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Design of Portable Electronic Brake Bleeder with Interchangeable Adapter and Integrated Trouble Light

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Abstract: This study explored on the design of a portable electronic brake bleeder with interchangeable adapters and integrated trouble lights, which can assist in brake fluid testing and maintenance. Educational technology is evolving rapidly, and educators must keep up with these advancements to remain effective. The researchers designed a portable electronic brake bleeder with interchangeable adapters and integrated trouble lights to assist in the brake fluid testing process. The interchangeable adapters were designed to fit different types of brake systems, while the integrated trouble lights provided real-time feedback on the status of the brake fluid during testing. The use of microfluidic technology in brake fluid testing has the potential to improve safety and reduce the risk of brake system failure in automotive vehicles. Using information from existing literatures, the prototype developed in the study has the potential to demonstrate accurate and reliable measurement of the boiling point of brake fluid samples and has a useful feature in assisting with the brake fluid testing process. This study will also consider optimizing the design of the microfluidic chip and improve the accuracy and reliability of the measurements in the development phase.

Keywords: *Portable Electronic Brake Bleeder, Trouble Light*

1. Introduction

Educational technology, learning principles and instructional materials are essential to create effective, engaging, and inclusive learning experiences that prepare students for success. By integrating these three components, educators can create a more comprehensive and engaging learning experience for students. Learning principles provide a foundation for effective instruction, educational technology provides tools to enhance instruction, and instructional materials provide content to support instruction. Combining these elements can create a more immersive and effective learning experience. A systematic review to investigate the integration of multimedia principles into digital learning materials. The study aimed to identify the current trends in multimedia learning, explore the effectiveness of multimedia principles, and provide insights into how these principles can be integrated into digital learning materials. The researchers reviewed 87 studies from 2010 to 2018 and found that most studies (63%) incorporated multimedia principles into digital learning materials, indicating a growing interest in the field. Educational technology is evolving rapidly, and educators must keep up with these advancements to remain effective. By combining learning principles, educational technology, and instructional materials, educators can stay up to date with the latest trends and technologies, allowing them to provide students with the best possible learning experience. practicing the skills taught is critical for students to become proficient in the skill, retain the knowledge they have gained, build confidence, identify areas of improvement, and transfer their learning to other contexts. The explores the role of practical training in developing skills in the TVET system of Pakistan. It revealed that practical training

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is essential for developing technical skills and improving employability in the TVET system. The study suggests that a focus on hands-on practice is necessary to enhance the quality of TVET programs in Pakistan. The studies of Wan Khairuzzaman et al. [1]; Abduh and Wahid [2]; and Puspitarsari et al. [3] highlights the importance of practical skills practice in automotive courses, including its role in developing technical skills, enhancing employability, and preparing students for the demands of the modern automotive industry.

Brake bleeder kit is designed to help remove air bubbles from the brake system, which can cause brake pedal sponginess and reduce braking performance. The kit typically includes a hand-held vacuum pump and a collection bottle, which is attached to the brake bleeder valve. The process of using a brake bleeder kit involves attaching the pump to the bleeder valve, creating a vacuum to draw brake fluid through the system and expelling any air bubbles. This process can be performed quickly and reliably, allowing for efficient brake servicing. Additionally, many brake bleeder kits come with adapters to fit a variety of different brake systems, making them a versatile tool for any automotive professional or DIY mechanic. Brake bleeding is an important maintenance procedure that should be performed regularly to ensure safe and reliable braking performance [4]. Li Li et al [5] evaluated the effectiveness of a new brake bleeder device designed for automotive brake system maintenance and compared the new device to a conventional brake bleeder kit and found that the new device was faster and more efficient at bleeding the brake system. In a separate study, Kumar et al [6] evaluated the effect of air entrainment on the performance of automotive brake systems and used a brake bleeder kit to bleed the brake system and found that it improved the performance of the system by removing air bubbles. Learning about the design of a portable electronic brake bleeder with interchangeable adapter and integrated trouble light is important for improving safety, efficiency, and innovation in the automotive industry, as well as for advancing careers in automotive technology. This study on portable electronic brake bleeder with interchangeable adapter and integrated trouble light was conducted to help individuals develop a range of skills in the automotive industry, including brake system maintenance, technical expertise, problem-solving, attention to detail, and tool proficiency.

This research was intended for the students of Automobile Mechanic Course at the Don Bosco Technical Institute of Makati. Inc, and any other institutions with automotive servicing course as support to their practical applications and evaluation skills in Performing Servicing Brake System under the Automotive Servicing NCII - Chassis Repair. This is also exclusive for hydraulic braking system only and not intended for pneumatic and mechanical braking system.

