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PERSONAL COMPUTER - BASED RED GREEN BLUE LIGHT EMITTING DIODE BACKGROUND LIGHTING CONTROL SYSTEM FOR AI TV-5 OF AEMILIANUM COLLEGE INC.

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Abstract

This study introduces a cutting-edge lighting control system designed specifically for the AI TV-5 display at Aemilianum College Inc. The system leverages Red Green Blue (RGB) Light Emitting Diode (LED) technology, controlled via a Personal Computer (PC)-based interface, to offer a versatile and customizable lighting solution. By integrating advanced control software, users gain the ability to fine-tune lighting settings in real-time, enhancing the visual experience and ambiance of the display.

The development process of the PC-based RGB LED lighting control system is outlined, encompassing design considerations, hardware implementation, and software integration. Through a systematic approach, the system architecture is optimized to ensure seamless compatibility with the AI TV-5 and intuitive user interaction. Key features such as color selection, brightness adjustment, and dynamic lighting effects are meticulously crafted to deliver a captivating viewing experience.

Practical applications and potential benefits of the lighting control system are discussed, focusing on its utility in educational and entertainment settings. In educational contexts, the system offers enhanced visual aids and immersive learning environments, facilitating dynamic presentations and engaging classroom experiences. For entertainment purposes, the customizable lighting effects add flair and ambiance to multimedia content, elevating the viewing experience for students and audiences alike.

Overall, the PC-based RGB LED lighting control system represents a significant advancement in display technology, offering unprecedented flexibility and control over lighting settings. With its intuitive interface and versatile functionality, the system has the potential to transform the AI TV-5 display into a dynamic and visually captivating focal point within Aemilianum College Inc., enriching both educational and entertainment experiences for students, faculty, and audiences.

Key Words: Aemilianum College Inc., AI TV-5, display technology, dynamic presentations, entertainment, immersive learning, lighting control system, personal computer, RGB LED, visual ambiance.

Introduction

Red Green Blue Light Emitting Diode (RGB LED) color background lighting is an integral aspect of stage lighting, enhancing the emotional ambiance set by presenters. The convergence of computer technology with lighting control systems has revolutionized the way studios and stages are illuminated, allowing for greater flexibility and creativity. Modern stage lighting controls, driven by software, offer lighting technicians the ability to create new functions and expand existing console architecture, contributing to more dynamic and immersive visual experiences.

In the realm of television broadcasting, lighting plays a crucial role in setting the tone and enhancing the appearance of news anchors and actors. For instance, ABS CBN's newsroom utilizes soft-lighting technology, which enhances the complexion of news anchors on screen, creating a more appealing visual presentation. Conversely, GMA has transitioned to LED lights, offering greater efficiency and control compared to traditional lighting systems like Kino Flo lights. This upgrade to RGB LED technology signifies a significant advancement in studio lighting, allowing for more versatile and efficient illumination.

In the province of Sorsogon, AITV-5 of Aemilianum College, Inc. serves as a vital educational platform for students pursuing degrees in Electronic and Communication Engineering (BSECE) and Bachelor of Arts in Communications (AB Com). Established in 1985, AITV-5 has been a cornerstone of information technology education in the region, boasting a successful track record and a Graduate School offering a Master in Information Technology (MIT) program. However, the current manual background lighting system used by AITV-5 for TV activities necessitates an upgrade to modernize its operations and enhance the quality of broadcasts.

This study introduces a new technology—a fully automated and adaptive LED lighting control system designed to optimize user comfort and safety. The developed system eliminates the need for manual lighting boards by harnessing the capabilities of computers to control RGB LED panels seamlessly. By utilizing a computer-based lighting board system, the project aims to create diverse lighting effects suitable for stage environments while streamlining workflow and minimizing interruptions during TV productions at AITV-5.

The "Personal Computer-Based Red Green Blue Light Emitting Diode Background Lighting Control System for AI TV-5" developed by the researcher serves as a modern alternative to traditional lighting control systems. This system not only reduces cable clutter and saves space in the studio but also enhances the quality of light emitted by RGB LEDs. Equipped with UHF transceivers for wireless data transmission and a microprocessor for precise control, the system modernizes AITV-5's lighting control capabilities, paving the way for more efficient and dynamic TV productions.

