IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, December 2024

Design and Development of Innovated Motor Control Trainer

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Abstract: *This study aims to design and development of motor control trainer for educational purposes in Surigao del Norte State University. Specifically, to evaluate the effectiveness of the proposed project, which is a motor control trainer. The study was conducted at Surigao del Norte State University, the project is tested out of 50 respondents that has knowledge regarding motor control, enough to understand the flow of the project its material used, functions, usage and how it works. These are invaluable resources for students, offering hands-on experience and practical knowledge in electrical and control systems. They enhance learning by providing a safe environment to experiment and troubleshoot, fostering essential skills that are crucial for future careers in engineering and technology. By engaging with these trainers, students not only build a strong foundation in motor control concepts but also develop a deeper understanding of sustainable practices in the industry. The findings of this study demonstrate that the developed motor control trainer has excellent educational applications. The proposed training system effectively teaches students the fundamental concepts of motor control through hands-on experience. It features various control mechanisms including speed regulation, direction control, and different starting methods that are essential for understanding motor operations in industrial applications. Additionally, based on the study's results, it is concluded that the training system serves as an effective educational tool in academic especially in engineering students, allowing students to gain practical experience in motor control principles while ensuring safety through built-in protection features. The trainer's modular design enables students to understand individual components and their interactions within the system. The trainer's versatility and robustness make it particularly suitable for intensive educational use where repeated demonstrations and student experiments are required.*

Keywords: Motor Control, Trainer, Innovated

I. INTRODUCTION

Quality education and training depends on the availability of school facilities and instructional equipment and materials in the workshops. It is through instructional equipment that students acquire maximum knowledge and skills effectively (L.L. Tejano 2018). Quality education builds our graduates competence in their chosen field and they must possess not only knowledge but the required technical skills aligned in the 21st Century [A. Emad Muhammad.2020].We need more instructional equipment to keep pace with this emerging technology. We are now in the 4th Industrial revolution and we should be ready in this significant transformation in the industry. This is the current trend in automation. It will create new manufacturing jobs. Therefore, we should develop our graduates to be well equipped with current technology to secure productive employment (A.R. Ajoke 2017).

In the field of motor control studies, it is essential for students to have hands-on experience with various control circuits and techniques. To facilitate this learning process, a trainer that incorporates a stop-start button, forward-reverse control, wye-delta control, and dynamic braking has been designed and developed. This trainer allows students to understand and practice the principles of motor control in a practical and interactive manner (Manuel A. Bajet, 2015).Motor control panel is used to determine variable frequency AC drive and a 3-phase AC motor used to teach the fundamentals of configuring and operating an AC drive. It can be used to teach motor drive troubleshooting skills, such as drive input, motor trainer, and drive contactor troubleshooting. (Ferrer et al.,2019).

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The cycle of teaching and learning for technical skill development involves incorporating pertinent and important instructional resources (Pereyras, 2020). Engineering professors have faced challenges in making the industrial environment comparable to the academic arrangement of a classroom. This is because practical application in an industrial setting often requires expensive equipment with standard functionality, usefulness, safety, and maintainability. Designing and setting up a trainer module that meets students demands for theoretical and practical knowledge is crucial. The addition of this trainer module, capable of various operations like straightforward start-stop, forward-reverse, and wye-delta operation, is like a full package for developing motor control abilities and methods. Furthermore, the motor control trainer board being considered has been created to accommodate training for various industrial applications, including FVNR (Full Voltage None Reverse), Forward-Reverse Operation, and Reduced Voltage Wye-delta operation.

The most typical motor operation utilized in various industries, depending on horsepower rating, uses the aforementioned form of connections. The "starter," the device that energizes an induction motor's circuit, is required to provide the motor with enough current to produce appropriate starting torque under the worst-case line voltage and load conditions. (Laboga, 2022).

The aim also of this project is to help people, especially the students of Surigao del Norte State University, by serving as the device to learn or train the Motor Control Trainer to enhance their knowledge and skill and to provide another control trainer to the university. The researcher is eager to work on a research project that will result in the creation of a practical, convenient, and knowledgeable technology.

II. REVIEW OF LITERATURE

The use of motor control circuits is an effective way to minimize cost through the use of smaller wires and reduced-amperage devices to motor controlling. Motor control circuits are often connected to lower voltages International Peer Reviewed Journal than the motor they control for operational safety and maintenance personnel.

