Development of a Microcontroller-Based Anti-Violence Billboard

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Abstract

Effective communication is crucial in institutions and public places, where digital display boards play a significant role in disseminating information. Traditional display boards often require constant reprogramming, limiting their flexibility and efficiency. This project addresses these limitations by designing and implementing a Light Emitting Diode (LED) scrolling message display system using an ATmega328 microcontroller. The system is specifically designed to promote anti-violence campaigns, such as "SAY NO TO EXAMINATION MALPRACTICE AND CULTISM," while also accommodating static printed images. The microcontroller-based system allows for easy and efficient message updates via a personal computer (PC) equipped with Visual Basic software (MEKUS), serving as the interface between the user and the display system. Messages are dynamically displayed on the LED board, providing clear and engaging communication. The system operates on a 5V DC power supply, with message scrolling controlled by shift registers using four IN4049 ICs. This design enhances the security and awareness within institutions by offering a reliable and user-friendly platform for real-time information dissemination. The advantages of this LED display system include ease of setup, programming, and handling, along with a clear presentation of scrolling text.

Keywords: LED scrolling message display, microcontroller, ATmega328, Visual Basic, anti-violence campaign, shift register, IN4049 IC, display board, communication system, assembly language.

Introduction

Background of the Study

In our fast-paced world, the ability to quickly and efficiently share information is essential, especially in places like educational institutions, offices, and transit hubs. Traditional display boards, which require manual updates, fail to meet the current demand for timely and efficient communication. These boards often involve labor-intensive message changes, resulting in delays and possible miscommunication.

Advancements in display technology have significantly enhanced how information is presented and updated. Digital display boards, controlled by microcontrollers, represent a major improvement. These systems enable dynamic and remote updates of messages, ensuring quick and accurate communication. This technological shift has significant implications for applications such as advertising, public announcements, and security alerts.

This study aims to leverage microcontroller technology to create an LED scrolling message display system. Specifically designed to support anti-violence campaigns in institutions, this system provides a platform for dynamic and impactful communication. The project seeks to overcome the limitations of traditional display boards by offering a system that is easy to update and capable of delivering real-time information effectively.

Problem Statement

Traditional display boards are inherently rigid, requiring manual changes for each message update. This inflexibility is a significant disadvantage, particularly in environments where information must be updated frequently and quickly. For instance, in educational institutions, crucial announcements related to safety, schedule changes, or emergencies need to be communicated immediately. Manually reprogramming display boards can cause significant delays and increase the workload for staff.

Furthermore, institutions face challenges in raising awareness and educating people about critical issues, such as violence prevention. Static display boards are ineffective at capturing attention or conveying urgent messages dynamically. This project addresses these issues by developing a microcontroller-based LED display system that allows for easy and rapid updates, enhancing the ability to disseminate important information and support anti-violence initiatives effectively.

Aim and Objectives

The main aim of this project is to develop a microcontroller-based LED scrolling message display system that improves the dissemination of anti-violence messages. The system is designed to be user-friendly, allowing for easy updates via a personal computer. The specific objectives of the project include:

1. Designing the System: Crafting a detailed design of a microcontroller-based display system that includes all necessary components and functionalities.

2. Constructing the Display Board: Building the physical layout of the display board, including the integration of LED matrices and other hardware components.

3. Simulating the System: Using simulation software to test the design and ensure that all components function together seamlessly.

4. Implementing the Design: Converting the simulated design into a working prototype, validating its performance in real-world conditions.

Scope of the Study

This study focuses on developing a prototype digital display board that combines a static printed image with a dynamic scrolling message feature. The system uses an ATmega328 microcontroller as the central control unit and interfaces with a PC for message updates. The scope includes the design, construction, simulation, and implementation of the display board, with a specific focus on promoting anti-violence campaigns within institutional settings.

The project does not aim to cover large-scale commercial implementations but provides a foundational framework that can be expanded for broader applications. The primary goal is to demonstrate the

feasibility and benefits of such a system in enhancing communication and security in educational and other institutional environments.

