Methodology

Previous research has suggested a variety of approaches to the problem of accident prevention in mountainous regions, such as the installation of radar sensors, cameras, and GPS systems. However, this work offers a more efficient and cost-effective solution by utilizing the ESP8266 microcontroller and the ESPNOW protocol for wireless communication. This solution is not only more cost-effective than other solutions, but it also has a faster response time and can easily be integrated with other systems.

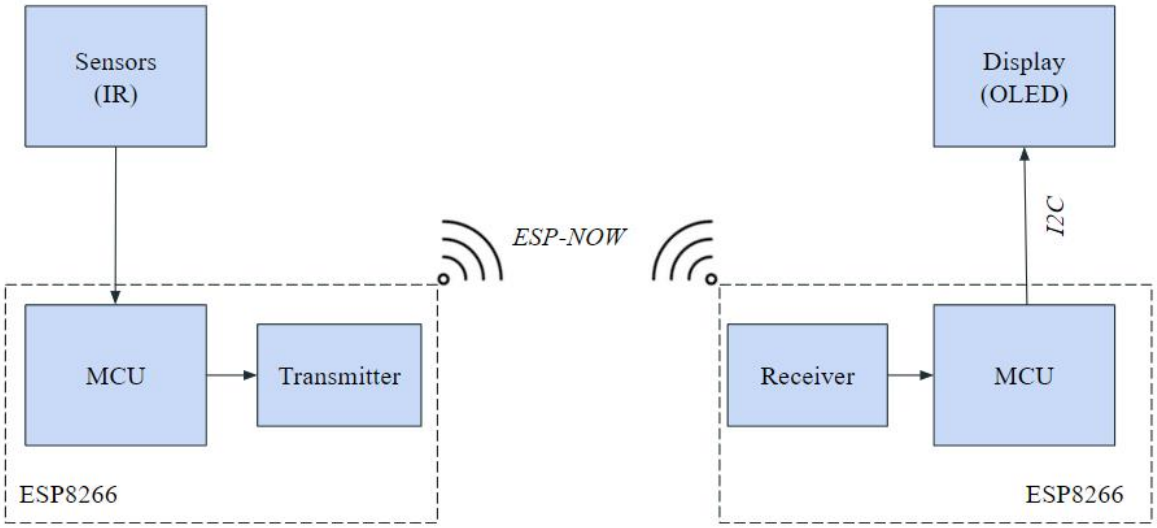

Figure 1. Block Diagram

From the above block diagram (Figure 1.), this work uses a system with two ESP8266 microcontroller modules, one acting as a transmitter and the other as a receiver. The transmitter module is connected to two IR sensors that are used to detect a vehicle passing through a hilly region before turning from one direction. The IR sensors detect the presence of a vehicle and send this information to the transmitter ESP8266 module, which then uses the ESP-NOW protocol to transmit this data to the receiver ESP8266 module.

The receiver ESP8266 module receives the data from the transmitter and uses it to determine whether a vehicle has passed or not. If a vehicle has passed, the receiver module will display this information on a screen and also send an alert to the driver on the other side of the hilly U-turn. This allows the driver to be aware of the presence of a vehicle on the other side of the hilly U-turn and make a safer and more informed decision when turning.1