Motor Control System Trainer as instructional equipment determine the possible laboratory activities on motor controls that can be performed in the trainer and evaluate its acceptability in terms of design and construction, functionality, durability, safety, and instructional applicability compare the evaluation of the three groups of respondents as to the general acceptability of the developed trainer [Holt (2018)].

Instructional device which can be used in the training and study of industrial motor controls, circuit designs, installation, assembly and troubleshooting of motor controllers of different applications in industrial establishments. This will eliminate the traditional method of teaching without any practical work or hands-on for the real devices of the different control circuits. Developing the required instructional equipment in Industrial Motor Controls is essential to meet industry standards and to facilitate training in the workshops. [Bartolome et al., (2020)]

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The usability and user experience of motor control trainers are critical factors influencing their effectiveness. Reviews by Johnson et al., (2019) and Park et al., (2021) highlighted the importance of user-centered design principles in creating intuitive and engaging training platforms. Factors such as interface design, feedback mechanisms, and customization options significantly impact user engagement and adherence to training protocols.

MOTOR CONTROL SYSTEM TRAINER

A motor control trainer as instructional equipment determines the possible laboratory activities on motor controls that can be performed in the trainer and evaluate its acceptability in terms of design and construction, functionality,

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durability, safety, and instructional applicability compare the evaluation of the three groups of respondents as to the general acceptability of the developed trainer [Holt (2018)].

MAGNETICCONTACTOR

Controlled switch used for switching an electrical power circuit, similar to a relay except with higher current ratings. A contactor is controlled by a circuit which has a much lower power level than the switched circuit(Machidon et al., 2018). Contactors come in many forms with varying capacities and features. Unlike a circuit breaker, a contactor is not intended to interrupt a short circuit current.

PUSH BUTTON

Is a mechanical device used to control an electrical circuit in which the operator manually presses a button to actuate an internal switching mechanism. They come in a variety of shapes, sizes, and configurations, depending on the design requirements. An essential component of industrial control panels and machines are push button switches. Push button switches can be used for a number of operations and controls, such as emergency shutdown, mode or setting selection, alarm activation, and motor start/stop. Muhammad et al., (2017) The purpose of this circuit is to control the motor manually and this circuit is for manually operated. This type of circuits is used in all scales of industries, where the motor is controlled manually by workers.

TIMER ON-DELAY RELAY

Is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit(Xiang et al., 2022).

OVERLOAD RELAY

A device that protects an electric motor against overloads and phase failure, senses the overloading of the motor and interrupts the power flow to the motor, thus protecting it from overheating and winding damages. Apart from overloads, it can also protect the motor from phase loss/failures and phase imbalance.

III. CONCEPTUAL FRAMEWORK

Material inputs in innovating the device is carefully planned, designed, constructed, tested and evaluated in order to achieve efficiency of the innovation.

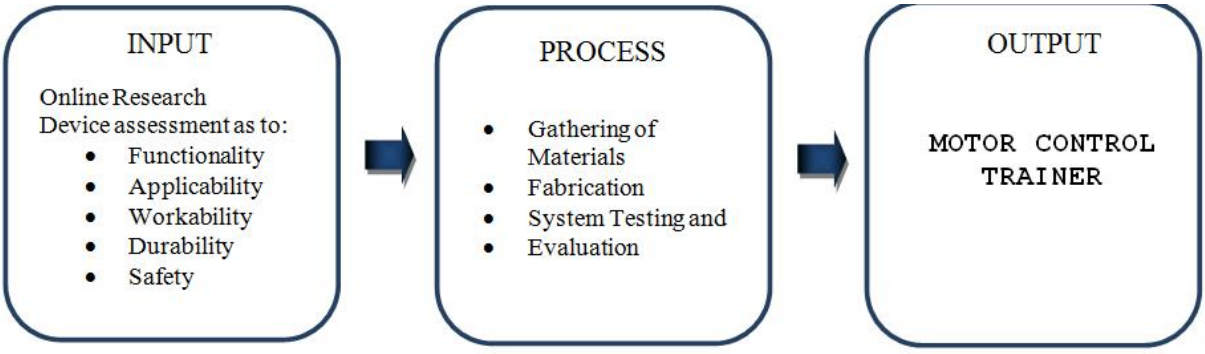

Figure 1: Model of the Study

Figure 1 shows the study's conceptual framework. The study's flow is depicted in the figure. First box represents the input of the study. This entails the first step in developing all the concepts in order to materialized the project. It also implicates on how the proposed project being weighed.The second box entails the designing and fabrication of the project. This area discusses the whole design of the project, its diagram and the connection point. Base on the materials gathered fabrication stage will follow by following the procedural design of the project.