Significance of the Study

This project is significant due to its potential to enhance communication tools in institutions, thereby improving overall safety and awareness. By enabling quick and easy updates to display messages, the microcontroller-based system can greatly improve the efficiency of information dissemination. This is especially important for promoting anti-violence campaigns, where timely and impactful communication can play a crucial role in prevention and awareness.

The project also contributes to the field of digital communication technologies by demonstrating the practical application of microcontroller-based systems in dynamic message displays. It offers a cost-effective and flexible solution adaptable for various uses, including security alerts, public announcements, and educational messages.

By showcasing the effectiveness of this system, the project aims to encourage the adoption of similar technologies in institutions, ultimately leading to improved communication and enhanced security.

Literature Review

Introduction

The literature review explores existing research and technologies related to digital display systems and microcontroller applications. The review highlights the evolution of display boards from traditional static boards to modern dynamic systems.

Evolution of Display Systems

Traditional display boards have evolved significantly over the years. Initially, these boards were entirely manual, requiring physical alteration of the display for any message change. With the advent of electronic display boards, the process became somewhat automated, but still lacked flexibility and ease of use.

Microcontroller-Based Systems

Microcontroller-based systems have revolutionized digital displays. These systems allow for more complex and dynamic displays, which can be easily updated and controlled. Research has shown that microcontroller-based displays are more efficient and cost-effective compared to traditional systems. Various studies have demonstrated the successful implementation of such systems in different settings, including educational institutions and public spaces.

Related Works

Several related works have explored the use of microcontroller-based systems for digital displays. For instance, Twaha and Zhang (2017) developed a PC-based moving message display board integrated with RF link technology, enabling wireless message transmission [1]. Despite its wireless capability, access to the device is restricted by manufacturer-imposed username and password verification, limiting user control.

Rahul and Preeti (2013) tackled latency issues in moving message display modules by designing a GSM-based multiple LED display board [2]. However, message editing is constrained by the need for a separate keyboard, affecting user convenience.

Vishvendra (2015) introduced a GSM-based LED dot matrix message display facilitating wireless communication with mobile devices. While offering wireless connectivity, the system lacks robust security measures [3].

Mayuresh et al. (2018) developed a GSM-based scrolling LED display [4] allowing message updates without reprogramming. Nevertheless, the system does not retain previous messages sent, impacting message archival.

Ahmed, Hasan, and Atiqul (2016) implemented an LED message display system leveraging cellular communication for rapid news dissemination [5]. However, the absence of message storage capability limits its functionality.

Priyanka et al. (2013) devised a GSM mobile phone-based LED scrolling message display system, enhancing communication efficiency through wireless mobile integration [6]. Nevertheless, message input is restricted to mobile phone typing.

A study by Aditi S. J. and Sudarshan R. D. (2016) demonstrated the use of a Raspberry Pi in smart board systems, highlighting the flexibility and functionality of such systems [7]. Similarly, Adriansyah A. and Dani A. W. (2016) discussed the implementation of a smart home system based on Arduino, illustrating the versatility of microcontrollers in various applications [8].

Methodology

Design Analysis

The design of the microcontroller-based LED scrolling message display system involves several key components:

- **Microcontroller (ATmega328):** Acts as the brain of the system, controlling the scrolling messages.

- **LED Display Board:** The output unit that visually presents the messages.

- **PC Interface:** A personal computer with Visual Basic (MEKUS) software, used to input and update messages.

- **Communication Interface:** The system communicates with the PC via a COM port, allowing for real-time updates.

The design process includes selecting appropriate components, designing the circuit, and writing the software to control the display. The block diagram and flow chart of the system are shown in Figure 1 and 2 respectively.

