

Re: IE11.19



P.A.W.S.

Pedestrian Avoidance Warning System

Presented By: All Systems Code



Who are we?

- We are a School First Lego League Robotics team from Bayview Glen School.
- Our team consists of a team of ten from Grade 5-8
- At the Regional Competition on Dec 15 – Team All System's Code won the Champion's Award on overall performance on Project, Core Value & Robot Design/Performance

Bayview Glen
INDEPENDENT : SCHOOL



The Problem

In 2019 alone, 38 pedestrians were lost on the streets of Toronto.

Our problem is that pedestrians are getting hit at intersections by cars and trucks, which is increasing the fatality rate and casualties in Toronto.

This should not be happening.



Our Research and Studies (Including Statistics)

- 2.8 million call Toronto home.
 - 3 million people move about Toronto everyday.
 - 69% of Pedestrian/ Vehicle accidents happen at intersections.

There are currently 26,300 intersections in Toronto. (45% are killed or seriously injuries are happen when people are on foot)

- Children are hit the most by cars because their perceptual abilities are slow to develop
- Elderly people are hit by cars the second most because their reflexes are limited, in addition to poor coordination and reduced speed of movement



Our Research and Studies (Including Statistics)

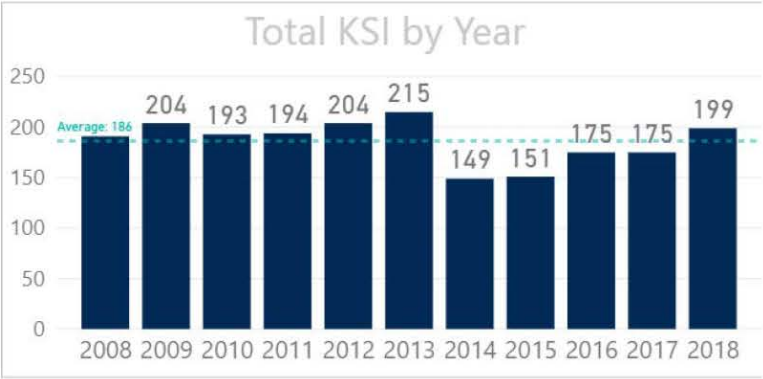
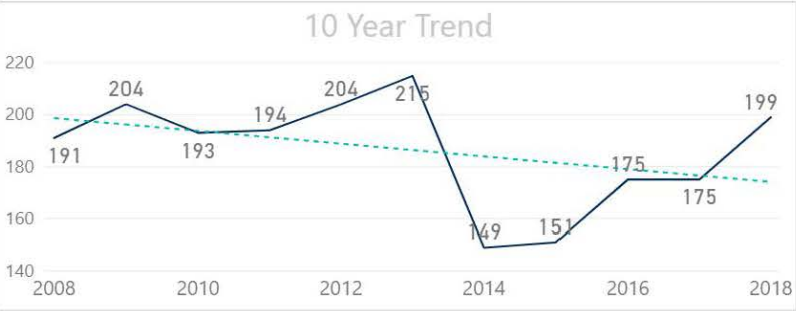
Fact: 38 people died in car accidents in the year of 2019

In December 20th, 2019 the Toronto Star quoted Police Chief Saunders

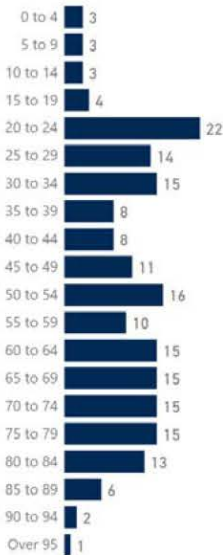
“People in enforcement are not going to be the cure for this. It’s utilizing the technology, it’s education and awareness from all factors of people being in a big city, whether they live, work or play here, I think will help drive and promote better opportunities to create better numbers and loss of life.”

Mayor Tory and Chief Saunders both stated: “There needs to be traffic-light safety improvements made in the city.”