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In order to get the desired product, project prototyping demands a great deal of attention, which can spark ideas. The collecting of tools and resources is a vital step in creating projects, according to Atkins (2014). In completing the project, it is the most important component. The third box complies the output of the device. It is understood that in this stage the device is now on its completion and undergo already series of testing.

Objectives of the Study

The main objective of the study is to produce an automated LPG gas leakage detector using Arduino base sensor device. Specifically, the study aims to:

1. Design and established of the innovative motor control trainer in terms of:
    - Technical designs and Specification
2. To established the procedures developing the trainer
3. Assess the respondent's degree of acceptance of the suggested educational tool based on its:
    - Functionality
    - Applicability
    - Workability
    - Durability
    - Safety
4. Develop user's manual

Significance of the Study

In this study, a development of a trainer on motor controls has been proposed as it benefits students who need to understand the basics of electrical motor control. This trainer provides students with the proper information they need in the connection of different control circuits, allowing them to learn about the operation and how to avoid the hazards associated with electrical motor controls. The following people stand to gain from the research that will be done by the researchers:

Students. This study will help them in their learning.

Instructor. Aims to help demonstrate hands-on learning to the students.

Future Researcher. Future researchers may use this research as a model for a new study. This will act as the "starting point" for upholding.

Scope and Limitations

The study was conducted to the students who studied motor controls especially to the students of Surigao Del Norte State University. These study focuses to the students learning to enhance their knowledge by hands on learning.The conduct of the project will be made by the researchers with the aid of relevant knowledgeable people. However, innovative ideas of the researchers shall still be followed.

Definition of Terms

Circuit Breaker. is an electrical safety device designed to protect an electrical circuit from damage caused by overcurrent. Its basic function is to interrupt current flow to protect equipment and to prevent the risk of fire.

Electric Motor. an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of torque applied on the motor's shaft.

Indicating Lights. indicator lights in motor control serve an important purpose by displaying the current status of a motor control system. Holt et al., (2020). They help operators and maintenance personnel determine whether the system is powered on or off. These lights provide a visual indication, allowing individuals to assess whether it is safe to approach and perform maintenance tasks on the motor circuit. By giving this visual feedback, indicator lights play a vital role in ensuring the safety and efficiency of motor control operations.

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Magnetic Contactor. a device that is powered by magnetism. Used to open and close the contacts in the motor control circuit, may also be called a magnetic switch or a contactor.

Overload Relay. cut off current to the motor when a high-current situation develops due to a ground fault, short circuit, phase failure, or mechanical jamming.

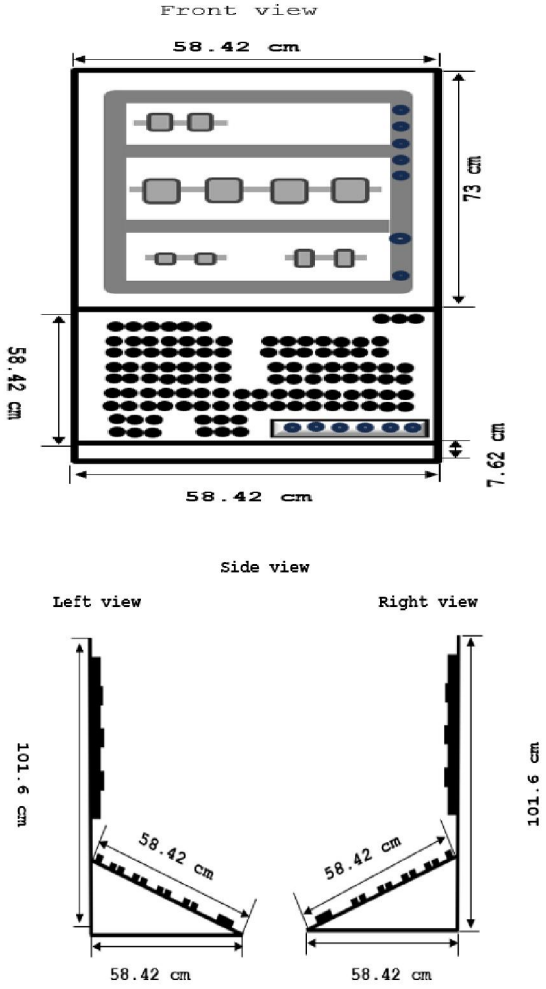
Prototype. Something that serves to illustrate the typical
qualities of a class; model; exemplar.