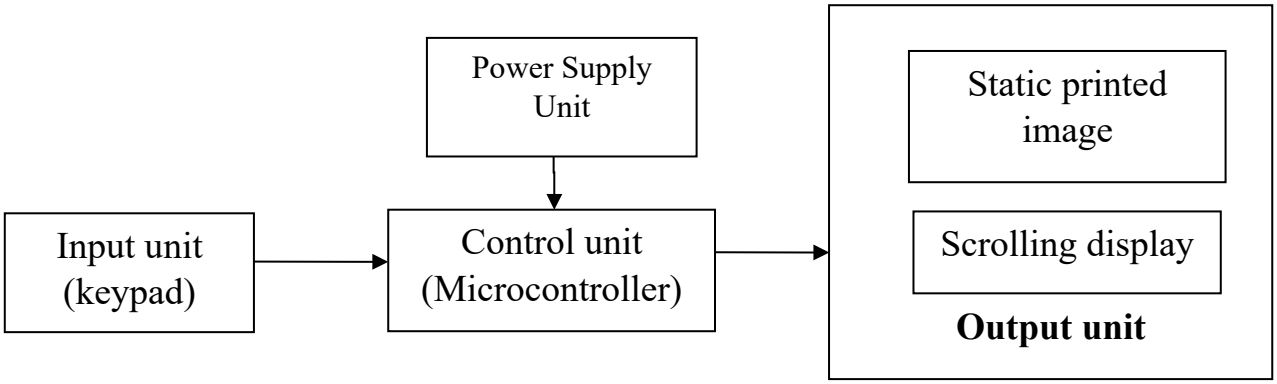

Figure 1: Block diagram of the display board

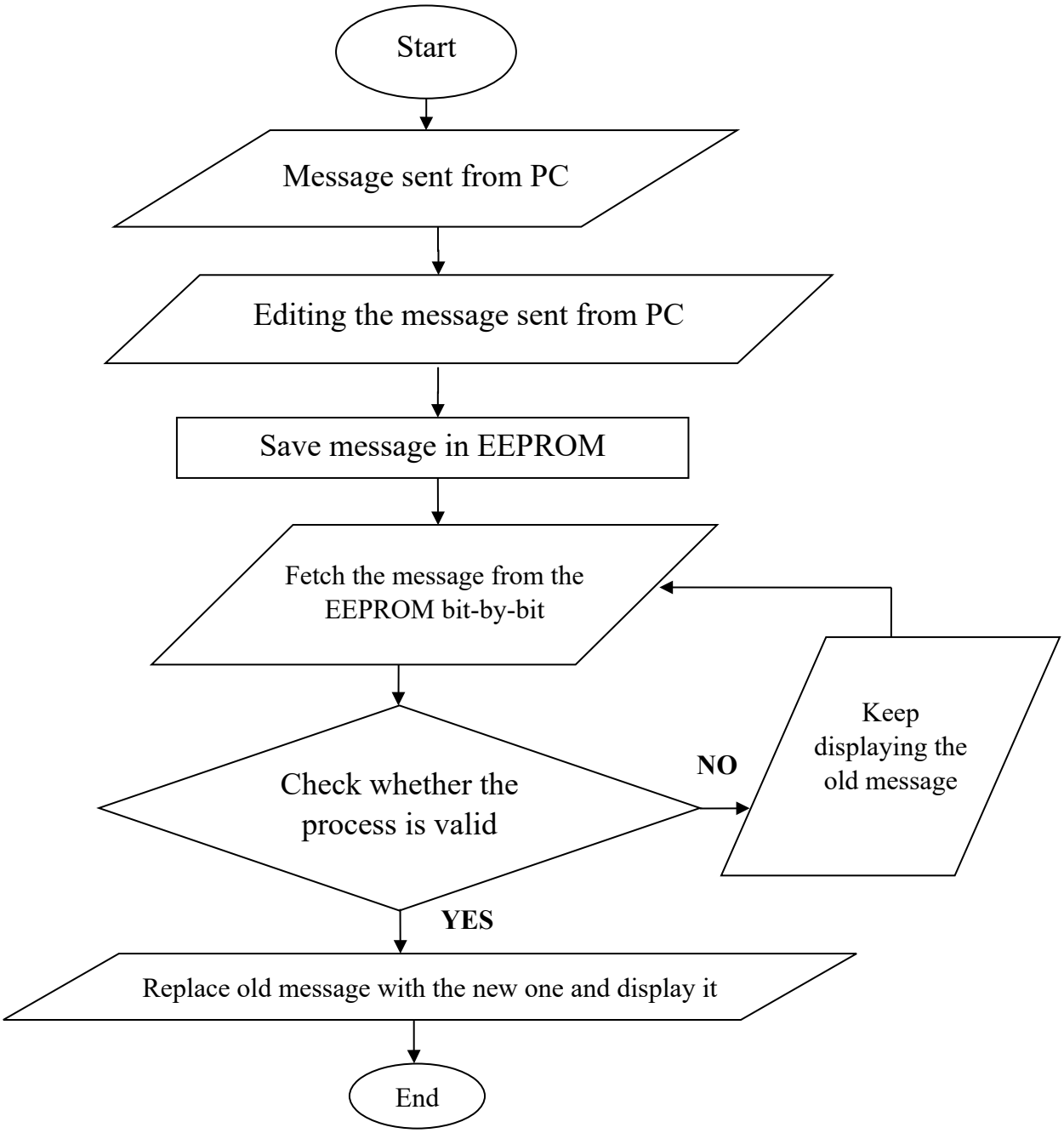

Figure 2: Flow chat of the display board

Construction Procedure

The construction of the display system is divided into three main units:

- **Power Unit:** This unit ensures a stable 5V DC supply to the system. It includes a step-down transformer, bridge