

Prototype Design of Bicycle Safety Application

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The manufacturing of a safety device integrated with the technology has gotten a lot of attention because of the bicycle safety distance sensor. The Arduino UNO was utilised as a programmed microcontroller, coupled with an ultrasonic sensor and an LED strip, to create a working and clever alarming system to assist cyclists in staying aware while cycling. This product seeks to lower the danger of accidents while also increasing the sensation of security. The project explains and details the product development process for a user-friendly vehicle detection system, with a broad scope that covers technical rapid prototyping and coding, team dynamics, decision-making, and change management. Before a functional final product was discovered and built, a formal prototype was created, greatly boosting the practicality and efficiency of detection. With a maximum range of 50 metres and a field of view of 1.30 degrees, the final product was put through rigorous testing. These parameters were crucial in determining the sensor's position on the bicycle frame. The sensor technology, which is paired with an LED strip along the top tube of the bicycle frame, accurately detects cars approaching from the rider's blind zone and communicates back to the bike driver via the lighting of the LEDs in both light and dark settings.

Additional Keywords and Phrases: Prototype design, Bicycle, Safety, Distancing sensor, Ultrasonic, Alarm

1 INTRODUCTION

Bicycle is used as one of the major modes of transport in India. There are about India has about 90 bicycles for every 1,000 people, in India. According to the Ministry of Road Transport and Highways' annual report on road accidents, the number of cyclists killed in road accidents surged by 37.7% and reached to 3,559.

The hazardous conditions of a cycling commute currently necessitate safety practises that are not readily available. The quantity of safety equipment a cyclist is required to wear in order to comply with traffic laws, or to improve traffic safety, may be ineffectual in encouraging safety.

If a car approaches from behind or close to the biker, something should be done to warn them. This is because, unlike a car, a bicycle does not have a side mirror, and mounting one on the handle of the bike is impractical.

To help bikers ride securely at night, researchers invented a sensor that can detect any car approaching from behind and alert the cyclist by blinking an LED light on the handlebar stem of the bike. An ultrasonic sensor is utilised in conjunction with an Arduino UNO microcontroller. Arduino is a free and open-source microcontroller that can be programmed, erased, and reprogrammed at any time.

The Arduino platform was created to give students and professionals an inexpensive and simple way to construct devices that interact with their surroundings using sensors and actuators. It is an open-source computing platform for building and programming electronic devices that is based on inexpensive microcontroller boards.

It may also operate as a minicomputer, receiving inputs and regulating outputs for a range of electronic devices, exactly like other microcontrollers. As a result, this bicycle safety distancing sensor is made with an Arduino microcontroller to detect when a vehicle approaches from behind the rider, and an LED light will illuminate to alert the cyclist.

2 RELATED PRODUCT STUDIES

The purpose of product design research is to compare products on the market. This comparison is based on a variety of factors, including design, function, and resemblance. As a result, product innovation is derived from a product that has undergone major changes in terms of features, qualities, or an issue that originates from the product itself. So, garage distance sensor, eye-fit: light & reading distance keeper, and social distance detector are three product comparisons that have similar innovation to our idea.

As a result, the comparisons and issues raised by other products can be used to develop a new bicycle safety distance sensor that will serve as an alternate tool for detecting vehicles approaching from behind and notifying cyclists via a blinking LED light on the bike's handlebar stem. The diagram below depicts a comparison of distance sensor products available on the market.

Table.1: Similar Innovation with Bicycle Safety Distancing Sensor

Item of Comparison	Product Name		
	Garage Distance Sensor	Eye-fit: Light & Reading Distance Keeper	Social Distance Detector
Diagram of product			
Similarities	To warn the driver when it is near to the object	To warn the person when they came near to the objects for example, television, book and computer	To warn the person to maintain a distance from each other
Differences	The person keeps hitting the wall of his garage because he could not estimate when he should stop the car	People may not notice the consequences of watching television or reading a book very near. They may suffer from poor eyesight due to their action.	Due to this pandemic, it is quite difficult to keep a distance in an open place.

