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Development of LED Tracing Pad with Rechargeable Module

Mark Neil C. Casidsid[1] and Rodolfo C. Bones, Jr.[2]

Capiz State University-Main Campus, Roxas City, Capiz, Philippines[1,2]

Abstract: Current tracing pad solutions often present several problems which may only operate if the device was plugged in all the time from the source of electricity. Traditional light boxes are bulky and require a constant power source, limiting portability and convenience. A conventional transparency is removably mounted in an opening in front of a box containing a translucent shade, which is mounted to pivot about its upper edge toward and away from the transparency, and to closed and open positions, respectively. A first lamp adjacent the lower edge of the shade illuminates the transparency when the shade is in its open position, and a second lamp rearward of the shade may be energized to superimpose an image of the shade onto the transparency, when the shade is closed (William A. Heindl, Jr., 1970) [1]. This study addresses the gap by developing an LED tracing pad mounted to a removable case and adjustable stand, integrated with a 235mm x 350mm solar panel compartment and a partitioned for drawing instruments, offering artists a portable, sustainable, and user comfort device for detailed tracing and design projects. The device allows LED tracing pad to use rechargeable that is generated by booth solar and alternating current (AC) in charging processes.

The LED tracing pad with a rechargeable module supplied with power source from both solar and alternating current (AC) would be a versatile tool for drafting students, architecture students, artists, illustrators and designers in tracing designs, drawings or patterns in a maximum size of 345mm x 475mm. It combines the benefits of a traditional tracing pad with the added convenience of portability and sustainable charging options which the device doesn't need to be plugged in all the time. A rigorous evaluation, involving 50 experts and end-users, assessed the device's performance using a five-point Likert scale. These evaluators were selected through purposive sampling based on their expertise. The testing and evaluation took place at Capiz State University-Main Campus, while the development work was done at the researcher's residence.

Testing revealed that the rechargeable module using 5V rechargeable battery has sufficient capacity to provide several hours of continuous use for 4 hours with a charging indicator to show charging status and battery level. The device's aesthetic, industrial-grade design prioritizes both user-friendliness and safety. Overall, the device received a "Very Acceptable" rating, demonstrating its effectiveness of its design, technical features, operating performance and composition that integrates a rechargeable module with safe wiring, ensuring continuous, sustainable power for use.

Keywords: LED, Rechargeable Module and Tracing Pad

I. INTRODUCTION

Background of the Study

LED tracing pads are indispensable tools for tracing drawings and plans, providing a consistent, adjustable, and energy-efficient light source that enhances visibility and accuracy. The portability and even illumination make them ideal for artists, designers, and professionals seeking to transfer intricate details onto new surfaces with ease and precision.

This study relates to an LED tracing pad mounted to a removable case and adjustable stand, connected into a 5V rechargeable module. A rechargeable module is energized via solar power or alternating current through a USB interface. These pads often feature adjustable brightness, touch sensitivity, and eyesight-protected technology. The storage capacity of the module provides several hours of continuous use for 4 hours with a charging indicator to show charging status and battery level without the need to be plugged in all the time even when in use. This device is used in animation, cartooning, tattoo tracing, craft projects, tracing of detailed drawings and architecture. They are also utilized in medical settings as X-ray viewers.

The device consists of an LED tracing pad mounted onto a removable case and adjustable stand, featuring a 235mm x 350mm solar panel and a partitioned compartment for drawing instruments offering artists a portable, sustainable, and user comfort device for detailed tracing and design projects.

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Significance of the Study

The LED tracing pad with a removable case and adjustable stand connected into a rechargeable module which energized by both solar and alternating current (AC) and offer numerous benefits, making it a valuable tool for artists, designers, illustrators and hobbyists. The module allow users to use the tracing pad anywhere without to be plugged in all the time. It eliminates the need to constantly purchase disposable batteries, saving money over time which has a long lifespan, reducing the need for frequent replacements and decrease the environmental impact associated with disposable batteries, free energy, making the tracing pad an environmentally mindful choice.

Scope and Limitation of the Study

The device was limited only on tracing or duplicating the design with the help of LED backlight that provides even and consistent lighting across the surface in a maximum measurement of paper to 345mm x 470mm. The LED tracing pad is mounted into a removable case and adjustable stand with a rechargeable module which is suitable on charging booth solar and alternating current (AC) with a sufficient capacity to provide several hours of continues use up to 4 hours.

II. METHODOLOGY

This study relates to the development of an LED tracing pad mounted into a 350mm x 485mm removable case that incorporates a removable mechanism located on front base of the LED tracing pad case. This design facilitates effortless attachment and detachment, enhancing user convenience for maintenance, portability, and versatility. Complementing this feature, the adjustable case engineered with an innovative adjustable mechanism strategically positioned on both the left and right edges of the case. This dual-edge mechanism allows seamless width customization, ensuring a secure and precise angle or height of the surface allowing users to trace images onto a new sheet of paper placed on top. Together, these mechanisms provide a robust, user-friendly solution that combines adaptability with ease for use in a sleek, ergonomic form factor.