rectifier, capacitors, and a voltage regulator. The power supply circuit is depicted in Figure 3.

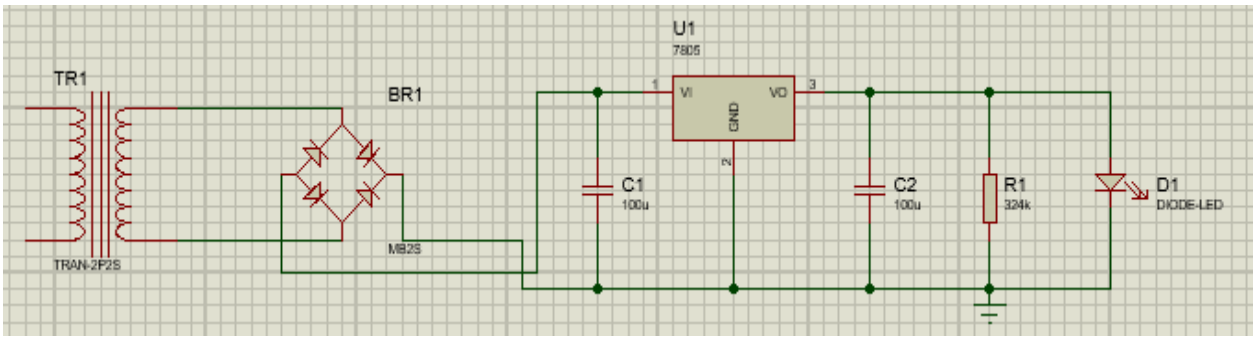

Figure 3: Power supply circuit

- **Processing Unit:** This unit (Figure 4), controlled by the ATmega328 microcontroller, handles the input from the PC and drives the LED display. Shift registers are used to manage the LED matrix.