Push Button. is a mechanical device used to control an electrical circuit in which the operator manually presses a button to actuate an internal switching mechanism. They come in a variety of shapes, sizes, and configurations, depending on the design requirements.

Timer On-Delay Relays. a combination of an electromechanical output relay and a control circuit. The contacts will open or close before or after a pre-selected, timed interval.

Project Design

Below is the architectural design of the research device, included the labeled parts of the research project.



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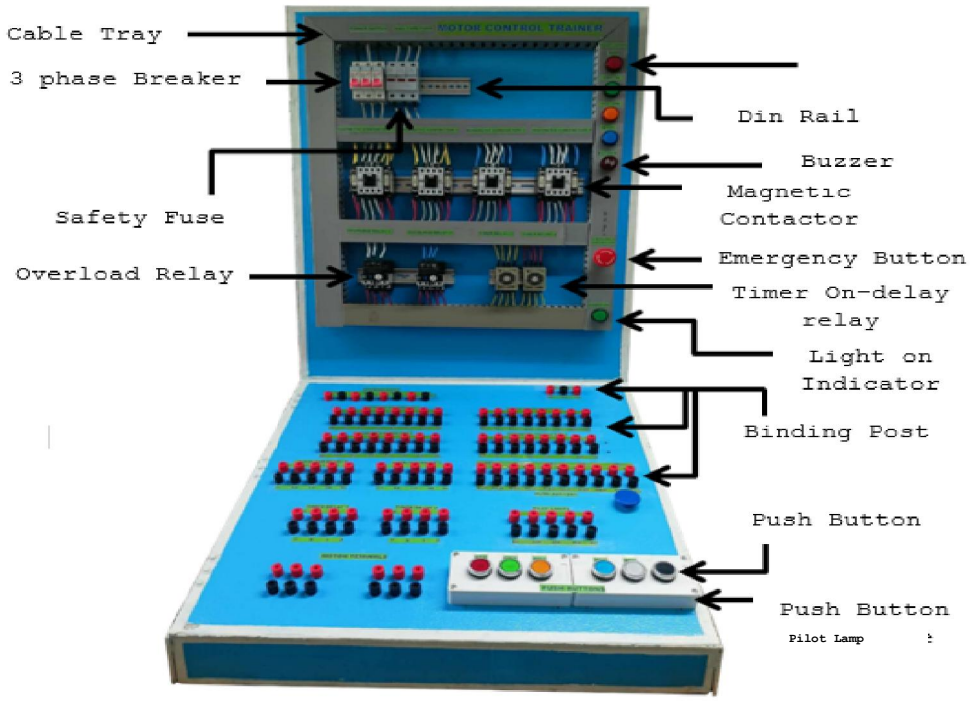