Pedestrian Data in Toronto



Total KSI by Age Group



Total KSI by Hour of Day

Day Name	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sunday		1		2							1			1	1			3	1	1		3	1	
Monday		1				1	2	1	3	2	2		2	1	2	3	3	2	3	1	1	1		4
Tuesday							1		1			1		1		2	3	2	3	2			2	1
Wednesday		1	1	2			2	3	2	1		4	1		1	4	1	1	4	1	1	1		2
Thursday		2	1	1	1			2	2	4	1		2		3		2	2	2		3	1	4	
Friday		1					5	3	1	2	3	2		1	3	2	2	2	2	3	1	1	1	2
Saturday		1	1	1			3		2	2			1		3	3		2	3	1	1	2		1



Top 10 Most Dangerous Intersections

1. Lake Shore Blvd. E. at Lower Jarvis St.

2. Lake Shore Blvd. E. at Don Roadway

3. Ellesmere Rd. at Bellamy Rd.

4. Lawrence Ave. E. at Midland Ave.

St. Clair Ave. at Old Weston Rd.

6. Sheppard Ave. at Morningside Rd.

7. Weston Rd. at Lawrence Ave.

8. Ellesmere Rd. at Morningside Rd.

9. Islington Ave. at Albion Rd.

10. Lake Shore Blvd. W. at Spadina Ave.



Our Solution!

P.A.W.S.

**Pedestrian Avoidance
Warning System**



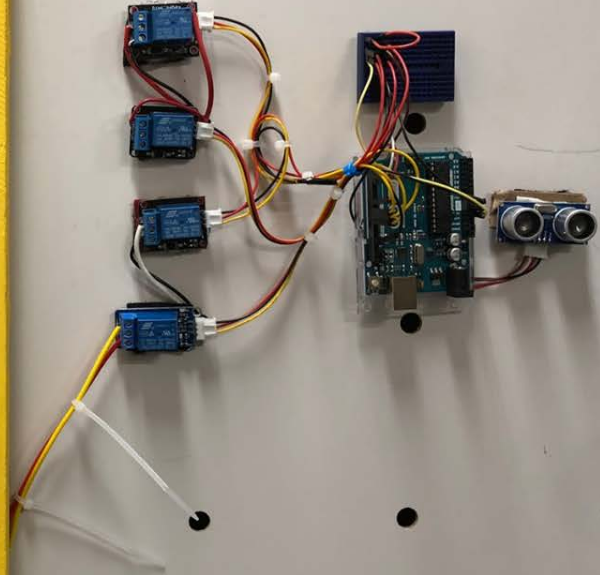


Our Solution

- Our solution is a sensor system that monitors the presence of pedestrians crossing the street. An ultrasonic sensor at each corner of an intersection detects pedestrians that are crossing and sends a signal to a '***new warning light***' which will alert drivers.



Our Prototype





Working Prototype

A prototype was developed with Arduino technology. This models the functionality of the PAWs solution

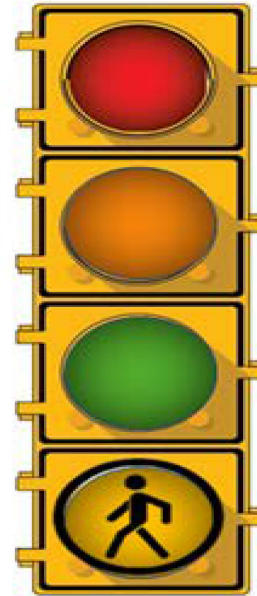
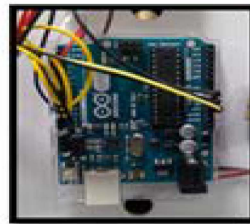
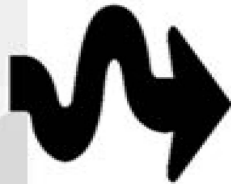
Solution

Prototype



Input:

The traffic light has a single input of an ultrasonic sensor, the sensor sends what it sees to the controller.



Flashing
NEW
Light
when
Sensor
Triggered

Processing:

The Arduino is the "brains" or "controller" of the traffic light. This takes what the sensor sees and chooses which switches to turn on or off. It cycles through the sequence of red, yellow, and green lights, as well as flashing the pedestrian light.