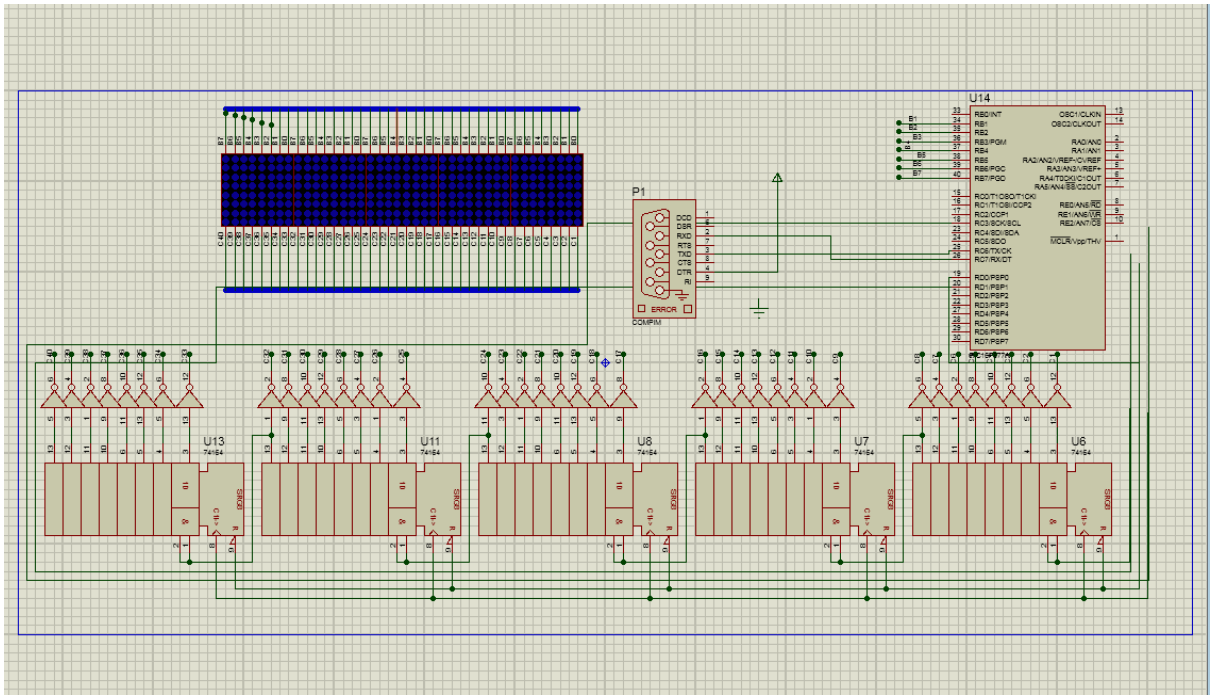

Figure 4: Display circuit showing LED connection with the Microcontroller

- **Display Unit:** The LED board displays the scrolling messages shown in Figure 5. The board was constructed using a matrix of LEDs, arranged to allow for dynamic message presentation.

