

# SMARTx: An Embedded Proximity Detection System for Reducing Collisions

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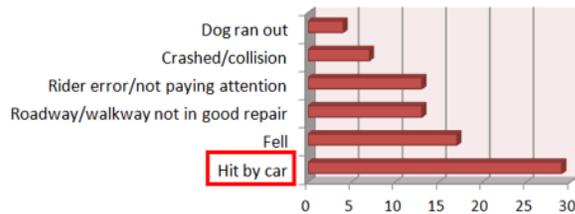


## Abstract

In 2012, a total of 726 bicycle riders died in the U.S., or 2% of all traffic fatalities during the year. Fifty-six bicycle rider fatalities occurred in Texas, which was the third highest in the nation. Almost 30% of all injuries were caused when cyclists are hit by a vehicle. This project aims to avoid potential collisions by giving cyclists an embedded proximity detection system to alert nearby drivers of their presence. In the proposed system, a cyclist periodically broadcasts a beacon message and a nearby driver receives the message on his/her smartphone to be alert. Here, zero interaction between driver and smartphone is done to remove any distraction. We are developing a proof-of-concept and envision to reduce collisions significantly.

## 1. Research Motivation and Approach

State	Total Traffic Fatalities	bicycle rider Fatalities
California	2,857	124
Florida	2,424	122
<b>Texas</b>	<b>3,398</b>	<b>56</b>



- Unfortunately the number of pedal-cyclist (later bicycle rider) traffic fatalities is non-negligible.
- Almost 30% of all injuries are caused when bicycle riders are hit by a car.

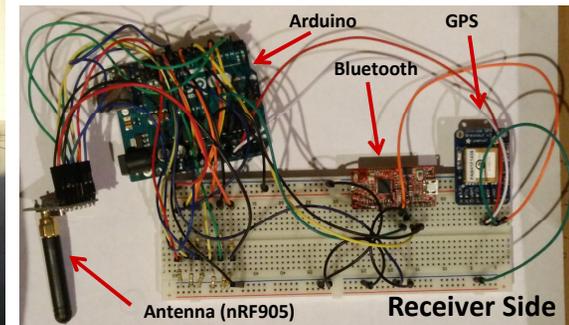
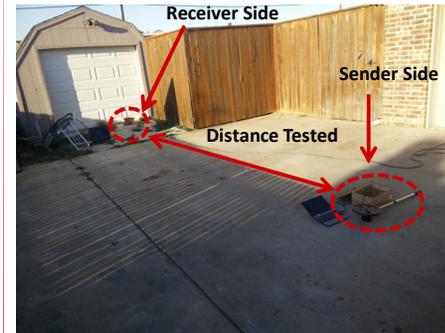
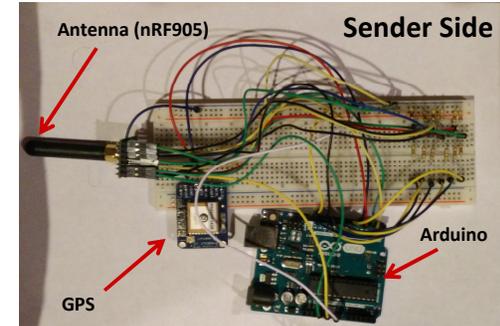
## Texas Roads



- A cyclist (or road worker, student, etc.) periodically broadcasts its location to closely by-passing vehicles to alert drivers.
- Propose an embedded proximity detection system Integrated with an increasingly popular smartphone.

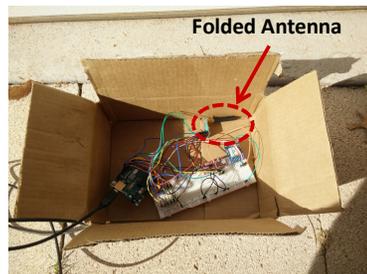
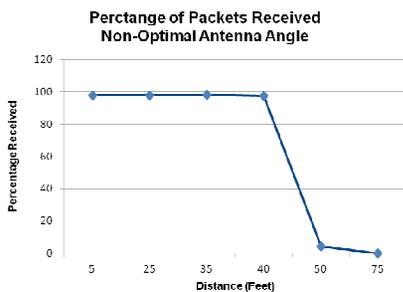
## 2. Design and Development of an Embedded Proximity Detection System

- A sender transmits a message piggybacked with its latitude and longitude periodically, every second.
- A receiver receives the message and calculate a distance.
- A receiver determines if the sender is located close enough.
- If close enough, the receiver sends a warning message (e.g., Alert sound) to driver's smartphone via Bluetooth.
- Note that driver does not need to interact with its smartphone, called **ZERO-INTERACTION**, to avoid any distraction.



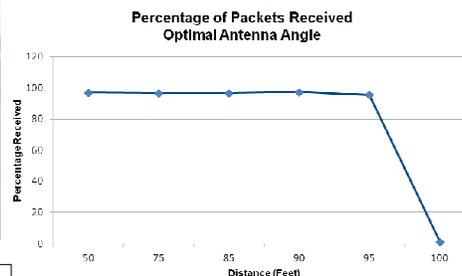
## 3. Field Experiments, Results, and Lessons

### Experiment #1: Folded Antenna



Distance (Feet)	Missed Packets	Received Packets	Total Packets	Percentage Received (%)
5	7	293	300	97.7
25	6	294	300	98.0
35	5	295	300	98.3
<b>40</b>	<b>8</b>	<b>292</b>	<b>300</b>	<b>97.3</b>
<b>50</b>	<b>287</b>	<b>13</b>	<b>300</b>	<b>4.3</b>
75	300	0	300	0.0

### Experiment #2: Straightened Antenna



Distance (Feet)	Missed Packets	Received Packets	Total Packets	Percentage Received (%)
50	9	291	300	97.0
75	10	290	300	96.7
85	10	290	300	96.7
90	8	292	300	97.3
<b>95</b>	<b>14</b>	<b>286</b>	<b>300</b>	<b>95.3</b>
<b>100</b>	<b>297</b>	<b>3</b>	<b>300</b>	<b>1.0</b>

- Realized that the angle of antenna significantly affects the transmission range.
- Retested with the antennas relatively straight up.
- In the percentage of receiving packets, surprisingly sharp decline from about **95 feet** was observed.

## 4. Concluding Remarks

- Designed and developed an embedded proximity detection system using Arduino and its communication components.
- Proposed system showed a viable approach to avoid collisions (average stopping distance, e.g., 109 feet at 30 miles per hour).

Please see the system explained here!!



Please see how the system was tested!!



- Tested without considering an antenna angle
- The transmission range of antenna gave about 40 feet.
- In the percentage of receiving packets, sharp decline from 97% to 4% from **40 to 50 feet** was observed, respectively