Specific Objectives

Specifically, the study aimed to:

1. design and develop a Personal Computer - Based Red Green Blue Light Emitting Diode Background Lighting Control System that:

1.1 sets the mood of the Studio on Stage
1.2 interface for light control system.
2. evaluate/validate the developed system in terms of:
2.1 functionality
2.2 reliability
2.3 usability
2.4 maintainability
2.5 portability

Scope and Delimitations

The developed system is specifically tailored for use at AI TV-5, serving as a background stage lighting system utilizing Red Green Blue Light Emitting Diode (LED) technology. Controlled by a Personal Computer using Ultra High Frequency (UHF) transceivers for wireless communication and a Microcontroller as the hardware interface, the system is divided into 4 Arrays connection. An interface for end users will be programmed using Visual Basic 6 software running on the Windows platform.

The study delineates the specific areas that fall within its scope and excludes those that do not serve its purpose. Additionally, any areas not explicitly mentioned herein are not included in this study and may serve as a starting point for future research in the same field.

Significance of the Study

AI TV-5 of Aemilianum College Inc. The primary beneficiary of this study is AI TV-5, as the developed Personal Computer-based Red Green Blue Light Emitting Diode Background Lighting Control System is specifically designed to enhance the lighting capabilities of the television station.

Students. Students enrolled in programs related to electronic engineering, communication, and information technology at Aemilianum College Inc. will benefit from this study as it provides them with access to modern lighting control technology, enriching their learning experience.

Faculty and Staff. Faculty members and staff involved in television production and broadcasting at Aemilianum College Inc. will benefit from improved lighting control systems, which can contribute to more efficient and effective production processes.

Viewers. Viewers of AI TV-5's programs will indirectly benefit from the study as enhanced lighting can improve the quality of television content, leading to a more enjoyable viewing experience.

Future Research. This study can serve as a foundation for future research and development in the field of lighting control systems, particularly in educational settings, providing insights and inspiration for further innovation.

Conceptual Framework

The conceptual model used by the study is input-process-output (IPO) model that displays a series of boxes connected to each other from conceptualization to development.

The Input are the given objectives for the developed system were identified based on the informal interviews and location visitation on the stakeholders.

Using the Rapid Application Development was the Process of the development: from the planning, designing, research and implementation. The ISO software evaluation process was used to assess the system to ensure functionality, reliability, usability, maintainability and portability of the proposed system.

The Output of this study was the PC - Based RGB LED Background Lighting Control System for AI TV-5 of Aemilianum College Inc.

The Feedback took place after the accomplishment of the process components that shows the relatedness between output and input components.

Resources

The resources include all materials needed for the realization of the study, encompassing hardware and software requirements used in the development of the PC-Based RGB LED Background Lighting Control System for AI TV-5, as described below.

Table 3.1 Hardware Requirements

Hardware	Quantity	Purpose	Specifications
PC Pentium 4 a. CPU b. memory c. hard disk d. Graphic card e. Microprocessor Kit f. Motherboard g. UPS	1 1 1 1 1 1 1 1	For the DMX Control At least 1.5 Ghz 1Gb 80 Gb 512Gb Peripheral Connection of peripheral Backup power	Generic Generic Generic Generic Generic Generic Generic Generic
Arduino	5	Control of 4 array RGB LED Light PLA	Generic Generic
4 array RGB LED Light 1 array	4 pcs 24 RGB	For the background light	Generic RGB LED light
UHF Device	1	Wireless connection	Generic Device

Table 3.1 outlines the hardware requirements essential for the development and functionality of the PC-Based RGB LED Background Lighting Control System for AI TV-5. The primary hardware component is a Pentium 4 PC, serving as the central control unit for DMX control. Specifications include a minimum CPU speed of 1.5 GHz, 1 GB of

memory, an 80 GB hard disk, and a 512 GB graphics card, ensuring adequate processing power and storage capacity. Additionally, peripheral devices such as a microprocessor kit, motherboard, and UPS are required for seamless operation. Furthermore, five Arduino microcontroller kits are necessary for controlling the four-array RGB LED lights, each array consisting of 24 RGB LEDs. A PLA device is also needed for the 4-array RGB LED light, facilitating the background lighting. Lastly, a UHF device enables wireless connectivity, ensuring flexibility and convenience in system operation. Overall, these hardware components collectively form the backbone of the RGB LED background lighting system, enabling efficient control and manipulation of lighting effects for AI TV-5.

