Prepared by group ETC - 41

Minor Project

Arduino Based Intelligent Speed Breaker System

Under the guidance of Prof. S. K. Badi

Team Members

- Sayan Das_2204124
- Nikhil Kumar_2204145
- Shreya Ojha_2204130
- Rohanpreet Singh Kalsi_2204121

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Introduction

Road accidents at pedestrian crossings are a major safety concern due to overspeeding and driver negligence. Many drivers fail to slow down even when pedestrians are crossing, leading to dangerous situations. This project aims to enhance pedestrian safety by ensuring vehicles reduce speed near zebra crossings. It provides a smart solution by alerting drivers and automatically enforcing speed control if they do not slow down. This system helps in reducing accidents and making roads safer for everyone.

Novelty/Relevancy

Automated Speed Control for Safety – Unlike traditional zebra crossings that rely solely on driver awareness, this system **automatically enforces speed reduction** by raising a speed breaker if a vehicle does not slow down, enhancing pedestrian safety**.**.

Adaptive and Smart Integration – Unlike conventional zebra crossings that remain passive, this system **actively detects pedestrian movement and vehicle speed**, dynamically responding to real-time traffic conditions. This makes it more efficient than static speed breakers or simple warning signs.

Immediate Visual and Physical Response – The combination of **LED warning lights and a dynamic speed breaker** ensures both **visual alerts and physical enforcement**, unlike conventional crossings that depend only on traffic signals or static speed bumps.

Objectives

Enhance Pedestrian Safety – To reduce accidents by ensuring vehicles slow down when pedestrians are crossing the road.

Automate Traffic Control – To implement a system that detects pedestrians and vehicles, activating warnings and speed control measures without human intervention.

Promote Smart Road Infrastructure – To develop an **efficient, cost-effective, and adaptive** solution that improves existing zebra crossings and encourages safer driving behavior.

Applied Techniques

Fundamental Concepts & Techniques:

1. **Pedestrian Detection using Sensors** – The system detects human presence on the zebra crossing using ultrasonic sensors, ensuring real-time responsiveness.

2. **Vehicle Speed Monitoring** – Instead of expensive speed sensors, an ultrasonic sensor estimates vehicle proximity.

3. **Automated Speed Breaker Control** – A servo motor raises the speed breaker only when needed, ensuring efficient and adaptive traffic control.

