bars were cut to a length of 508 mm, four bars to 304.8 mm, and another four bars to 457.2 mm to form the main frame structure. For the door section, additional hollow mild steel bars were cut, consisting of four pieces with a length of 457.2 mm and four pieces with a length of 228.6 mm.



PARTS LIST			
ITEM	QTY	PART NUMBER	MATERIAL
1	1	Body Frame	Hollow Mild Steel
2	1	Aluminium Plate Door	Aluminium Sheet Plate
3	1	Aluminium Plate Door	Aluminium Sheet Plate
4	1	Bottom Cover	Aluminium Sheet Plate
5	1	Side Cover	Aluminium Sheet Plate
6	1	Side Cover with hole	Aluminium Sheet Plate
7	1	Top Cover	Aluminium Sheet Plate
8	1	Back Cover	Aluminium Sheet Plate
9	1	Back Cover	Aluminium Sheet Plate
10	1	Trolley Handle	Mild Steel
11	1	12V/60W Electric Oil Extractor Pump	Metal
12	1	10L HDPE Plastic Bottle	HDE Plastic
13	1	12V Battery	Polypropylene Resin
14	4	Castor Wheel Holder	Stainless Steel
15	4	Castor Wheel	White Polypropylene
16	2	Stainless Steel 90 Degree Angle Code	Stainless Steel
17	1	Bracket Holder For Pump	Aluminium
18	2	Switch	Plastic
19	4	Door Handle	Stainless Steel
20	1	Bracket Holder For Battery	Aluminium

Fig. 1. CAD drawing of the oil extractor.

After completing the steel cutting process, aluminium sheet plates were prepared to serve as the outer casing of the unit. Using a grinder, four aluminium plates were cut to 508 mm × 457.2 mm, four plates to 304.8 mm × 457.2 mm, and another four plates to 508 mm × 304.8 mm. These panels were later attached to the frame structure using drilling and riveting processes. Subsequently, welding was performed to assemble the mild steel frame, ensuring rigidity and stability of the structure. Grinding operations were carried out to remove sharp edges and welding imperfections, improving safety and surface finish. Drilling and riveting processes were applied to securely fasten the aluminium panels to the frame, completing the physical fabrication of the engine oil extractor body. This systematic approach to design and fabrication ensured that the final prototype met the required functional, ergonomic, and structural performance criteria.

3 Results and Discussion

The total final cost of the portable engine oil extractor prototype (Fig. 2) is RM 366.50, which represents the actual expenditure incurred during fabrication. This cost includes all essential components such as the structural frame, electric oil extractor pump, power supply (battery), control switches, storage container, wheels, fasteners, and finishing materials. Compared to commercially available pneumatic engine oil extractors, which are generally priced significantly higher due to their reliance on air compressor systems and larger construction, the proposed design offers a cost effective alternative without compromising functionality. The relatively low cost demonstrates that the portable engine oil extractor can be fabricated using readily available materials and basic manufacturing processes, making it economically viable for small and medium sized automotive workshops. Furthermore, the reduced dependence on expensive auxiliary equipment such as air compressors contributes to lower initial investment and maintenance costs. As a result, the total cost of RM 366.50 supports the feasibility of this project as an affordable workshop tool that can be adopted by mechanics with limited financial resources.

Fig. 2. Finish product.

The portable engine oil extractor is highly suitable for use in automotive workshops (Fig. 3), particularly for routine engine oil servicing tasks. Its main application is to extract engine oil efficiently without requiring the vehicle to be lifted using jacks or ramps. This reduces servicing time and minimizes safety risks associated with working underneath vehicles. Due to its compact and mobile design, the extractor can be easily moved around the workshop using the integrated wheels, allowing mechanics to service multiple vehicles conveniently. The ability to relocate the unit without manual lifting improves ergonomics and reduces physical strain. This feature is especially beneficial in workshops with limited space, as the extractor can be stored easily when not in use. In addition, the electrically powered extraction mechanism enables consistent and continuous oil suction, resulting in faster oil removal compared to manual hand pumps. This improves workflow efficiency and allows mechanics to serve more customers within the same working period. The system is also suitable for extracting other non-corrosive automotive fluids, further enhancing its practicality.