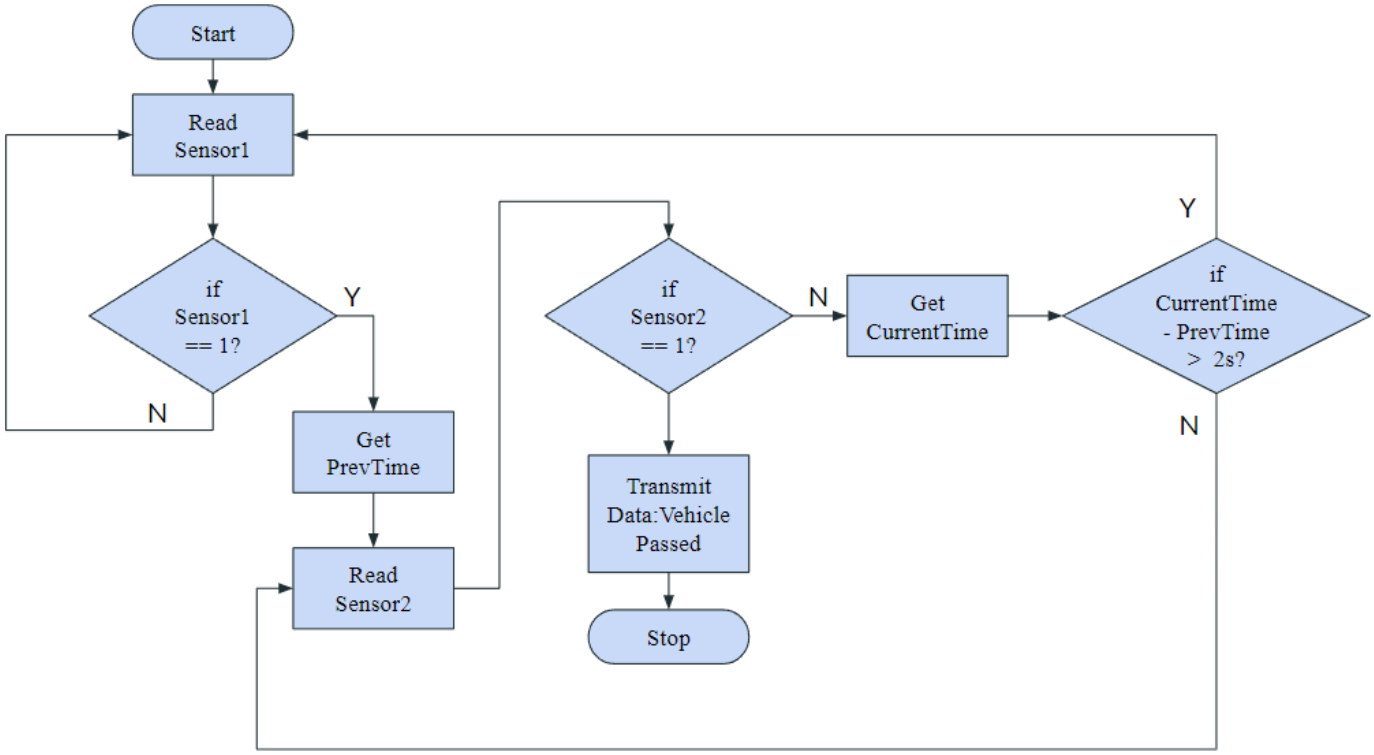

Figure 2. Flowchart of Transmitter Section

The process of detecting a vehicle using two infrared (IR) sensors, where the vehicle is only moving in one direction, is depicted in the flow chart (Figure 2.) that can be found above the transmitter section. This chart is located above the figure that describes the process. The procedure begins with the reading from sensor 1. In the event that sensor 1 picks up on the presence of a vehicle, the system will save the current time as the "PrevTime," which indicates the presence of a vehicle. After that, the system examines sensor 2 to see if it has picked up any signs of a vehicle. If sensor 2 also picks up on a vehicle, this indicates that the vehicle is approaching from the desired direction; consequently, the system will communicate the detection through ESPNOW if this is the case. In the event that sensor 2 does not identify the presence of a vehicle, the system will continue to read sensor 2 for a period of two seconds by repeatedly retrieving the current time and subtracting it from the PrevTime value. In the event that the result is greater than two seconds, which indicates that the vehicle was approaching from the other side, the system will restart the process by reading sensor 1 again.

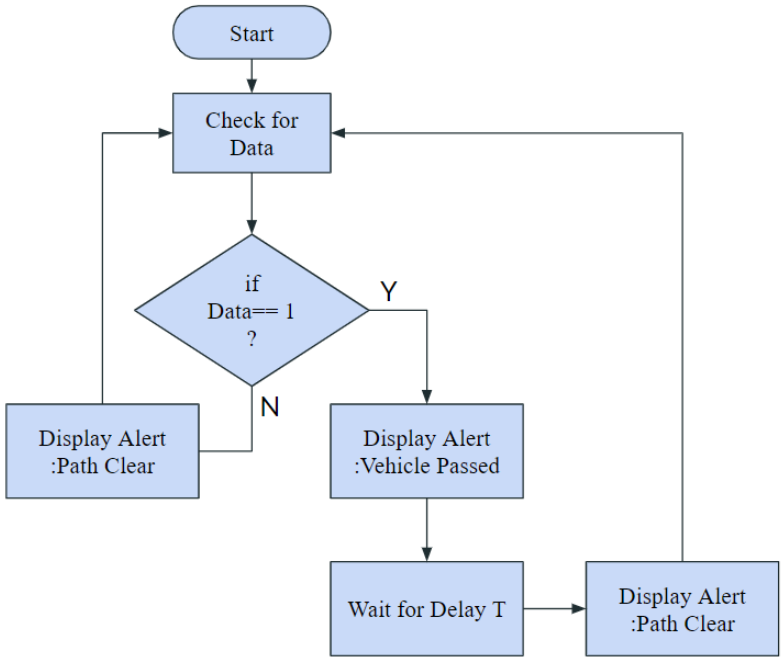

Figure 3. Flowchart of Receiver Section

The system will begin the process by monitoring in real-time for the arrival of data indicating that a vehicle has passed. In the event that the system does not receive any data, it will display the message "Path Clear." In the event that the system receives data, it will display the warning "Vehicle Passed, Slow Down" on the screen. After that, the controller waits for a period of time denoted by the factor T before re-displaying the message "Path Clear" and continuing to repeatedly check for new data from the transmitter section.