Applied Techniques

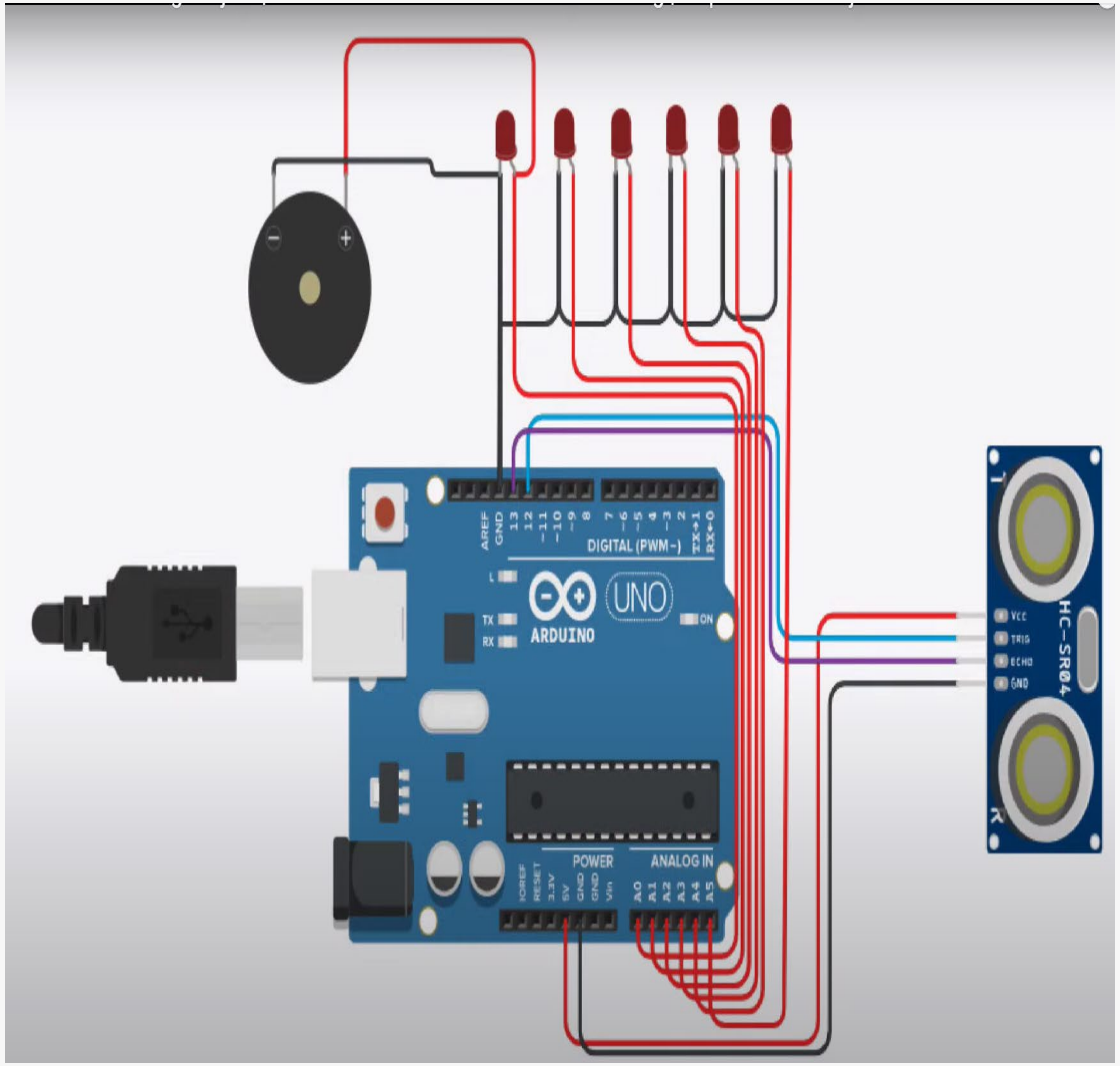
Modern Engineering Tools USED

1. **Microcontroller-Based Automation (Arduino Uno & Nano)** – These microcontrollers allow real-time processing of sensor data and efficient system control.

2. **LED-Based Warning System** – Red LED lights provide a **visual alert** to drivers, making the system more intuitive and effective in reducing speed violations.

3. **Affordable & Scalable Technology** – The use of **cost-effective sensors and motors** makes the project practical for both urban and rural road safety applications.