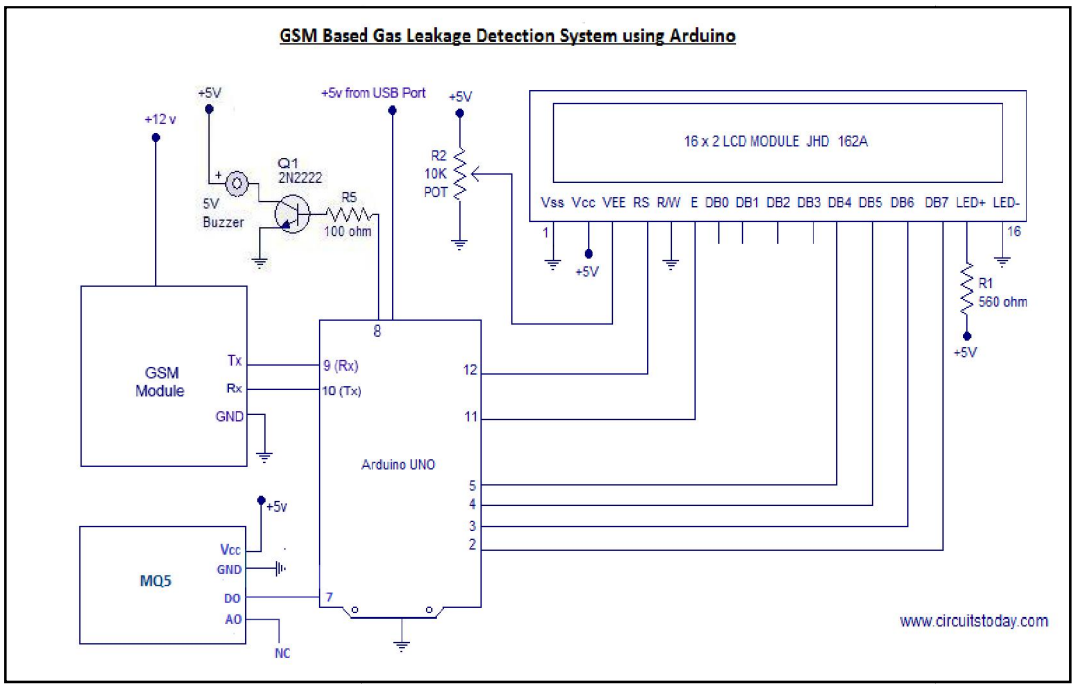

Figure 2: Project Design

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Project Development

The project's production process includes the following steps.

1. Gather all necessary material needed in making the said project.
2. Check and make sure that all the devices to be use is functional and not defective.
3. Put all the required components and organized based on the diagram
4. Check all the wiring components if it is exactly connected to the right connecting point.
5. Test the components if it is functioning well.
6. After setting all the components, checking the proper wiring connections, now the motor control device is ready to use.

Operation Procedure

In determining the performance of the device, the following procedure was followed:

1. Read and analyze the given diagram of the circuit.
2. Ensure that the motor control trainer is connected to a proper power source (typically 220v or 400V AC, depending on the trainer).
3. Check all the components to be use. Ensure the emergency stop button is easily accessible.
4. Control Switch identify the control switches on the trainer, including Start, Stop, and Emergency Stop.
5. Connect all the connecting pins to the binding post from the respective components and devices.
6. After putting altogether, the connections use testing device to ensure if it's totally working.

Testing Procedure

In order to assure that every part of the device is working properly, the following test procedure should be done:

1. Check every part of the device.
2. Testing the functionality of every parts.
3. Check each connection points.
4. Set the time for estimated desired timing function.
5. Test the device and conduct an assessment and efficiency on it.

Evaluation Procedures

Evaluation is a way to determine the acceptability of the proposed project. Selected people were asked to rate the performance of the device. These respondents were composed of selected residents in Surigao City who have specialized on the field. Prior to the actual demonstration/evaluation of the device, the researcher explained the function of the device as well as its specification of the trainer. Before the evaluation sheet was given to the respondents, its content was discussed by the researchers. When the evaluation has been accomplished, the result was tabulated and computed to find the mean of every criterion as well as the overall mean.

The respondents will then evaluate the said proposed project based on usability, quality of design, functionality, safety, and efficiency. The evaluation sheet is provided where respondents can write their comments and suggestions for further improvement of the device.

V. RESULTS AND DISCUSSIONS

Evaluation result of the study is based on the instruments made by the researchers. Each variable in the instruments reflect on the project that caters the process of propose project.