This flowchart (Figure 3.) is attempting to receive the data that is being transmitted by the transmitter section of the system, which indicates the passing of a vehicle and based on that information, it is displaying messages on a screen. Before re-displaying the "path clear" message, the delay time T is included to eliminate the possibility of any false positives and to ensure that the vehicle has moved on before the display of the message.

Results & Discussion

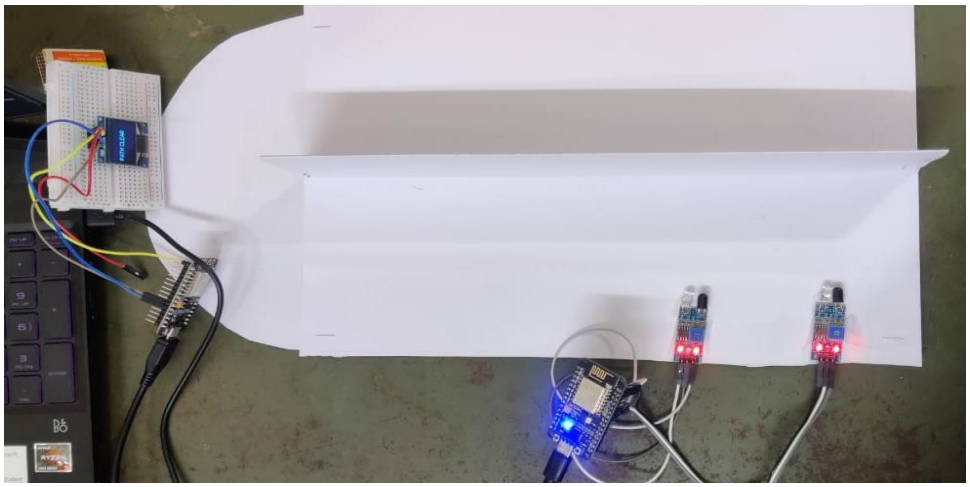

Figure 4. System Setup when path is clear

Figure 4. shows a scenario when there is no vehicle passing near the curve. The IR sensors send the data to ESP32 and wireless communication takes place between the two microcontrollers. The OLED displays the interpretation of data received by the receiving ESP. The IR sensors do not detect a vehicle and a message of 'Clear Path' is displayed on the OLED.

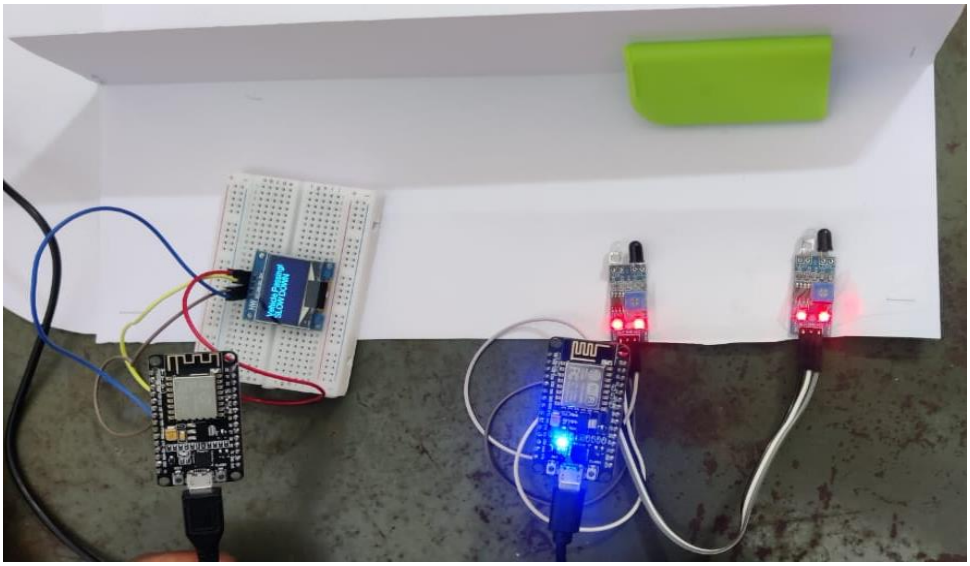

Figure 5. System when vehicle is passing

Figure 5. depicts a scenario when a car is passing near the curve. The IR sensor detects the vehicle and immediately displays a message 'Vehicle Passing! Slow Down' . This will alert the vehicle coming from the opposite side.

Conclusion

The purpose of the work is to reduce the number of accidents that occur in hilly areas. The transmitter section detects the passing of a vehicle for only moving in one direction and transmits this information to the receiver section. The receiver section then sends a warning message to the vehicles that are on the opposite side of the road and displays it on a screen. For wireless communication between the transmitter section and the receiver section of the project, the ESPNOW protocol is being utilized. This system can help to reduce the number of accidents that occur in hilly areas by warning drivers of the presence of oncoming traffic and encouraging them to proceed with caution. This work can be implemented in a way that is both cost-effective and scalable by making use of ESP8266 MCUs, which come at a low cost and are readily available.