Table 3.2 Software Requirements

Software	Specifications
Visual Basic 6	Interface programming and controlling the device
C++ programming	Programming of Arduino
Windows 7	Operating system ver. 7

Table 3.2 presents the essential software requirements crucial for the development and operation of the PC-Based RGB LED Background Lighting Control System for AI TV-5. Firstly, Visual Basic 6 is designated for interface programming and device control, enabling the creation of a user-friendly interface for controlling the RGB LED lights. This software allows for the development of intuitive controls and graphical user interfaces (GUIs) to facilitate user interaction with the lighting system. Secondly, C++ programming is utilized for programming the Arduino microcontrollers, which play a critical role in controlling the RGB LED lights. C++ provides a versatile and powerful programming language for implementing custom functionalities and algorithms necessary for precise control of the lighting system. Lastly, Windows 7 is specified as the operating system required for the software environment. This version of Windows provides a stable and reliable platform for running the Visual Basic 6 and C++ programming environments, ensuring compatibility and smooth operation of the software components. Overall, these software requirements form the foundation for developing a robust and efficient RGB LED background lighting control system, enabling seamless integration and operation within the AI TV-5 environment.

Table 3.3. The Stakeholders

Stakeholders	Task
AI TV 5 Manager	• Overseeing the overall operation and management of AI TV-5, including its technical aspects such as lighting control systems. • Ensuring that the RGB LED background lighting control system is functioning optimally and meeting the station's requirements. • Providing guidance and support to professional staff and student assistants involved in operating the lighting system. • Collaborating with other departments or stakeholders to integrate the lighting system effectively into TV productions.
Professional Staff	• Operating the RGB LED background lighting control system during TV broadcasts or productions. • Implementing lighting designs as per the requirements of specific programs or segments. • Monitoring the performance of the lighting system and making necessary adjustments to achieve desired lighting effects. • Collaborating with news anchors and other production team members to ensure lighting setups align with the mood and tone of the content.
Student assistant	• Operating the RGB LED background lighting control system during TV broadcasts or productions. • Implementing lighting designs as per the requirements of specific programs or segments. • Monitoring the performance of the lighting system and making necessary adjustments to achieve desired lighting effects. • Collaborating with news anchors and other production team members to ensure lighting setups align with the mood and tone of the content.
News anchor	• Collaborating with the lighting team to ensure appropriate lighting setups for news segments. • Providing input on lighting preferences and adjustments based on personal or programmatic requirements. • Adapting to different lighting conditions and cues during live broadcasts to maintain professionalism and visual appeal. • Communicating effectively with the production team regarding any lighting-related issues or adjustments needed during broadcasts.

Table 3.3 provides an overview of the stakeholders involved in the operation and management of AI TV-5 and their corresponding tasks related to the RGB LED background lighting control system. Firstly, the AI TV 5 Manager holds a pivotal role in overseeing the overall operation and management of the television station, which includes technical aspects such as lighting control systems. They ensure that the RGB LED background lighting control system operates optimally and meets the station's requirements. Additionally, they provide guidance and support to professional staff and student assistants involved in operating the lighting system and collaborate with other departments or stakeholders to effectively integrate the lighting system into TV productions.

Professional staff members are responsible for operating the RGB LED background lighting control system during TV broadcasts or productions. They implement lighting designs according to the requirements of specific programs or segments, monitor the performance of the lighting system, and make necessary adjustments to achieve desired lighting effects. Collaboration with news anchors and other production team members

is crucial to ensure that lighting setups align with the mood and tone of the content being produced.

Student assistants share similar responsibilities with professional staff members, assisting in the operation of the RGB LED background lighting control system during TV broadcasts or productions. They contribute to implementing lighting designs, monitor system performance, and collaborate with the production team to ensure effective lighting setups. This involvement provides them with practical experience and skills relevant to the broadcasting and production industry.

News anchors play a vital role in collaborating with the lighting team to ensure appropriate lighting setups for news segments. They provide input on lighting preferences and adjustments based on personal or programmatic requirements, adapt to different lighting conditions and cues during live broadcasts to maintain professionalism and visual appeal, and communicate effectively with the production team regarding any lighting-related issues or adjustments needed during broadcasts.