Beyond professional workshop use, the portable engine oil extractor can also function as an emergency or mobile servicing tool, such as for roadside assistance or personal vehicle maintenance. Its portability, simple operation, and low cost make it an attractive solution for both professional mechanics and individual users.

Fig. 3. Oil extractor application in the workshop.

Table 1 presents a comparison between the portable engine oil extractor and the manual hand pump in terms of time taken and amount of engine oil extracted. The comparison was conducted at equal time intervals ranging from 1 to 6 minutes to evaluate extraction efficiency. The results show that both the portable engine oil extractor and the manual hand pump require the same extraction time at each interval. This indicates that time alone is not the distinguishing factor between the two methods. Instead, performance differences are reflected in the volume of oil extracted within the same time. At every time interval, the portable engine oil extractor consistently extracted a larger volume of engine oil compared to the manual hand pump. For example, after 1 minute of operation, the portable extractor removed 0.8 L of oil, whereas the manual hand pump removed only 0.5 L. This performance difference became more pronounced as time increased. After 6 minutes, the portable extractor achieved a total extraction of 3.3 L, while the manual pump extracted only 2.0 L.

Table 1. Comparison between engine oil extractor and manual hand pump.

Time taken to extract Engine oil (minute)		Amount of extracted Engine oil (liter)	
Portable extractor	Manual	Portable extractor	Manual
1	1	0.8	0.5
2	2	1.3	0.9
3	3	1.8	1.2
4	4	2.3	1.5
5	5	2.8	1.8
6	6	3.3	2.0

The data clearly demonstrate that the portable engine oil extractor has a higher extraction rate than the manual hand pump. This improvement can be attributed to the electrically powered pumping mechanism, which provides continuous and uniform suction. In contrast, the manual hand pump relies entirely on human effort, resulting in lower suction efficiency and gradual operator fatigue. From an operational perspective, the portable engine oil extractor offers significant advantages. It allows mechanics to extract more oil within the same working time while reducing physical strain. This leads to improved productivity, reduced fatigue, and enhanced workshop efficiency. The manual hand pump, although functional, is less efficient and more physically demanding, making it less suitable for high frequency servicing tasks.

4 Conclusion

This project successfully achieved its primary objective of designing and fabricating a portable engine oil extractor that is cost effective, efficient, and suitable for practical workshop applications. Compared to commercially available systems such as pneumatic oil extractors, the proposed design offers a significantly lower manufacturing cost while maintaining reliable oil extraction performance. In addition, experimental results confirm that the portable engine oil extractor can extract engine oil more efficiently than a manual hand pump within the same operating time.

The outcomes of this study demonstrate that the proposed system can effectively reduce servicing time, minimize physical effort, and improve working ergonomics for mechanics and other users. By eliminating the need for continuous manual pumping, the device helps reduce operator fatigue and enhances overall productivity during engine oil servicing. Owing to its compact size and mobility, the extractor is also well suited for workshops with space limitations.

Several improvements are recommended to further enhance the performance and durability of the system. First, the installation of a stainless-steel filter at the inlet hose is recommended to trap fine particles and contaminants, thereby preventing damage to the pump and extending its operational lifespan. Second, upgrading the power system to a higher capacity battery (up to 100 W) is recommended to increase suction power and further reduce oil extraction time.

Finally, due to its portability, ease of operation, and independence from fixed infrastructure, the developed portable engine oil extractor has strong potential to be used as an emergency oil changing tool. It can be conveniently deployed in various locations and is suitable not only for professional workshop use but also for personal and mobile servicing applications.

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Disclosure of Interests. The authors have no competing interests

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