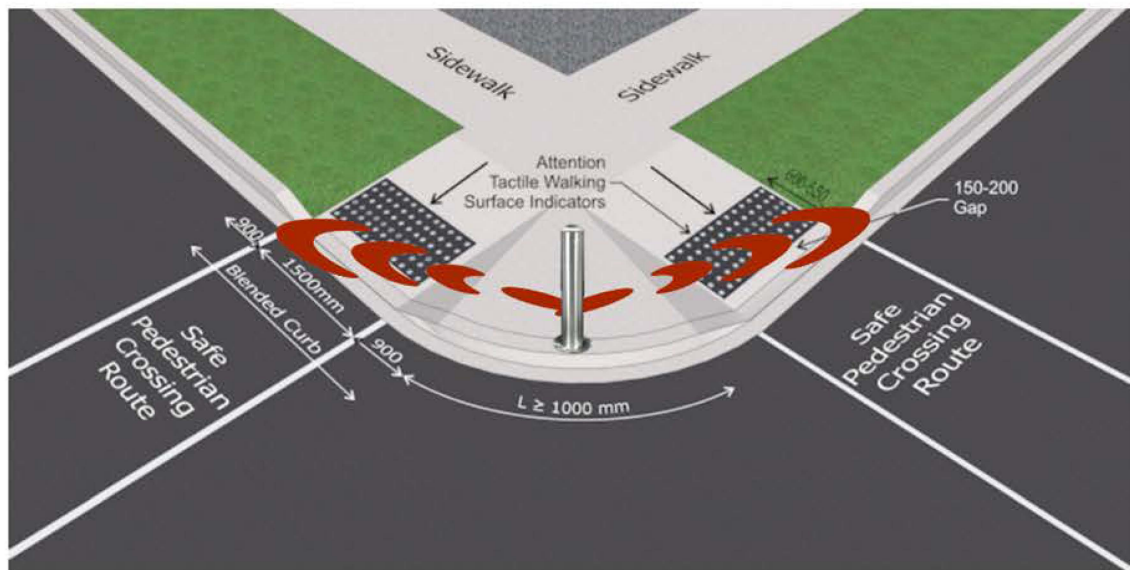
Output:

The lights in the traffic light are turned on and off by switches called relays. These switches are either connected to the button of the light, to simulate pressing the button, or the switches connect and disconnect the batteries from the light.



Sensor Placement

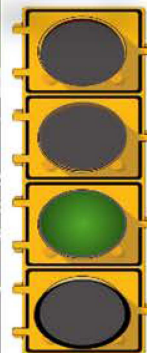
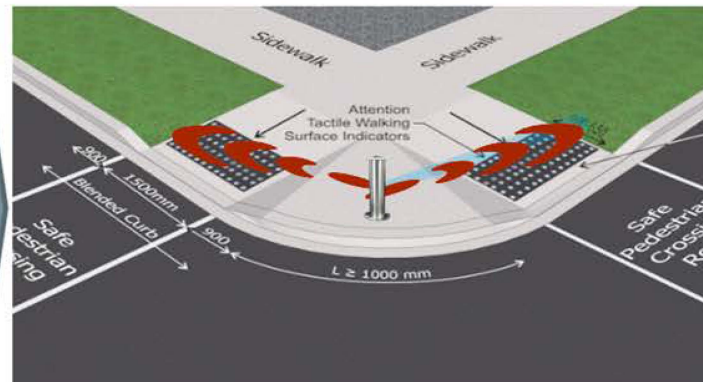
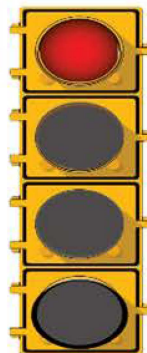
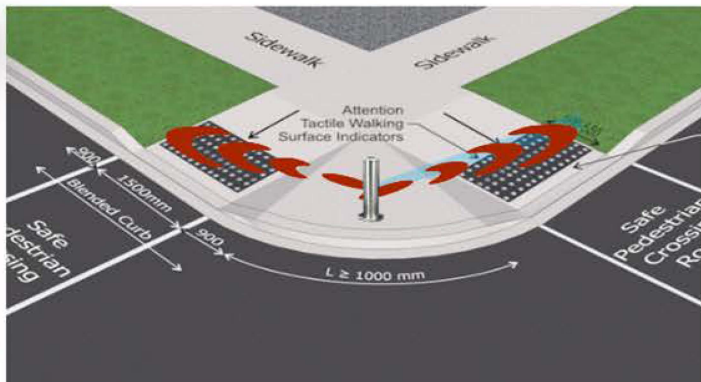
Embedded Sensors on installed bollards between crossings