Acceptability of Motor Control based on its Functionality

Functionality	Mean	Qualitative description
Function of the device is meet as it expected.	4.82	Highly Acceptable
The device performs the task effectively.	4.80	Highly Acceptable
The device has a minimal error	4.64	Highly Acceptable

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The device can develop practical skills in motor control	4.50	Highly Acceptable
The device can develop practical skills in motor control	4.48	Highly Acceptable
Average mean	4.65	Highly Acceptable

4.21 – 5.00	Excellent
3.41 – 4.20	Very Good
2.61 – 3.40	Good
1.81 – 2.60	Fair
1.00 – 1.80	Poor

The table presents the degree of acceptance of the suggested educational tool based on its functionality. The results show that the functionality of the device was highly acceptable overall, with an average mean score of 4.65. Specifically, the function of the device was found to be highly acceptable as it met the expected criteria, with a mean score of 4.82.

Additionally, the device was perceived as highly effective in performing its intended tasks, with a mean score of 4.80. The device was also found to have a minimal error, with a mean score of 4.64, indicating a high level of accuracy and reliability.

Furthermore, the device was evaluated to be highly acceptable in its ability to develop practical skills in motor control, with mean scores of 4.50 and 4.48 respectively. These findings suggest that the educational tool is well-suited for developing and enhancing motor skills, which is a crucial aspect of its functionality.

Overall, the table demonstrates that the suggested educational tool was highly accepted by the users in terms of its functionality, meeting the expected criteria and performing its tasks effectively, with minimal errors and the ability to develop practical motor control skills.

Acceptability of Motor Control Trainer based on its Applicability

Applicability	**Mean**	**Qualitative description**
The device has a specific application	4.88	Highly Acceptable
The device accommodates the specific needs of its user.	4.88	Highly Acceptable
The trainer will be used in laboratory work in motor control.	4.82	Highly Acceptable
The device meets the safety standards.	4.68	Highly Acceptable
The device can provide students with hands-on experience in operating and troubleshooting motor	4.64	Highly Acceptable
Average mean	4.78	Highly Acceptable

The table presents the degree of acceptance of the suggested educational tool based on its applicability. The results show that the applicability of the device was highly acceptable overall, with an average mean score of 4.78.The table indicates that the device was found to have a highly acceptable specific application, with a mean score of 4.88. Additionally, the device was perceived as highly accommodating to the specific needs of its users, also with a mean score of 4.88. These findings suggest that the educational tool is well-suited for its intended purpose and meets the specific requirements of its target audience.

Furthermore, the table shows that the device was highly acceptable for use in laboratory work in motor control, with a mean score of 4.82. This suggests that the device is well-suited for educational and training purposes in the field of motor control.

The device was also found to meet safety standards, with a mean score of 4.68, indicating that it is not only functional but also safe for use in an educational setting. Additionally, the device was highly accepted for its ability to provide students with hands-on experience in operating and troubleshooting motor, with a mean score of 4.64.Overall, the table demonstrates that the suggested educational tool was highly accepted by the users in terms of its applicability, meeting specific needs, accommodating user requirements, and providing a safe and practical learning experience in the field of motor control.

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Acceptability of Motor Control Trainer based on its Workability

Workability	Mean	Qualitative description
Availability of materials	4.66	Highly Acceptable
Availability of expertise	4.78	Highly Acceptable
Availability of tools and machines for fabricating	4.62	Highly Acceptable
Availability of training and support resources	4.62	Highly Acceptable
Availability of ensuring they provide valuable educational experiences.	4.48	Highly Acceptable
Average mean	4.63	Highly Acceptable

The table presents the degree of acceptance of the suggested educational tool based on its workability. The results show that the workability of the device was highly acceptable overall, with an average mean score of 4.63.The table indicates that the availability of expertise for the device was highly acceptable, with a mean score of 4.78. This suggests that the necessary expertise and knowledge are readily available to support the effective use and implementation of the educational tool.

Additionally, the availability of materials and the availability of tools and machines for fabricating the device were both found to be highly acceptable, with mean scores of 4.66 and 4.62, respectively. These findings indicate that the required resources for the production and assembly of the device are readily accessible.

Furthermore, the table shows that the availability of training and support resources for the device was highly acceptable, with a mean score of 4.62. This suggests that users can access the necessary guidance and support to effectively utilize the educational tool.

However, the table also shows that the availability of ensuring the device provides valuable educational experiences was slightly lower, but still within the highly acceptable range, with a mean score of 4.48. This indicates that while the device is generally well-received, there may be some concerns or room for improvement in ensuring its educational value and effectiveness.