Planning

Planning is the foundational phase of the development process, where the researcher delves into the current background lighting system utilized by the system's constituent, AI TV-5. As highlighted in previous chapters, AI TV-5 stands as an emerging educational TV program in Sorsogon City, with its production recording needs expanding over time, necessitating a more advanced approach to cater to its growing clientele. An integral component of production recording is the quality of the output, particularly in recorded news and related materials. In this phase, the researcher identifies any existing problem areas and proposes viable solutions to enhance the system's effectiveness and efficiency.

Research

Research plays a pivotal role in the development process, aiming to gather accurate and relevant data essential for the system's development. In this endeavor, the researcher embarked on various activities to ensure comprehensive data collection. This included visiting the premises of AI TV-5 to gain firsthand insights into its operations and existing background lighting system. Additionally, conducting Key Informant (KI) interviews with the AI TV-5 Manager facilitated a deeper understanding of the specific requirements and challenges faced by the organization. Furthermore, the researcher explored existing systems and studies related to background lighting control systems to leverage existing knowledge and best practices in the field. By synthesizing information from multiple sources, the research phase provided a solid foundation for informed decision-making and system development.

Design

In the design phase, the insights and data collected during the requirement planning stage were utilized to craft the user design of the system. This process involved consulting with the respondents, as well as seeking input from an IT expert. Multiple iterations and revisions were undertaken based on the feedback received from these stakeholders.