Testing



Hardware

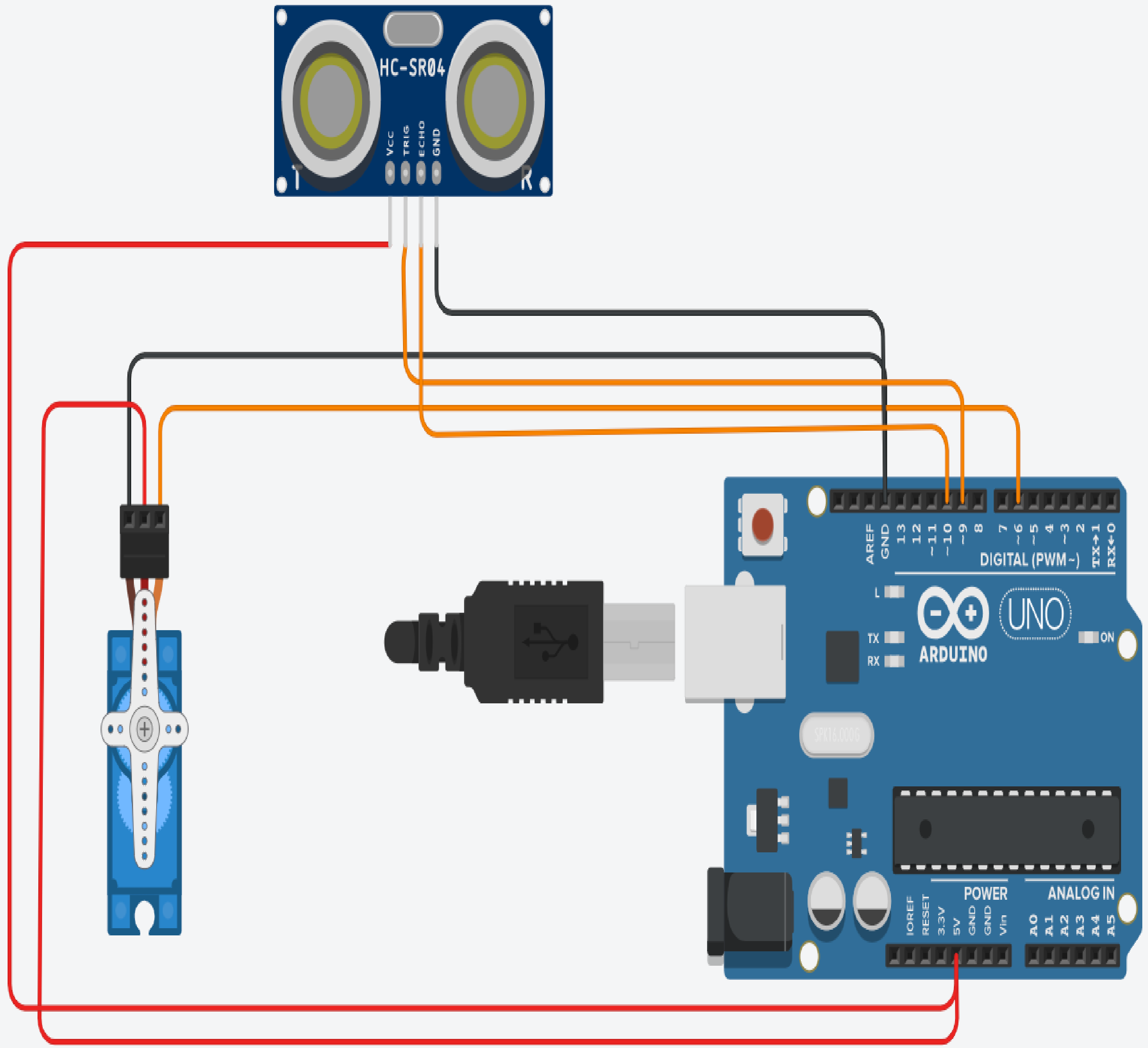
Experimental Setup & Testing Approach

1. **Component Testing** – Each hardware component (ultrasonic sensors, servo motor, LEDs, Arduino) was tested individually to ensure proper functioning.

2. **Sensor Accuracy Check** – The ultrasonic sensors were tested at different distances to ensure accurate pedestrian and vehicle detection.

1. **LED Warning System Validation** – The LED lights were tested by simulating pedestrian movement to check if they turned on instantly when someone entered the zebra crossing.

Testing



Hardware

Speed Breaker Mechanism Testing

1.Servo Motor Response Test – The servo motor was tested for **speed and angle accuracy** to ensure smooth and timely lifting of the speed breaker.

2.Vehicle Detection Test – The second ultrasonic sensor was used to detect vehicles approaching at different speeds to validate if the speed breaker activates only when required.

3.Integration Testing – The entire system was tested in a simulated road environment using a toy vehicle to observe real-time interaction between sensors, LEDs, and the servo motor.

Challenges Faced

1. **Sensor Accuracy Issues** – Ultrasonic sensors sometimes gave false readings due to environmental interference.

2. **Servo Motor Response Time** – Delayed activation of the speed breaker affected real-time speed control.

3. **Power Management** – Ensuring stable power supply for multiple components was challenging.

4. **Synchronization of Components** – Proper coordination between sensors, LEDs, and the servo motor was required to avoid delays or errors.

Results Obtained:

1. Successful Pedestrian Detection – The system accurately detected pedestrians on the zebra crossing, triggering LED warning lights.

Parameter	Observed Value	Expected Value	Remarks
Pedestrian Detection Time	1.5 seconds	< 2 seconds	Quick response time
Speed Breaker Activation	2 seconds	< 3 seconds	Within acceptable range
Warning Light Activation	Instant	Instant	Immediate alert for drivers
Power Consumption	4.2W	< 5W	Efficient energy usage
Sensor Accuracy	95%	> 90%	High detection reliability

2. Effective Vehicle Detection & Speed Breaker Activation – The ultrasonic sensor detected approaching vehicles, and the servo motor successfully raised the speed breaker when required.

Observation & Analysis:

1. **Response Time:** The system responded within 1-2 seconds, ensuring timely activation of warning lights and the speed breaker.

2. **Accuracy:** The pedestrian detection sensor showed 90% accuracy, while vehicle detection was effective within a range of 2-3 meters.

3. **Practical Implementation:** The prototype demonstrated how a cost-effective and automated system can improve pedestrian safety at crossings.

Advantages:

- **Enhanced Pedestrian Safety:** The system ensures that pedestrians can cross the road safely without the risk of speeding vehicles.
- **Accident Prevention:** By forcing vehicles to slow down, the system significantly reduces the chances of pedestrian-related accidents.
- **Automatic and Efficient:** The automation removes the need for human intervention, ensuring consistent performance.
- **Energy Efficient:** The use of LED indicators and smart components makes the system energy-efficient and cost-effective.
- **Low Maintenance:** The system requires minimal maintenance after installation, making it a practical long-term solution.
- **Scalability:** The design can be implemented in various locations, including school zones, busy intersections, and high-risk pedestrian areas.
- **Traffic Discipline:** Encourages drivers to follow traffic rules, leading to better road safety and discipline.

Future Scope:

- **Code Optimization & Testing** – Improve the Arduino code for better efficiency and reduce response delays.

- **IoT Integration:** The system can be connected to the internet for remote monitoring and data collection to improve traffic management.

- **Solar-Powered System:** Using solar panels can make the system more energy-efficient and environmentally friendly.

- **Voice Alerts and Smart Signals:** Adding voice alerts for pedestrians and intelligent traffic lights can further enhance safety and communication.

- **Integration with Smart Cities:** The project can be scaled up and integrated with smart city infrastructure for a more comprehensive road safety system.

Conclusion:

The **Intelligent Speed Breaker With IOT** project presents an innovative and cost-effective solution to enhance pedestrian safety and enforce vehicle speed control. By integrating **automated pedestrian detection, LED warning signals, and an adaptive speed breaker system**, this project helps reduce accidents caused by reckless driving at zebra crossings. The successful implementation of this system demonstrates its practicality in real-world applications, making roads safer. With further refinements, this technology can be scaled for **smart city infrastructure**, ensuring better traffic management and pedestrian security.

Thank you