3 PROTOTYPE DESIGN

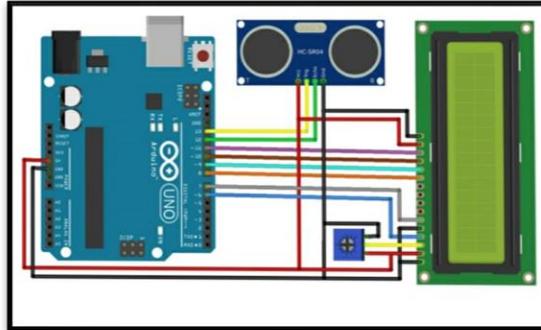


Fig 1: Prototype of Bicycle Safety App

The bicycle is designed based on the requirements. The prototype design includes Arduino UNO microcontroller (ATMega328P), lithium ion battery, LEDs, and MB1200 XL ultrasonic sensor. An ultrasonic sensor is connected to the Arduino UNO board to detect vehicles from behind. LED light board is placed on the handle of the bicycle to give warning to the cyclists. Overall, the Bike is implemented with the Arduino UNO board. Figure __ shows the overall design and layout of the Arduino UNO prototype. The circuit project consists of the main components that are combined to form one complete circuit that can function in good condition. This circuit is consisting of Arduino UNO board, ultrasonic distance sensor, LED's.

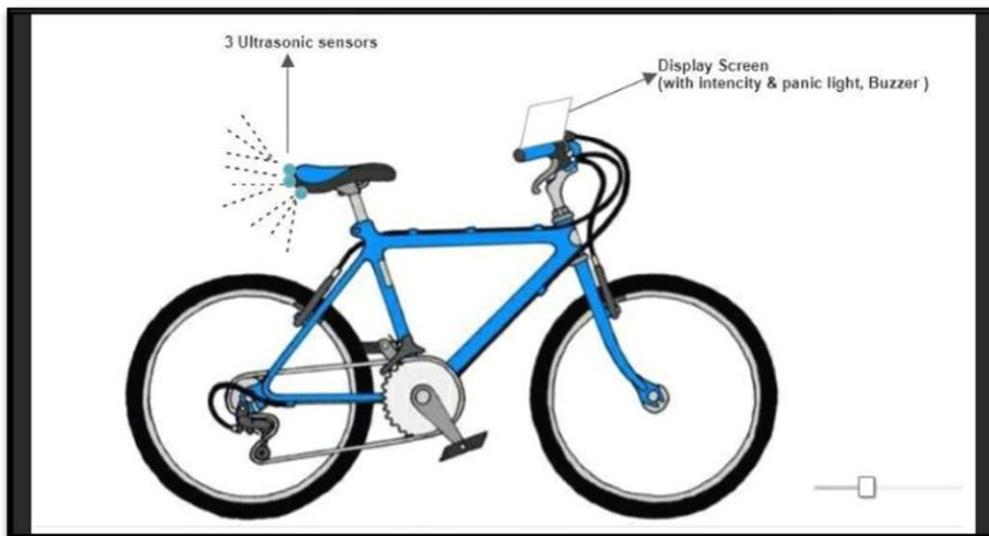


Fig 2: Bicycle Safety System mounted on Bicycle

The Smart Bicycle architecture diagram depicts how the sensors are interfaced and mounted on to the bicycle. Arduino UNO microcontroller (ATMega328P) is used as central hardware unit which is interfaced with the

sensors used in the project. And the LCD display which is on the Arduino UNO will display the Distance measured by Sensors.

Ultrasonic Sensor (MB1200 XL)

Ultrasonic sensor works on a principle similar to radar or sonar which evaluates attribution of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

Arduino UNO microcontroller (ATMega328P) is used as central hardware unit which is interfaced with the sensors used in the project.

LCD(16x2) Display

16x2 LCD is one kind of electronic device used to display the message and data.

