IMMERSIVE HEAD MOUNTED VIRTUAL REALITY BASED SAFETY ANALYSIS OF SMARTPHONE DISTRACTED PEDESTRIANS AT STREET CROSSING

Arash Kalatian

LITrans

Ryerson University

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COLLABORATORS

Ryerson University

- Bilal Farooq
- Anae Sobhani
- Zihui Zhong
- Rafael Vasquez

PEDESTRIAN SAFETY

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- ***Pedestrian fatalities to all traffic related deaths :***

Canada:		United States	
2010:	13.7 %	2010:	13.0 %
2014:	15.7 %	2015:	15.3%

reason for this increase?

rise in distracted pedestrian

talking, texting, surfing the web, looking for directions, or playing games on the phone

Cognitive demand required for crossing is divided by technological distractions, the pedestrian's awareness is reduced resulting in unsafe and risky crossing behaviours

ANALYSIS OF SMARTPHONE DISTRACTED PEDESTRIANS

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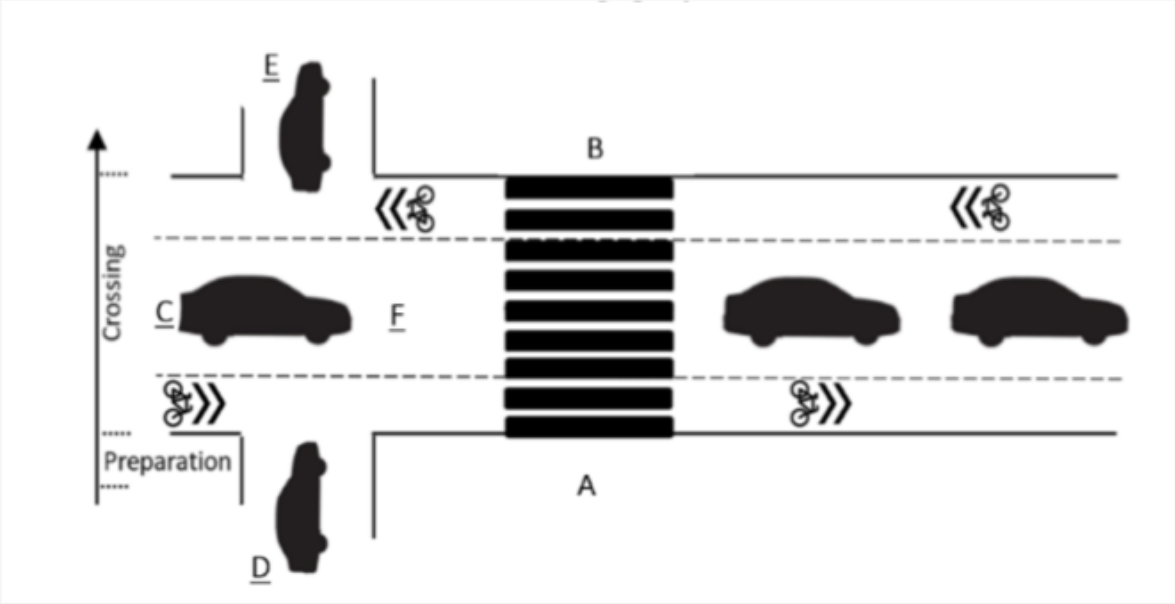
- *Three Scenarios of pedestrians crossing was implemented in IHMVR*
- :

• with no distraction
• while solving a maze puzzle on their phone
• while solving a maze puzzle with flashing and color changing LED lights installed on road crossing



WHAT IS IHMVR?

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- Immersive Head Mounted Virtual Reality (IHMVR): a VR display device, uses an optical system to directly present virtual scenes received by the display
- Measuring physical reactions of participants
- Testing various scenarios for incidents before making irreversible decisions

EXPERIMENT

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- Forty two volunteers
- they completed at least 30 trials in blocks of 10 trials.
- The experiment continued until 10 successful crossings were recorded for each condition.
- the gaps between cars: Poisson distribution (μ=4 s)
- two safe gaps (5 and 7 seconds)
- Each trial was 60 seconds, ended whenever the participant finished crossing.

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A rendering of the virtual environment from a pedestrian's viewpoint facing the intersection as if trying to make a crossing decision

DESCRIPTIVE ANALYSIS

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Variables		Condition	General	Female	Male
Crossing Behaviour Attributes	**Wait time duration** *(s)*	Non-distracted	18.0	20.9	16.0
		Cell phone	21.0	23.9	19.4
		Cell phone & LED	21.0	24.4	19.2
	Crossing duration *(s)*	Non-distracted	4.4	3.9	4.7
		Cell phone	4.2	4.1	4.3
		Cell phone & LED	3.8	3.7	3.8
	Crossing speed *(m/s)*	Non-distracted	1.0	1.0	1.0
		Cell phone	0.9	1.0	0.9
		Cell phone & LED	1.0	1.0	1.1
	Initial walking speed *(m/s)*	Non-distracted	1.6	1.5	1.6
		Cell phone	1.5	1.4	1.6
		Cell phone & LED	1.6	1.6	1.6
Distraction	**% time the head was oriented toward cellphone during waiting time** *(%)*	Cell phone	72.9	68.0	76.2
		Cell phone & LED	74.7	69.8	78.0
	% time the head was oriented toward cellphone during crossing *(%)*	Cell phone	73.5	73.1	73.7
		Cell phone & LED	69.6	71.5	68.3
	# of head orientations to cellphone during a trail *(N/s)*	Cell phone	0.2	0.2	0.2
		Cell phone & LED	0.2	0.2	0.1

DESCRIPTIVE ANALYSIS

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Safety Measures Attributes					
Maximum acceleration *(m/s^2)*	Non-distracted	6.1	4.8	6.9
	Cell phone	5.1	4.5	5.5
	Cell phone & LED	5.2	5.5	5.0
Maximum deceleration *(m/s^2)*	Non-distracted	8.5	4.9	10.9
	Cell phone	12.8	4.3	18.6
	Cell phone & LED	5.0	4.6	5.3
Crossing success *(%)*	Non-distracted	76.9	70.6	81.2
	Cell phone	61.4	64.7	59.2
	Cell phone & LED	68.8	65.9	70.8
Crossing failure *(%)*	Non-distracted	22.6	28.2	18.8
	Cell phone	36.9	31.8	40.4
	Cell phone & LED	30.2	32.4	28.8
Crossing time-out *(%)*	Non-distracted	0.5	1.2	0.0
	Cell phone	1.9	3.5	0.8
	Cell phone & LED	1.0	1.8	0.4
Minimum PET	Non-distracted	1.2	1.1	1.2
	Cell phone	1.0	1.1	1.0
	Cell phone & LED	1.1	1.2	1.1

FUTURE WORK

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- PET Analysis: MNL model
- Wait time analysis: Proportional Hazard Model
- Implementing VR for other purposes: Pedestrian AV interaction

THANK YOU!