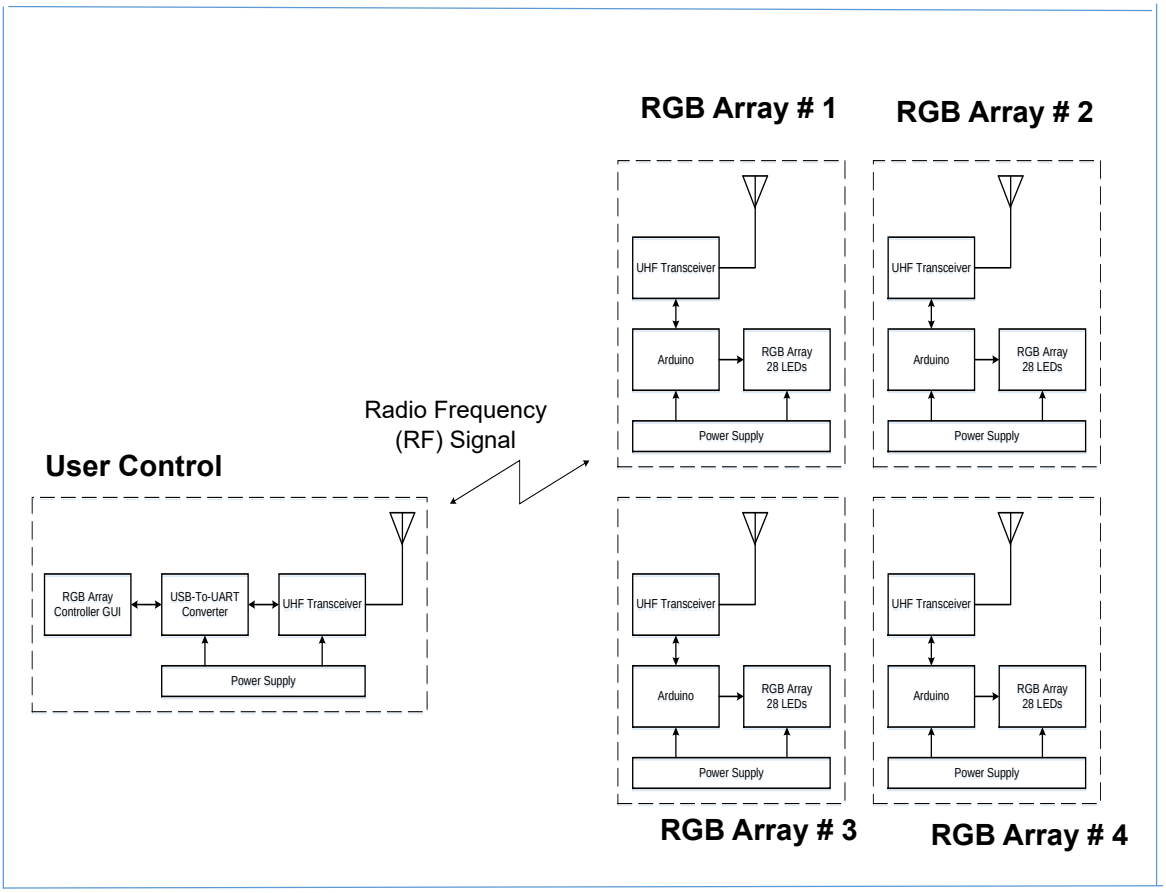

Figure 4.1 Overview of the PCB-RGB-LED-BLCS

The user controls serve as the primary interface for managing the LED lights, utilizing a Graphic Unit Interface (GUI) that offers a wide range of color combinations. This interface allows users to change, combine, and mix colors accurately before sending commands to the LED lights. A color picker tool is integrated into the GUI for each of the four LED arrays, enabling users to select pre-defined color combinations with ease, embodying the "what you see is what you get" principle familiar to users of traditional computer GUIs. Additionally, a UART (Universal Asynchronous Receiver/Transmitter) microchip is employed to control the interface between the computer and its attached serial devices. Acting as a USB to Serial UART converter

module, it facilitates seamless communication between the computer and the LED lighting system without the need for additional devices or programming.

The USB-SER board boasts several innovative features that distinguish it from conventional USB to Serial Converter boards. With a 256-byte receive buffer and a 128-byte transmit buffer, it utilizes advanced buffer smoothing technology to enable high data throughput. Furthermore, it offers a 6MHz clock output signal option for driving external MCUs or FPGAs. The TX and RX pins of the USB-SER can be directly connected to the corresponding pins of a microcontroller or serial application, simplifying the serial cable replacement connection process. Ideal for embedded systems requiring a serial connection to a computer, the board connects directly to the USB bus via a standard mini B receptacle connector. It appears as a standard serial COM port on any Windows computer, seamlessly converting applications that communicate with this COM port to USB and back to UART for communication with the target board.

Operating in the UHF frequency spectrum provides several advantages, including reduced interference due to a wider frequency spectrum. Despite weaker propagation compared to VHF signals, UHF signals offer better penetration through wood, steel, and concrete, making them ideal for urban environments. The UHF transceiver employed in the LED lighting system simultaneously connects to four LED arrays, each capable of self-testing to detect malfunctioning LEDs for easy replacement. Additionally, Arduino, an open-source electronics platform, serves as the foundation for the system, offering user-friendly hardware and software for reading inputs and controlling the LED lights. Arduino boards consist of physical programmable circuit boards and an Integrated Development Environment (IDE) used to write and upload computer code, facilitating seamless integration and customization of the lighting control system.