An LED tracing pad is a flat, light-emitting device that illuminates drawings from underneath, transforms its features with a rechargeable module, integrated with a 235mm x 350mm solar panel compartment, safety wirings and a partition for drawing instruments located at the back portion of the base's stand. The rechargeable module is designed for versatile energy sourcing, capable of being energized by both solar power and alternating current (AC). An integrated mini push-button switch, conveniently mounted on the module, provides intuitive on/off control for seamless operation and energy management.

A 235mm x 350mm solar panel inserted on the solar panel compartment located on the back of the LED tracing pad case to trickle-charge the battery in sunlight was connected to a 5V rechargeable module as a source to energize the device using USB-C port, however the same type of port can be used for charging the module in alternating current (AC) outlet. The 5V rechargeable module has an indicator to prevent overcharging and ensure efficient charging or show charging status and battery level. The module features an overcharge protection that prevents damage to the battery from excessive charging and low battery indicator that blinks when the battery is running low.

The device is capable of animation, cartooning, tattoo tracing, craft projects, tracing of detailed drawings and architecture utilizing LED tracing pad that provide several hours of continuous use for 4 hours.

III. RESULTS AND DISCUSSIONS

Results of LED Tracing Pad with Rechargeable Module in Terms of Design, Technical Features, Composition, Operating Performance and Safety

Shown in Table I was the results evaluated by forty (40) experts of cylindrical silk screen printing device in terms of design, technical features, composition, operating performance and safety. The table revealed that the device was "Very Acceptable". Likewise, its specification has an overall mean of 4.76 interpreted also as "Very Acceptable" this means that LED tracing pad with rechargeable module in terms of its operating performance is sustainable and free energy which generated by both solar and alternating current that provides several hours of continuous use for 4 hours. This evaluation is comparable to that of Taduran and Piao (2005) [2], analyzes the performance of a rooftop grid tied photovoltaic system where solar energy reduces electrical consumption and provides free energy.

The design is robust, providing stable support across various adjustable angles that prioritize user convenience, featuring intuitive mechanisms for angles and height adjustment. Technically, the stand employs durable, lightweight materials and secure locking joints, ensuring longevity and ease of transport. Regarding safety precautions, the design incorporates non-slip padding to prevent accidental movement and smooth edges to minimize pinch points, ensuring a secure and user-friendly experience during operation and handling.

However, the summary of the results evaluated by ten (10) end users of cylindrical silk screen printing device in terms of design, technical features, composition, operating performance and safety revealed that the device was "Very Acceptable". Likewise, its specification has an overall mean of 4.78 interpreted also as "Very Acceptable" this means

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that the device was very useful of its removable and adjustable case that the design facilitates effortless attachment and detachment, enhancing user convenience for maintenance, portability, and versatility.
Further, the result is largely comparable to the study of Ghadimi, H. et al. (2023) [3], Ergonomic design and assessment of adjustable laptop stand used in the typing task were adjustable laptop stand significantly reduced discomfort and improved typing tasks, suggesting its potential to enhance user comfort and productivity. However, further longitudinal studies are needed to assess the long-term effects of this intervention.

Table I. Results of LED Tracing Pad with Rechargeable Module in Terms of Design, Technical Features, Composition, Operating Performance and Safety.

FACTORS AND PARAMETERS	MEAN EXPERTS	MEAN USERS	VERBAL INTERPRETATION
1. Design	4.77	4.84	Very Acceptable
2. Technical Features	4.80	4.75	Very Acceptable
3. Composition	4.78	4.74	Very Acceptable
4. Operating Performance	4.71	4.77	Very Acceptable
5. Safety	4.76	4.78	Very Acceptable
Overall Mean	**4.76**	**4.78**	**Very Acceptable**

IV. SUMMARY OF FINDINGS

The researcher conducted this study to develop an LED Tracing Pad with Rechargeable Module. Specifically, this study aimed to: determine the operating performance of LED tracing pad with rechargeable module in terms of design, technical features, composition, operating performance and safety precautions was rated as “Very Acceptable”. This indicated that the device is both aesthetically pleasing and professionally constructed. The design, technical features and composition facilitate effortless attachment and detachment, enhancing user convenience for maintenance, portability, and versatility. Thus, its performance and safety standards suggest that the device is sustainable and free energy which generated by both solar and alternating current that provides several hours of continuous use for 4 hours and ensures a secure and user-friendly experience during operation and handling. This invention implies that the device meets the evaluators’ expectations for quality and functionality, making it a viable option for commercialization.

V. CONCLUSION

Based on the findings, the following conclusions are formulated:
The development of LED tracing pad with rechargeable module achieved a "Very Acceptable" rating in terms of design, technical features, composition, operating performance, and safety precautions. This signifies that the device is not only visually appealing and well-constructed but also performs reliably and safely. The device's sustainable, dual-source energy system, user-friendly design, and ease of maintenance contribute to its overall viability and versatility. These positive results suggest that the LED Tracing Pad with Rechargeable Module successfully meets quality and functionality expectations, making it a promising candidate for commercialization. However, Long-term studies are needed to fully determine the intervention's sustained outcomes.

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