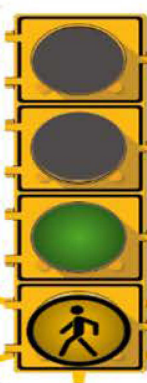
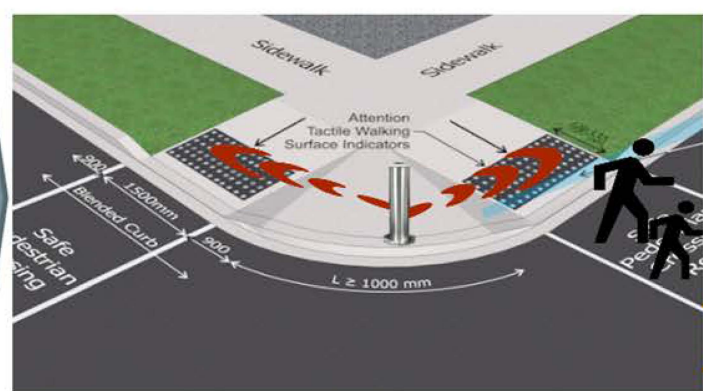
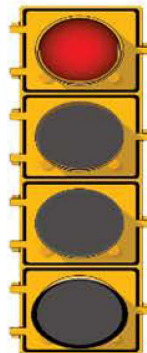
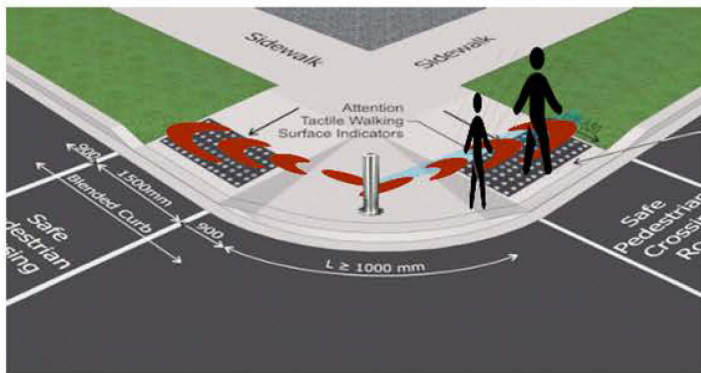