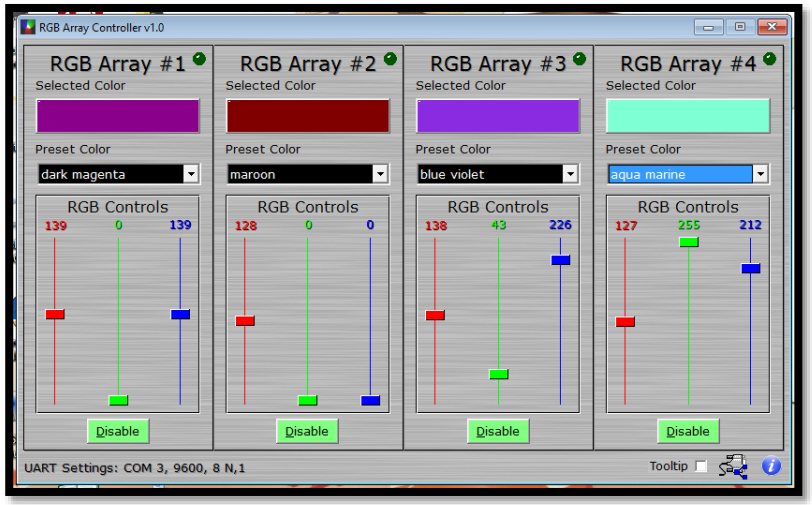

Figure 4.2 RGB Led Background Control System

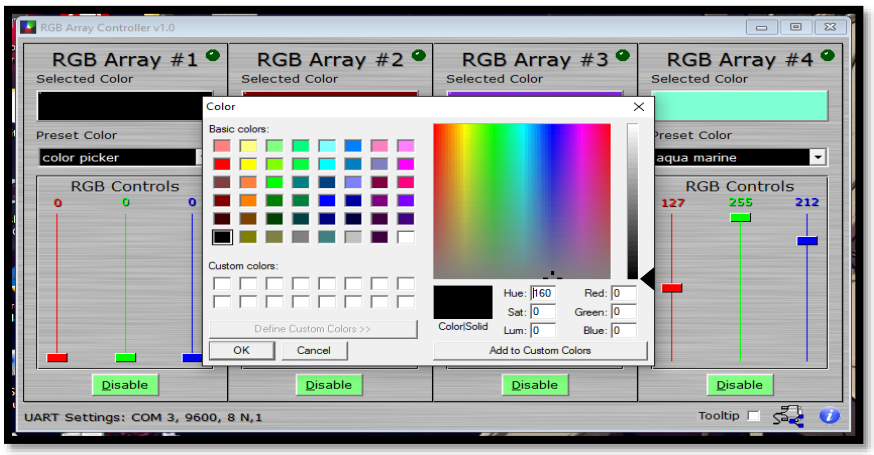

Figure 4.3 The Colour Picker

Table 4.8 Overall Evaluation

QUALITY CHARACTERISTICS	Mean
Functionality	95
Reliability	91.66
Usability	88.33
Efficiency	88.33
Maintainability	95
Portability	88.33
OVERALL MEAN	**91.66%**

Table 4.8 presents the overall evaluation of the developed system based on various quality characteristics, each rated on a scale from 0 to 100. Functionality, which assesses the system's ability to meet specified requirements and perform its intended tasks, received the highest mean score of 95, indicating a robust and highly functional system. Reliability, measuring the system's ability to consistently perform without failures, closely followed with a mean score of 91.66, reflecting the system's dependability and stability.

Usability, evaluating the ease of use and user-friendliness of the system, received a mean score of 88.33, indicating a high level of accessibility and intuitive interface design. Efficiency, which assesses the system's performance in terms of resource utilization

and speed of execution, also received a mean score of 88.33, suggesting efficient utilization of system resources and timely execution of tasks.

Maintainability, measuring the ease with which the system can be modified, updated, or repaired, received a high mean score of 95, indicating that the system is well-designed and easily maintainable. Portability, assessing the ease of transferring the system to different environments or platforms, received a mean score of 88.33, suggesting that the system can be effectively deployed across various settings.

The overall mean score, calculated as the average of all quality characteristics, is 91.66%. This indicates a high level of satisfaction across all evaluated aspects, reflecting the effectiveness, reliability, and usability of the developed system. Overall, the system demonstrates strong performance across key quality characteristics, validating its suitability for use in the intended context.

Summary

This study delved into the enhancement and modernization of the current Background Lighting system utilized by AI TV-5 in their studio settings. The primary focus was on integrating a controlled PC (Personal Computer) as the main board for the Background Lighting, alongside incorporating color using RGB LED light arrays. The objectives of the study were twofold: firstly, to design and develop a PC-Based RGB LED Background Lighting Control System with the capacity to set the mood of the studio on stage and provide an intuitive interface for light control. Secondly, the study aimed to evaluate and validate the developed system across key criteria including functionality, reliability, usability, maintainability, and portability. By addressing these objectives, the study aimed to significantly enhance the capabilities and performance of the Background Lighting system, thereby improving the overall quality and effectiveness of studio productions at AI TV-5.

Findings

Based on the data gathered in this study, the findings were as follows:

1.1 The PC-Based RGB Led Background Lighting Control System successfully achieved the objective of setting the mood of the studio on stage. Through the integration of RGB LED light arrays and a user-friendly interface, the system provided versatile control over lighting colors, intensities, and effects. This allowed for the creation of diverse atmospheres tailored to the specific requirements of different studio productions, enhancing the overall aesthetic appeal and visual impact of the televised content.

1.2 The system also effectively served as an interface for the light control system, facilitating seamless interaction between the user and the lighting setup. The graphical user interface (GUI) implemented in the system provided intuitive controls for adjusting various lighting parameters, such as color, brightness, and transition effects. This simplified the process of configuring and fine-tuning the lighting settings, enabling operators to efficiently manage the illumination of the studio environment during recording or live broadcasts.

Findings for the evaluation and validation of the developed system in terms of functionality, reliability, usability, maintainability, and portability, with an overall rating of 91%, are as follows:

2.1 Functionality. The evaluation revealed that the system exhibited robust functionality, meeting the desired objectives of controlling RGB LED background lighting effectively. Users were able to manipulate lighting parameters, such as color combinations and intensity levels, with precision and ease. The system reliably executed its intended functions, ensuring seamless operation during studio recordings or live broadcasts.