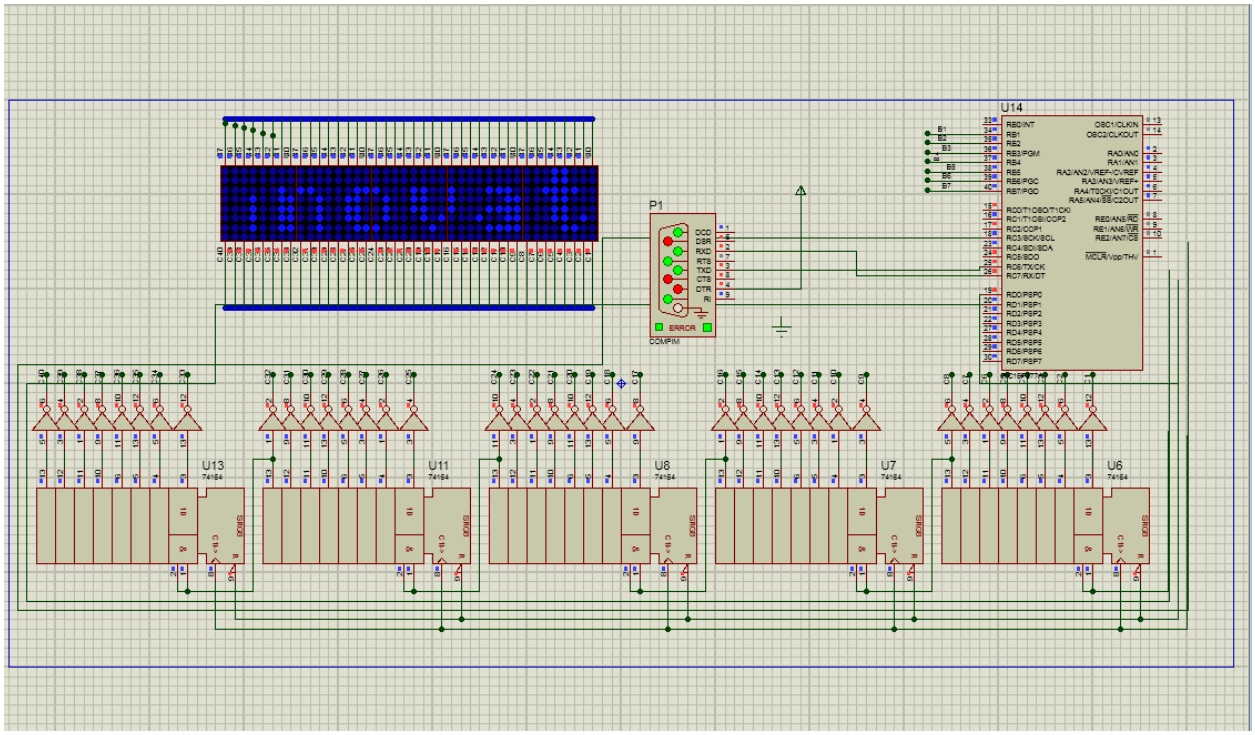

Figure 5: Simulation of the display circuit using proteus 8.1 software

Each unit is constructed and tested individually before integrating them into the complete system.

Results and Discussion

Performance Test

The performance of the system was tested in several stages:

- **Power Unit Test**: The power unit was tested to ensure it provided a stable 5V DC supply. The test confirmed that the unit consistently delivered the required voltage, ensuring reliable operation of the processing and display units.

- **Processing Unit Test:** The microcontroller and associated circuitry were tested to verify that they correctly processed input from the PC and controlled the LED display. The test showed that the microcontroller effectively managed the scrolling messages.

- **Display Unit Test:** The LED board was tested to ensure that it accurately displayed the messages. The test involved sending various messages from the PC and observing their display on the LED board.

Operation of the Display System

The system operates through the following steps:

1. Power On: The system is powered on, initializing the microcontroller and LED display.

2. Message Input: Messages are typed on the PC using Visual Basic (MEKUS) software. The interface is illustrated in Figure 6.

3. Message Transmission: The message is sent to the microcontroller via the COM port.

4. Message Display: The microcontroller processes the message and controls the LED board to display the message in the selected format (scrolling or static).

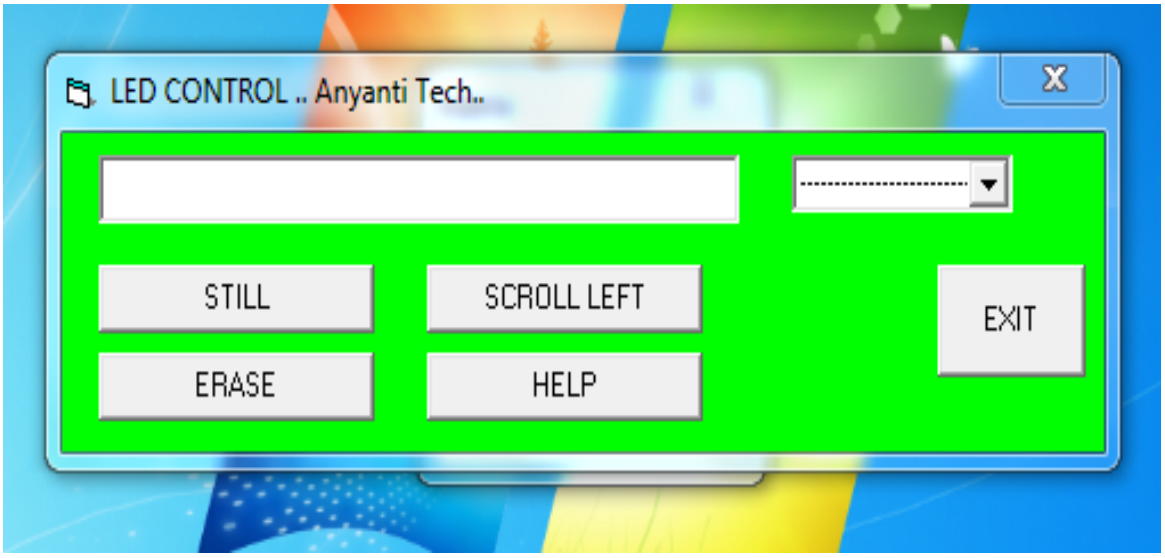

Figure 6: Interface of the Visual basic software

Presentation of Results

The results were documented through visual observations and photographs. Figures 7 and 8 in the document show the display board in operation, successfully displaying the input messages. The tests confirmed that the system operated as intended, with accurate and dynamic message presentation.