Working Scenarios

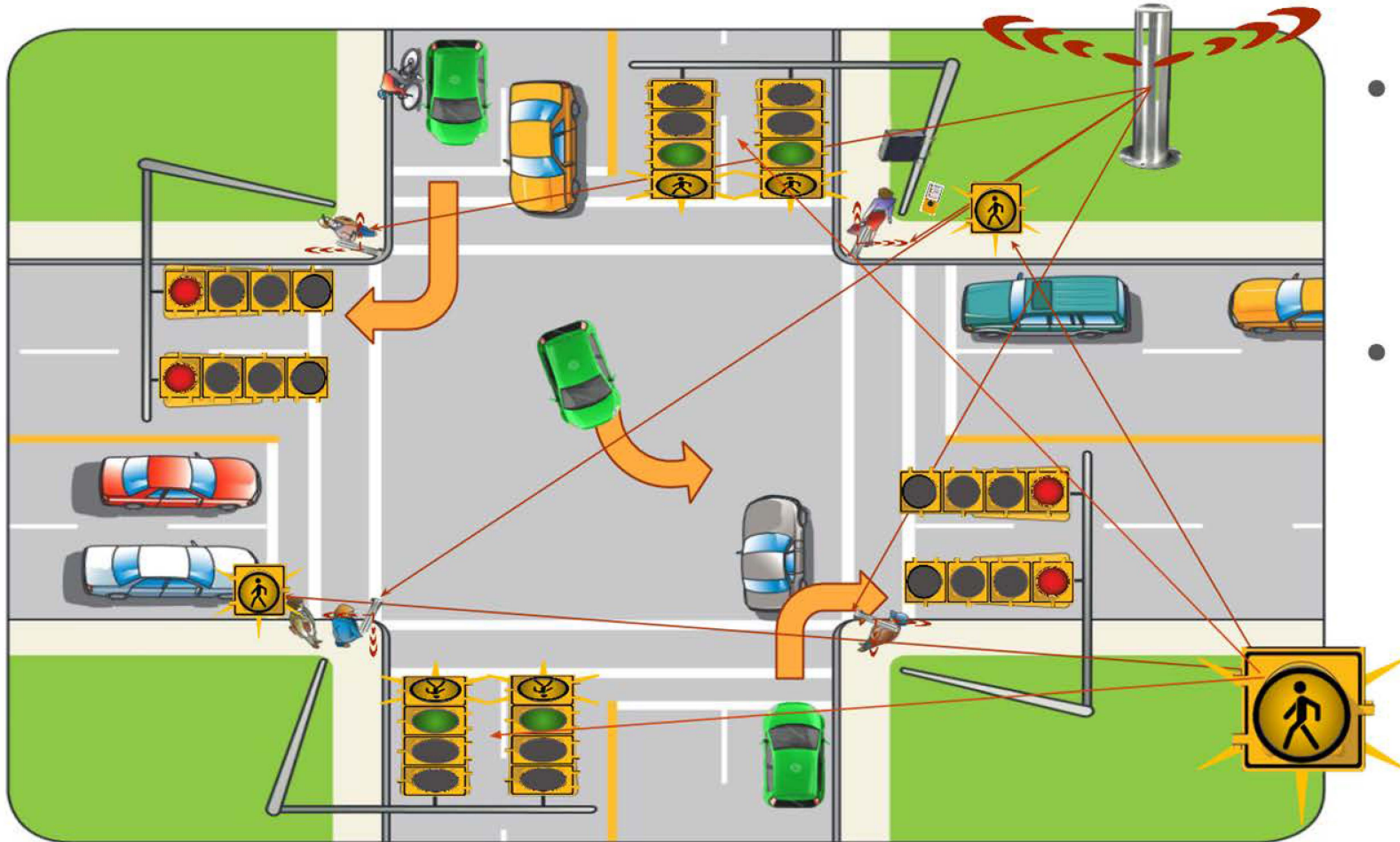
No
Pedestrians



Pedestrians
Present



Traffic Scenario Sensor Placement



- Bollard sensors are placed at all corners of pedestrian sidewalks
- Flashing warning signals are placed at all traffic lights and right turning lanes