Overall, the table demonstrates that the suggested educational tool was highly accepted by the users in terms of its workability, with the availability of expertise, materials, tools, and support resources being highly satisfactory. The slightly lower score for ensuring valuable educational experiences suggests an area for further consideration and improvement.

Acceptability of Motor Control Trainer based on its Durability

Durability	Mean	Qualitative description
Resistance for deformation	4.76	Highly Acceptable
Quality of the design	4.76	Highly Acceptable
Endurance of the unit to high temperature	4.82	Highly Acceptable
Resistance to environmental factors	4.68	Highly Acceptable
Longevity of components	4.64	Highly Acceptable
Average mean	4.73	Highly Acceptable

The table presents the degree of acceptance of the suggested educational tool based on its durability. The results show that the durability of the device was highly acceptable overall, with an average mean score of 4.73.The table indicates that the endurance of the unit to high temperatures was highly acceptable, with a mean score of 4.82. This suggests that the device is capable of withstanding exposure to high temperatures without compromising its functionality or structural integrity. Furthermore, the resistance for deformation and the quality of the design were both found to be highly acceptable, with mean scores of 4.76 for each. These findings indicate that the device is well-designed and able to withstand physical stresses and deformation, ensuring its reliable performance. The table also shows that the resistance to environmental factors was highly acceptable, with a mean score of 4.68. This suggests that the device is capable of withstanding various environmental conditions, such as humidity, moisture, or exposure to elements, without experiencing significant degradation or performance issues. Finally, the longevity of the device's components was also

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highly acceptable, with a mean score of 4.64. This indicates that the components used in the educational tool are durable and have a long lifespan, contributing to the overall durability and reliability of the device.

Overall, the table demonstrates that the suggested educational tool was highly accepted by the users in terms of its durability, exhibiting strong resistance to deformation, high temperatures, environmental factors, and ensuring the longevity of its components. These findings suggest that the device is well-designed and capable of withstanding the rigors of educational use over an extended period.

Acceptability of Gas Leakage Detector System based on its Safety

Safety	Mean	Qualitative description
Absence of sharp edges	4.82	Highly Acceptable
Absence of toxic materials	4.72	Highly Acceptable
Provision for protection	4.70	Highly Acceptable
Emergency stop mechanism	4.62	Highly Acceptable
Clear safety instruction and labels	4.62	Highly Acceptable
Average mean	4.70	Highly Acceptable

The table presents the degree of acceptance of the suggested educational tool based on its safety. The results show that the safety of the device was highly acceptable overall, with an average mean score of 4.70. The table indicates that the absence of sharp edges was highly acceptable, with a mean score of 4.82. This suggests that the device is designed with a strong focus on minimizing potential hazards and ensuring a safe user experience. Furthermore, the absence of toxic materials was also highly acceptable, with a mean score of 4.72. This finding is crucial, as the presence of toxic materials could pose significant risks, especially in an educational setting where the device may be used by students. The provision for protection was another aspect that was highly acceptable, with a mean score of 4.70. This indicates that the device incorporates appropriate safeguards and protective measures to prevent injuries or accidents during use.

Additionally, the emergency stop mechanism and the clarity of safety instructions and labels were both found to be highly acceptable, with mean scores of 4.62 each. These features are essential for ensuring user safety, as they provide a means to quickly and effectively respond to any potential issues or emergencies that may arise.

Overall, the table demonstrates that the suggested educational tool was highly accepted by the users in terms of its safety. The device exhibits a strong focus on eliminating sharp edges, avoiding toxic materials, providing adequate protection, and incorporating clear safety instructions and emergency stop mechanisms. These safety features are crucial in an educational setting, where the well-being of the users is of paramount importance.