Figure 7: Testing of the display board

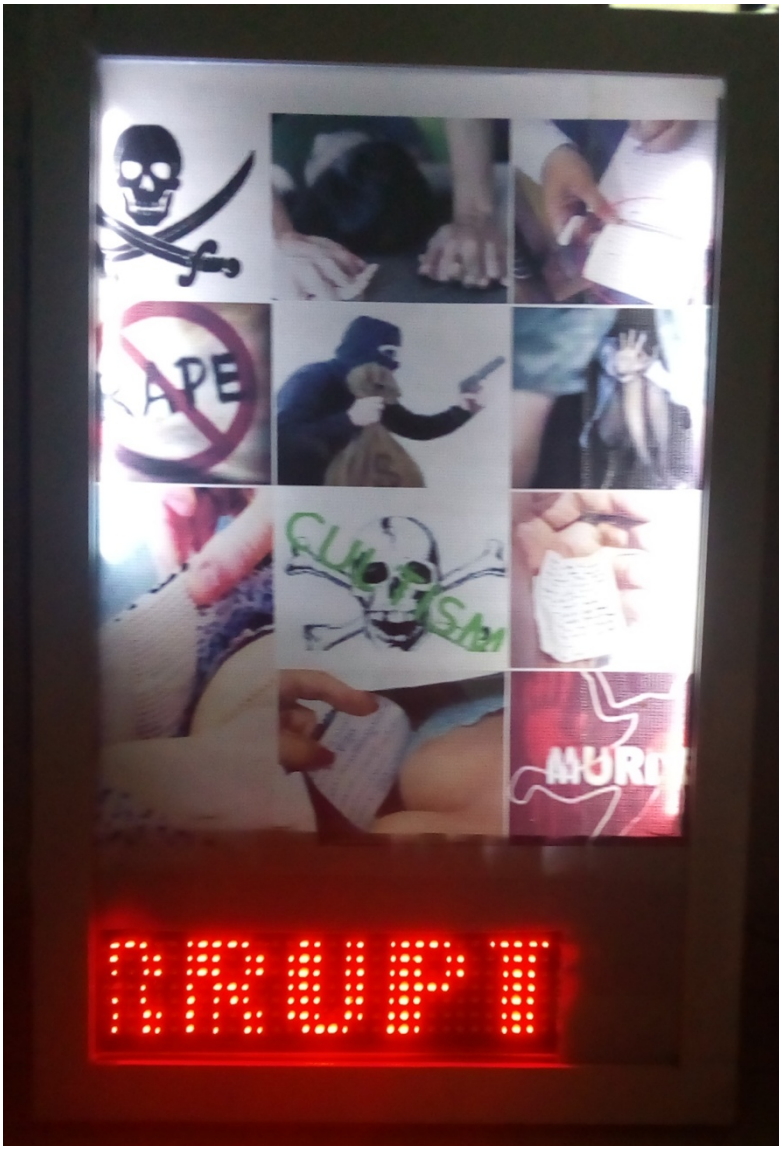

Figure 8: Testing of the display board and the printed static image

Discussion of Results

The results demonstrate the effectiveness of the microcontroller-based system in controlling the LED display. The use of an ATmega328 microcontroller and Visual Basic software (Figure 6) provides a flexible and user-friendly interface for updating messages. This system offers a significant improvement over traditional display boards, allowing for quick and easy updates, thereby enhancing communication and security in institutions.

Conclusion and Recommendation

Conclusion

The microcontroller-based LED scrolling message display system developed in this project successfully addresses the limitations of traditional display boards. By allowing for easy updates via a PC, the system enhances the flexibility and efficiency of message dissemination. This system can play a crucial role in promoting anti-violence campaigns and improving security in institutions and public places.

Contribution to Knowledge

The project contributes to the body of knowledge by demonstrating the practical application of microcontroller-based systems for dynamic message displays. It provides a framework for developing similar systems that can be used in various settings to improve communication and security.

Recommendation

Institutions should consider adopting this microcontroller-based display system to enhance their communication tools, particularly for promoting anti-violence campaigns. Future research should focus on optimizing the system for larger displays and integrating additional features, such as wireless communication and remote control, to further enhance its capabilities and applications.

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