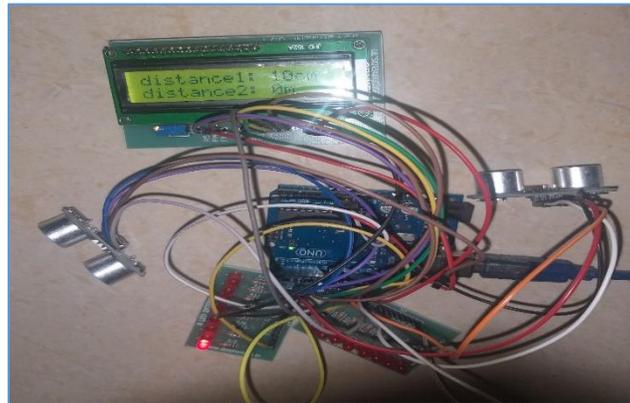


Fig 3: Initial Prototype of Bicycle Safety Application

The system of LED strip light (also known as an LED tape or ribbon light) is a flexible circuit board populated by surface mounted light-emitting diodes (SMD LEDs) and other components that usually comes with an adhesive backing. Traditionally, strip lights had been used solely in accent lighting, backlighting, task lighting, and decorative lighting applications. Increased luminous efficacy and higher-power SMDs have allowed LED strip lights to be used in applications such as high brightness task lighting, fluorescent and halogen lighting fixture replacements, indirect lighting applications, Ultra Violet inspection during manufacturing processes, set and costume design, and even growing plants.

A battery is a device consisting of one or more electro chemical cells with external connections for phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction

converts high-energy reactants to lower energy products, and the free-energy difference is delivered to the external circuit as electrical energy. Historically the term "battery" specifically referred to a device composed of multiple cells. However, the usage has evolved to include devices composed of a single cell.

The system consists of only one main component, a microcontroller unit which acts as the brain of the system. Input and output components such as transmitter, receiver, led lights, and LCD modules are connected to the system brain. The transmitter generates a 40 kHz signals and begin the transmission time together with the process of sending signals. While the signals begin to transmit through ultrasonic transducer, the microcontroller will capture the starting point of transmission time and hold it until the receiver gets the echo signal back. The signal will contact with any obstacle ahead and will bounce back to the receiver circuit. When the signal is back, the receiver must detect the echo signal, process & send to the microcontroller. The microcontroller will stop the transmission time immediately and will calculate the range using the transmission time and display the range on LCD modules. If the transmit signal cannot touch any obstacle in front it, or the time is very fast, the system will display error message on the LCD modules. And LEDs On/Off in the give range/Distance measured by sensors. We use LEDs for Distance indication purposes from obstacles behind the bicycle.

Formula used :- $(\text{speed_of_sound} \times \text{time}) / 2$

Speed of sound = 340m/s.

4 CONCLUSION AND FUTURE WORK

One of the technologies that can assist bikers in ensuring their safety on the road is this Bicycle Safety setup. When a car approaches, the LEDs and LCD display can provide bikers a warning. This technology has the potential to reduce the frequency of accidents involving bikes and other vehicles. Cycling has been more popular in recent years, with more cyclists taking to the streets.

While there are many benefits to this trend, bikers often have difficulty staying safe in heavy traffic. Because cities are sometimes sluggish to implement distinct bike lanes, it is up to cyclists to secure their own safety. As a result, our bicycle technology is assisting in these personal safety measures. The LEDs and LCD display are on the handlebars, and the sensor, together with the Arduino UNO, is placed below the seat of the bicycle.

We're aware of a slew of new bicycle safety distance sensors on the market. Our concept, on the other hand, uses LEDs and an LCD display to inform the biker. Its purpose is to make cyclists aware of oncoming automobiles behind them. The Arduino UNO allows us to manufacture them at a reasonable cost.

We can add a buzzer to the hardware for another signal in the future as a recommendation. If the riders are unaware of the LEDs, the buzzer will alert them. Furthermore, the ultrasonic distance sensor can be switched to a sonar device that detects a three-foot barrier around riders. The MB1200 XL can identify approaching vehicles, but thanks to innovative technology, the bicycle can also detect vehicles far behind it. Finally, the position of the LEDs and LCD may be adjusted via the handlebar. This position can serve as a warning not only to cyclists, but also to motorists and motorcyclists. Furthermore, this circumstance has the potential to minimise the number of accidents in India, which has been on the rise recently.

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