2. Method

The general objective of this research study is to develop an automotive tool that will address the need in performing quick and reliable brake servicing process that can also be used as an instructional material for teaching. The portable electronic brake bleeder with interchangeable adapter and integrated trouble light has the following features:

a. Components are placed in a aluminum suitcase to make it lightweight and portable;
b. Low generating power due to low voltage high speed pump. (DC 12v 60w 0.8MPA centrifugal pump);
c. Simple wiring harness are used for convenient wiring connections which are safe for students to handle.
d. Clear canisters and hoses for the safe handling of brake fluid;
e. Bleeder screw adapters (6mm, 8mm, 10mm, 12mm,);
f. Flexible LED Light (DC 12v 40w) for illumination especially during night

3. Result

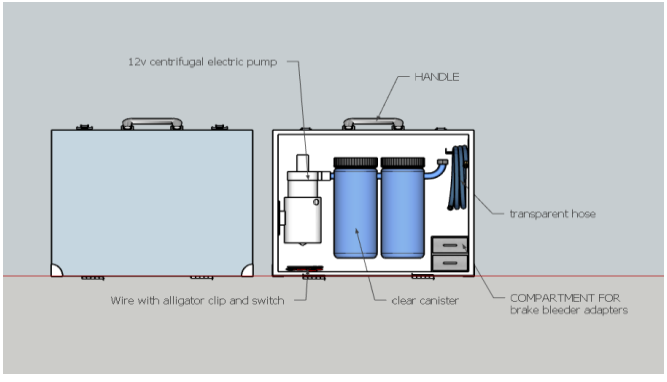

Fig.1. Design and Development of Portable Electronic Brake Bleeder with Interchangeable Adapter and Integrated Trouble Light

4. Discussion

The best design for a portable electronic brake bleeder with interchangeable adapter and integrated trouble light will depend on the user's specific needs and requirements. It is important to carefully evaluate the features and capabilities of different designs before making a purchase to ensure that the brake bleeder meets the user's needs and expectations. However, some key features that can contribute to a high-quality design include:

a. Durability: The brake bleeder should be made of high-quality materials that are durable and can withstand repeated use in a variety of conditions.
b. Compatibility: The brake bleeder should be compatible with a wide range of vehicle makes and models and should include interchangeable adapters to ensure a secure and accurate fit on different brake systems.
c. Ease of use: The brake bleeder should be easy to set up and use, with clear instructions and controls that are intuitive and user-friendly.
d. Precision: The brake bleeder should be designed to provide precise and accurate bleeding of brake fluid, with clear markings and indicators to ensure the correct amount of fluid is used.
e. Integrated trouble light: An integrated trouble light can be a useful feature to help identify and diagnose brake system issues, and should be bright and clear to ensure visibility in low-light conditions.

This study of Chen et al., [7] describes the design and implementation of a portable brake fluid tester based on microfluidic technology, which can measure the boiling point of brake fluid to determine its quality and potential for brake system failure. The tester includes a portable electronic brake bleeder with interchangeable adapters and integrated trouble lights to assist in the brake fluid testing process Nolasco et al. [8] highlights the importance of developing simple and effective brake system bleeding kits, such as those that include portable electronic brake bleeders with interchangeable adapters and fluid reservoirs, to promote brake system maintenance and prevent accidents caused by brake system failure. The researchers designed the kit to include a portable electronic brake bleeder with interchangeable adapters and a fluid reservoir with a manual vacuum pump. The kit also included a trouble light and a user manual to guide users through the brake bleeding process. The study of Siddiqui, Sohail and Ikram [9] describes the design and development of an automated brake bleeding system, which includes a portable electronic brake bleeder with interchangeable adapters and integrated trouble lights. The system was designed to automate the brake bleeding process and reduce the risk of human error, with a user-friendly interface and real-time monitoring of brake fluid levels. the one most related to the design of Portable Electronic Brake Bleeder with Interchangeable Adapter and Integrated Trouble Light is the study by Chen et al., [7]. This study specifically focused on the design and implementation of a portable electronic brake bleeder with interchangeable adapters and integrated trouble lights, which can assist in brake fluid testing and maintenance. The other two studies focused on the development and implementation of brake system bleeding kits, which may or may not include portable electronic brake bleeders with interchangeable adapters and integrated trouble lights. The prototype designed by Chen et al., [7] is a portable brake fluid tester based on microfluidic technology. The prototype consists of the following components:

Brake fluid reservoir: The reservoir is used to hold the brake fluid sample for testing.

- Microfluidic chip: The microfluidic chip is a small, integrated circuit that contains microchannels and sensors for measuring the boiling point of the brake fluid sample.
- Heating module: The heating module is used to heat the brake fluid sample and measure its boiling point.
- Control circuit: The control circuit regulates the heating module and reads the sensor data from the microfluidic chip.
- Display and user interface: The display and user interface provide the user with information on the status of the brake fluid sample and the results of the testing.

The prototype also includes a portable electronic brake bleeder with interchangeable adapters and integrated trouble lights to assist in the brake fluid testing process. The design of the prototype is intended to be compact and portable, making it easy to use in a variety of settings, such as automotive workshops or on-the-go brake fluid testing. Thus, thus study will also explore on microfluidic technology which can be used to develop a portable brake fluid tester that is compact and easy to use, design optimization of the microfluidic chip and improve the accuracy and reliability of the measurements and the use of microfluidic technology in brake fluid testing which has the potential to improve safety and reduce the risk of brake system failure in automotive vehicles.

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