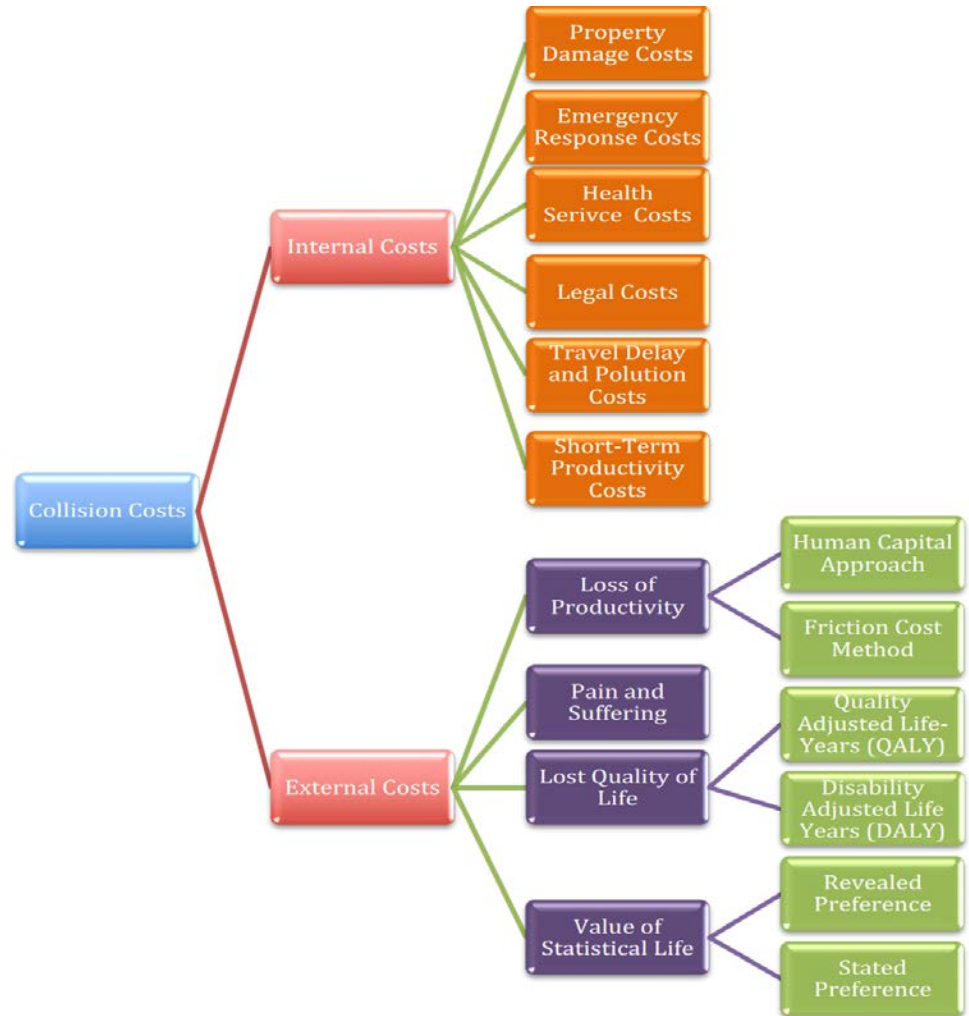


Advantages

- Passive system – does not need engagement from pedestrian.
- Can continually scan for people crossing – and calculated walking speed of pedestrian.

Costs to be considered when there is an accident

According to Drivetolive.ca



Costs to be considered when there is an accident According to Drivetolive.ca

The Cost of a Pedestrian Fatality

Single Fatality total costs 2.4M

In 2019 with 38 Deaths in Toronto
Estimated total cost is 91M

Table ES-2: Summary of Estimated Human Capital Collision Costs: Updated Study 2017

HUMAN CAPITAL Costs		Collision Costs (by Victim)				Collision Costs (by Collision)		
Report Chapter	Cost Category	Fatality	Major Injury	Minor Injury	Property Damage	Fatality	Injury	PDO
4.1	Discount Future Earnings							
4.1.1	Long-Term Income Loss (Fatal Collision Victim)	\$1,855,990	\$0	\$0	\$0	\$1,873,520	\$0	\$0
4.1.2	Long-Term Income Loss (Disabled Injury Victim)	\$132,083	\$73,210	\$7,044	\$0	\$143,405	\$21,742	\$0
4.1.3	House-Hold Productivity and Disruption Costs	\$112,316	\$59,331	\$6,796	\$0	\$121,943	\$19,326	\$0
4.2	Pain, Suffering and Grief							
4.2	Pain, Suffering and Grief	\$79,735	\$122,115	\$2,719	\$0	\$85,712	\$48,341	\$0
TOTAL for HUMAN CAPITAL Costs:		\$2,180,125	\$254,656	\$16,558	\$0	\$2,224,580	\$89,408	\$0
TOTAL for HUMAN CAPITAL + DIRECT Costs:		\$2,389,953	\$376,771	\$50,546	\$14,391	\$2,450,139	\$137,749	\$14,065