Overall Acceptability

Characteristics	Average mean	Rank	Qualitative Description
Functionality	4.65	4	Highly Acceptable
Applicability	4.78	1	Highly Acceptable
Workability	4.63	5	Highly Acceptable
Durability	4.73	2	Highly Acceptable
Safety	4.7	3	Highly Acceptable
Grand mean	4.698		Highly Acceptable

The table presents a summary of the degree of acceptance of the suggested educational tool across various characteristics. The results show that the overall acceptance of the device was highly acceptable, with a grand mean score of 4.698.Looking at the individual characteristics, the table indicates that the applicability of the device was ranked as the highest, with a mean score of 4.78. This suggests that the device was found to be highly suitable and accommodating for its intended purpose and user needs.The durability of the device was ranked second, with a mean score of 4.73. This indicates that the device was perceived as highly durable, able to withstand various environmental factors, maintain its structural integrity, and ensure the longevity of its components.The safety of the device was ranked

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third, with a mean score of 4.70. This is a crucial aspect, as it demonstrates that the device was designed with a strong focus on user safety, including the absence of sharp edges, toxic materials, and the incorporation of appropriate protective measures and emergency stop mechanisms. The functionality of the device was ranked fourth, with a mean score of 4.65. This suggests that the device was highly accepted in terms of its ability to perform its intended functions effectively, with minimal errors and the capacity to develop practical motor control skills. Finally, the workability of the device was ranked fifth, with a mean score of 4.63. This indicates that the device was highly accepted in terms of the availability of materials, expertise, tools, and support resources necessary for its effective implementation and use. Overall, the table presents a comprehensive summary of the degree of acceptance of the suggested educational tool, highlighting its strong performance across various characteristics, with the applicability, durability, and safety of the device being the most highly accepted aspects. These findings suggest that the device is well-suited for educational purposes and likely to be well-received by users.

VI. SUMMARY

This study aimed to evaluate the effectiveness of the proposed project, which is a motor control trainer. It focuses on the primary usage, functionality, applicability, workability, and safety aspects of the project, as well as how it effectively assists people through innovative means. The project is tested out of 50 respondents that has knowledge regarding motor control, enough to understand the flow of the project its material used, functions, usage and how it works.

VII. FINDINGS

Based on the comprehensive evaluation of the "Motor Control Trainer," the following key findings have emerged:

- Functionality: Demonstrates that the suggested trainer was highly accepted by the users in terms of its functionality, meeting the expected criteria and performing its tasks effectively, with minimal errors and the ability to develop practical motor control skills.
- Applicability: The trainer exhibits versatility tool was highly accepted by the users in terms of its applicability, meeting specific needs, accommodating user requirements, and providing a safe and practical learning experience in the field of motor control.
- Workability: Trainer was highly accepted by the users in terms of its workability, with the availability of expertise, materials, tools, and support resources being highly satisfactory. The slightly lower score for ensuring valuable educational experiences suggests an area for further consideration and improvement
- Durability: Trainer was highly accepted by the users in terms of its durability, exhibiting strong resistance to deformation, high temperatures, environmental factors, and ensuring the longevity of its components. These findings suggest that the device is well-designed and capable of withstanding the rigors of educational use over an extended period.
- User Safety: Trainer was highly accepted by the users in terms of its safety. The device exhibits a strong focus on eliminating sharp edges, avoiding toxic materials, providing adequate protection, and incorporating clear safety instructions and emergency stop mechanisms. These safety features are crucial in an educational setting, where the well-being of the users is of paramount importance.

VIII. CONCLUSIONS

Motor control trainer provide students with hands-on experience in electrical and control systems, enhancing learning and fostering essential skills for engineering and technology careers, while also fostering understanding of sustainable practices. Motor control trainers serve as essential tools for students, providing hands-on experience and practical knowledge in electrical and control systems. Enhanced Learning Environment: They create a safe space for students to experiment and troubleshoot, which significantly enhances the learning experience. Engaging with these trainers fosters essential skills that are crucial for future careers in engineering and technology. Students build a solid understanding of motor. Interaction with motor control trainers also promotes a deeper understanding of sustainable practices within the industry.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, December 2024

IX. RECOMMENDATIONS

Encouraged to actively participate in hands-on exercises, collaborate with equal during troubleshooting activities, and enhance problem-solving skills and gain diverse perspectives. Engaging in regular practice sessions will help solidify concepts and improve technical skills Students should actively explore the various functionalities of the motor control trainer to deepen their comprehension of motor control systems. Collaborating with classmates on projects can enhance learning through the exchange of ideas and problem-solving strategies.

Additionally, participating in hands-on simulations will provide practical experience, which is essential for mastering theoretical concepts. Regularly reviewing and discussing the outcomes of experiments will also reinforce understanding and retention of key principles.

Future Researchers: They are encouraged to conduct studies similar to this idea for further improvements

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