2.2 Reliability. The system demonstrated high reliability, consistently delivering stable performance without significant disruptions or malfunctions. Throughout the testing phase, there were minimal instances of system downtime or errors, indicating that the system could be relied upon to operate dependably under various conditions. This reliability instills confidence in users regarding the system's capability to fulfill its intended purpose consistently.

2.3 Usability. The system was evaluated to be highly usable, as evidenced by the intuitive user interface and straightforward operation. Users, including professional staff and student assistants, found the system easy to understand and navigate, requiring minimal training for proficiency. The graphical user interface (GUI) facilitated efficient interaction, allowing users to adjust lighting settings effortlessly to achieve desired effects.

2.4 Maintainability. The system demonstrated good maintainability, with provisions for easy troubleshooting, updates, and repairs. Components were designed to be accessible and replaceable, minimizing downtime in the event of hardware failures or software issues. Additionally, the system architecture supported scalability, enabling future enhancements or modifications to be implemented seamlessly without compromising system integrity.

2.5 Portability. The system exhibited satisfactory portability, as it could be deployed and utilized across different studio environments with relative ease. While the primary control unit was based on a personal computer (PC), the system components were designed to be compact and adaptable, facilitating transportation and setup in various production settings. This portability enhances the system's versatility and suitability for use in diverse broadcasting scenarios

Conclusions

Based on the findings, the conclusions:

1. The successful design and development of a PC-Based RGB Led Background Lighting Control System for AI TV-5 of Aemilianum College Inc. The system effectively achieved its objectives of setting the mood of the studio on stage and serving as an interface for the light control system. Through the integration of RGB LED light arrays and a user-friendly interface, the system provided versatile control over lighting colors, intensities, and effects, enhancing the overall aesthetic appeal and visual impact of televised content.

2. The evaluation of the developed system revealed high functionality, reliability, usability, maintainability, and portability, with an overall rating of 91%. The system exhibited robust functionality, stable performance,

intuitive usability, ease of maintenance, and satisfactory portability, making it a valuable asset for studio productions at AI TV-5.

Recommendations

Based on the successful design and development of the PC-Based RGB Led Background Lighting Control System and its high evaluation ratings, the following recommendations are proposed:

1. Continuous Improvement: Despite the system's high functionality and reliability, it is essential to continuously monitor and improve its performance to adapt to evolving technological advancements and user requirements. Regular updates and enhancements should be implemented to address any emerging issues or opportunities for optimization. This could involve incorporating new features, enhancing existing functionalities, or improving user interfaces based on feedback from users and stakeholders.

2. Training and Capacity Building: To maximize the benefits of the RGB Led Background Lighting Control System, comprehensive training programs should be conducted for AI TV-5 staff, including professional staff and student assistants. Training sessions should focus on system operation, troubleshooting, maintenance procedures, and best practices for optimizing lighting effects. By investing in staff training and capacity building, AI TV-5 can ensure proficient use of the system and foster a culture of continuous learning and improvement.
3. Integration with Production Workflows: The RGB Led Background Lighting Control System should be seamlessly integrated into AI TV-5's production workflows to streamline operations and enhance efficiency. Collaboration between lighting technicians, directors, and other production team members is essential to ensure that the system is utilized effectively during studio recordings and live broadcasts. Clear communication channels and standardized procedures should be established to facilitate smooth coordination and collaboration among different departments.

4. Regular Maintenance and Support: To maintain the system's reliability and performance, AI TV-5 should establish a comprehensive maintenance schedule and provide adequate technical support for troubleshooting and repairs. This includes regular inspections, software updates, and hardware checks to identify and address any potential issues proactively. Additionally, a dedicated support team should be available to assist users with any system-related queries or concerns, ensuring minimal downtime and uninterrupted production activities.

5. Future Expansion and Upgrades: As AI TV-5 continues to grow and evolve, there may be opportunities to expand the capabilities of the RGB Led Background Lighting Control System or integrate additional features and technologies. Stakeholder feedback and market research should be solicited to identify potential areas for improvement or innovation. By staying abreast of industry trends and leveraging emerging technologies, AI TV-5 can remain at the forefront of television production and deliver compelling content to its audience.

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