Table ES-1: Summary of Estimated DIRECT Collision Costs: Updated Study 2017

DIRECT Collision Costs		Collision Costs (by Victim)				Collision Costs (by Collision)		
Report Chapter	Cost Category	Fatality	Major Injury	Minor Injury	Property Damage	Fatal	Injury	PDO
3.1	Property Damage							
3.1.1	Vehicle Repairs	\$29,853	\$21,288	\$18,020	\$9,409	\$32,412	\$17,626	\$9,130
3.1.2	Auto-Insurance Administration	\$4,397	\$2,157	\$1,540	\$423	\$4,774	\$1,751	\$411
3.1.3	Out-of-Pocket Expenses	\$1,346	\$1,053	\$972	\$633	\$1,462	\$946	\$614
3.1.4	Towing Services	\$818	\$661	\$676	\$508	\$888	\$735	\$493
3.2	Emergency Response Costs							
3.2.1	Police Costs	\$6,200	\$1,925	\$618	\$188	\$6,621	\$741	\$188
3.2.2	Fire / Rescue Costs	\$3,023	\$4,307	\$1,168	\$0	\$3,282	\$2,462	\$0
3.2.3	Ambulance Costs	\$914	\$1,934	\$621	\$0	\$992	\$744	\$0
3.2.4	Coroners Costs (Fatal Only)	\$1,994	\$0	\$0	\$0	\$2,165	\$0	\$0
3.3	Health Service Costs							
3.3.1	Emergency Room Costs	\$2,007	\$341	\$288	\$0	\$2,179	\$502	\$0
3.3.2	ICU Care Costs	\$59,775	\$40,443	\$0	\$0	\$64,899	\$5,908	\$0
3.3.3	Acute Care Costs	\$11,517	\$8,611	\$0	\$0	\$12,505	\$1,258	\$0
3.3.4	Rehabilitation Costs	\$3,946	\$2,209	\$204	\$0	\$4,284	\$643	\$0
3.3.5	Continuing Care Costs	\$23,280	\$14,387	\$832	\$0	\$25,276	\$3,407	\$0
3.4	Legal Costs							
3.4.1	Correctional Services	\$1,294	\$402	\$13	\$0	\$1,405	\$60	\$0
3.4.2	Court Costs	\$456	\$142	\$5	\$0	\$495	\$21	\$0
3.4.3	Legal Aid and Prosecution	\$461	\$143	\$5	\$0	\$500	\$21	\$0
3.4.4	Funeral Costs (Fatal Only)	\$10,109	\$0	\$0	\$0	\$10,975	\$0	\$0
3.5	Travel Delay Costs							
3.5.1	Delay Costs Caused by Collision	\$20,511	\$11,247	\$6,142	\$2,598	\$20,511	\$6,466	\$2,598
3.5.2	Extra Fuel Consumption	\$1,484	\$814	\$444	\$188	\$1,484	\$468	\$188
3.5.3	Environmental / Pollution Costs	\$3,028	\$1,660	\$907	\$384	\$3,028	\$954	\$384
3.6	Productivity / Disruption Costs							
3.6.1	Short-Term Work-Place (Injury)	\$18,654	\$8,394	\$1,531	\$0	\$20,253	\$3,628	\$0
3.6.2	Short-Term Work-Place (Fatal)	\$4,761	\$0	\$0	\$0	\$5,169	\$0	\$0
3.6.3	Short-Term Work-Place (PDO)	\$0	\$0	\$0	\$59	\$0	\$0	\$59
TOTAL for DIRECT Costs:		\$209,828	\$122,115	\$33,987	\$14,391	\$225,558	\$48,341	\$14,065



Costs to install an intersections according to 311 Toronto

- Construction crew, wiring person, police “traffic director”

Installation Cost

A new signal installation costs between \$80,000 and \$160,000 per installation. The cost is dependent on certain factors.

- Mode of Control – Semi-actuated signals require detection devices at the intersection. Midblock pedestrian signals need less equipment.
- Phasing – Left turn arrows require additional signal equipment and detection devices.
- Traffic system – SCOOT (traffic adaptive) requires additional equipment in the cabinet and detection upstream of the intersection. TransSuite (traffic responsive) requires system detection.
- Utilities – Avoiding/relocating existing utilities such as gas, cable, hydro, water, sewage and telephone.
- Intersection geometry – Offset and skewed intersections require more signal equipment.
- Intersection spacing – Closely spaced intersections require adjacent signals to be hardwire interconnected.
- Communication – Telephone lines are required for remote monitoring of signal operations.
- Special features – Transit priority, rail pre-emption, firehall pre-emption and accessible pedestrian signals require specialised equipment.

The yearly maintenance cost is between \$10,000 – \$15,000 per installation. Drivers also have increased costs for fuel, time delay, and accidents. This adds to the reasons for installing signals only where clearly justified.

Preventing one single Fatality offsets the installation cost of a signal installation 15 fold.



Connection to Vision Zero

Our project helps to fulfill the aim of Vision Zero by reducing pedestrian fatalities and injuries in Toronto.



Next Steps

Some of next steps we hope to achieve include:

1. Starting a pilot project like SCAT and Insync to see if our project is successful
2. Making the P.A.W.S. more durable
3. Making it “weather proof” so we will not get any false positives



Conclusion

- With the incorporation of the PAWS system, and Vision Zero we can jointly work together to reduce death and injury of pedestrians

Thank You!