Smart Bicycle Safety System

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Introduction

This project aims to develop a smart bicycle safety system with enhanced features to ensure the rider's safety. By integrating ultrasonic sensors, an LCD display, and LEDs, the system detects nearby obstacles, provides haptic feedback, and signals warnings. A PIC16F877A microcontroller controls the system, ensuring efficient data processing and actuation. This project highlights the importance of embedded systems in everyday applications, showcasing their potential to improve safety and usability. The system is designed to be compact, reliable, and cost-effective, making it suitable for integration into modern bicycles.

Design

The electrical design incorporates a PIC16F877A microcontroller to manage various components, including ultrasonic sensors for obstacle detection, vibration motors for feedback, flex sensors for brake activation, LEDs for signaling, a Hall-effect sensor for speed measurement, and a servo motor for kickstand control. An LCD displays the speed, with all components powered by a 5V supply.

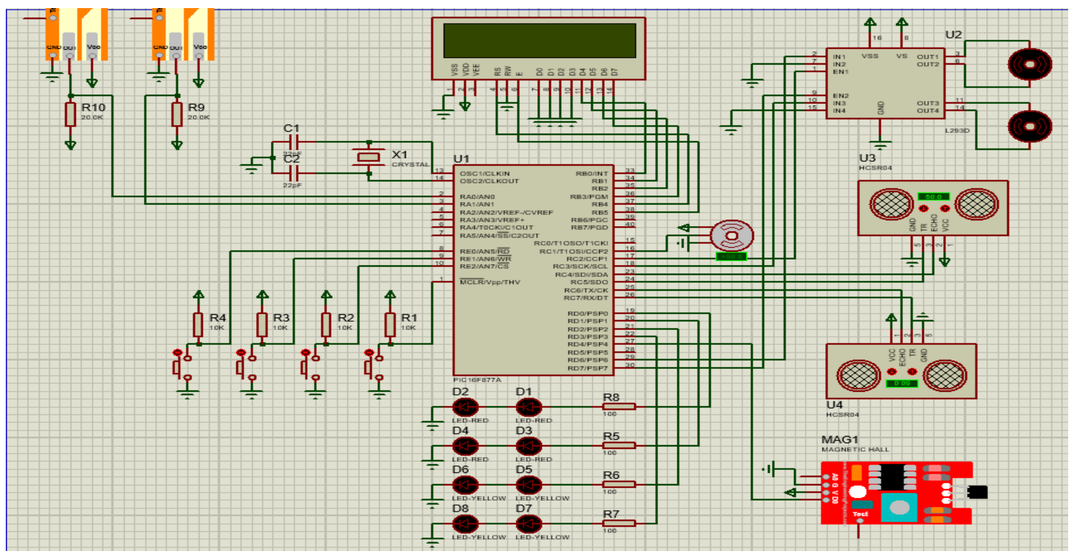

Figure 1: Electrical Design

This flowchart outlines the program's logic to coordinate the system's functionality.

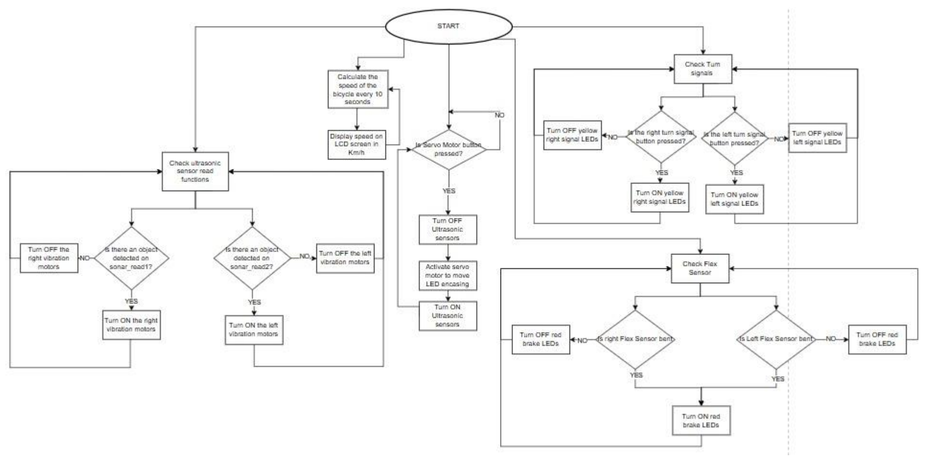

Figure 2: Software Design Approach

Results

Once the system is operating, all functions activate.

Figure 3 shows the brake lights and left turn signal activated

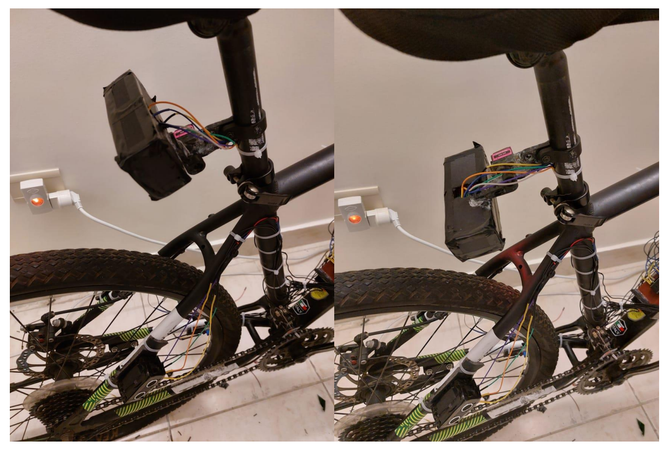

Figure 4 shows the servo in neutral position, then when activated

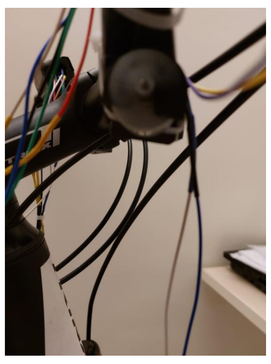

Figure 5 shows the right vibration motor activated

The results demonstrate the successful integration and functionality of the smart bicycle safety system. Each component operates seamlessly in response to the respective inputs, ensuring a user-friendly and responsive experience. The activation of brake lights and turn signals provides clear and immediate visual feedback, while the servo motor adjusts accurately to its commanded positions. Additionally, the vibration motor delivers effective tactile feedback, ensuring the rider's awareness of potential obstacles. These results validate the system's reliability and effectiveness in enhancing bicycle safety.

Conclusion

This project demonstrates how embedded systems can enhance bicycle safety through automation and real-time feedback. By integrating sensors, actuators, and control logic, we created a system that actively improves rider awareness and reduces potential risks. The use of ultrasonic sensors for obstacle detection, haptic feedback through vibration motors, and automated signaling functions showcases the potential of microcontroller-based designs in addressing critical safety concerns. Future work could include additional sensors for enhanced coverage, IoT integration for remote monitoring, and solar charging for improved sustainability.