Group 15
EEL 4914
9/18/2020
Initial Project Document
Divide & Conquer Version 1.0

Light Saver

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Group 15

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Project Narrative

This project idea started with an incident that not only happened to one of us, but has been repeated many times in the past. When Covid-19 started many people started jogging and running outside to get a bit of fresh air and escape the enclosure of their homes trying to mentally and physically refresh from a long quarantine. When people go out they will encounter crossing walks at lights where even when the pedestrian has the right of way, there is a high risk of a distracted driver turning right causing an accident and hitting the pedestrian. One night, a group member went out for a jog with his wife and had one headphone on to listen to music. As he approached the intersection, the light for the pedestrian warning sign was at a walk state. The pedestrian had the right of way to cross the road, but the vehicle did not yield. The car had turned right and did not even notice or care to check if there was a pedestrian that was going to cross. Our group member was lucky to have his wife alert him about the vehicle's movement, and stop him from entering the road at the last moment. If it was not for his partner, the situation would have ended in a crash and injuries, causing a chaotic day.

Our team inspiration is to create a solution called **Light Saver** device.The goal will be that the **Light Saver** is vital to improve pedestrian safety, and also to warn the vehicles that there is a pedestrian or bicyclist that may potentially cross the road. Most drivers when approaching a right turn do not yield for sufficient durations to safely observe the traffic environment, or potentially the light is green but the pedestrians still have the right of way. That being said, vehicles can be hazardous in right turn settings, and if we can accurately warn a vehicle that a pedestrian or bicyclist is crossing. It has the potential impact to save lives and make the world a better place.

Another perspective of crosswalks and problems faced by group members using them can be solved as well. Personally experienced problems are that buttons on current crosswalks can be unresponsive, and pedestrians do not know if they have engaged the crosswalk light to allow them to pass. Many times, pressing the buttons does not engage the crosswalk. There are some crosswalks which engage without any pedestrians being present, causing undue delay for vehicles to wait until they have a green light. By formulating a more pronounced and effective method for intersections and pedestrian crosswalks, this will improve both safety and traffic efficiency.

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According to most recent statistics provided by the National Highway Traffic Safety Administration (NHTSA), in 2018 there were 6283 pedestrian fatalities in traffic crashes. That accounts for 17.2% of all traffic deaths in that year. The most prominent age group within those statistics were ages 25-34, who composed 15.4% of pedestrian fatalities. In a broad technical study performed by Dunlap and Associates Inc, they found that Right Turn on Red laws have contributed to an increase in frequency of accidents occuring between motor vehicles and pedestrians/cyclists at intersections.

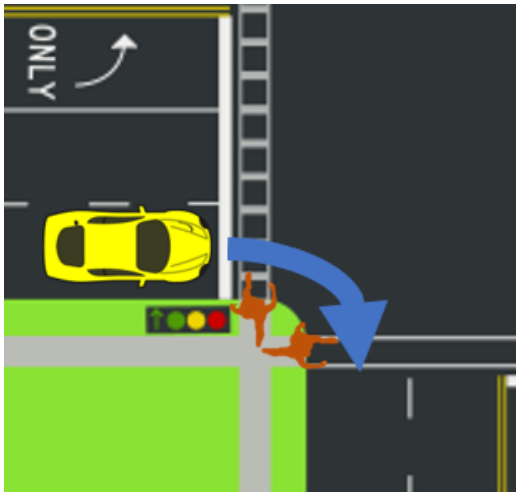

Figure 1: Pedestrian at Turning Vehicle

Vehicles at turn signals according to the RTOR laws must completely stop at the red light, observe and yield to cross vehicle traffic, and only turn if there is availability. As shown in Figure 1, this leads to the phenomenon of the driver focusing their attention towards the left, and they may not observe pedestrians at the intersection approaching from the right. The pedestrian or bicyclist are under the false impression that if the vehicle is stopped at the intersection, that the vehicle will not turn on red. This conflicting viewpoint between the vehicle driver and pedestrian lead to an increase in accidents occurring. The ideal outcome is to prevent this confusion in the first place and make vehicle drivers more aware of their surroundings and prevent pedestrian accidents at such intersections and right turn scenarios, and Figure 2 demonstrates a possible solution which can be implemented in scenarios Fig 3-7.

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Figure 2: Prototype Design

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Possible Implementation sidewalks


Figure 3: Sidewalk Scenario


Figure 4: Sidewalk Scenario


Figure 5: Sidewalk Scenario


Figure 6: Sidewalk Scenario


Figure 7: Sidewalk Scenario

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Project Requirements

1.0	The Light Saver will detect pedestrians approaching the crosswalk within 5 feet radius using 2 directional motion sensors and Computer Vision.
1.1	The Light Saver will alert vehicles of the presence of pedestrians using 4 mounted LED lights, and 1 vertical LED strip.
1.2	The Light Saver will be self powered, using 12V Solar Panels, with 24 hour functional operating time, Maximum 100W power consumption, utilizing battery for backup power.
1.3	The Light Saver sign will be max 600 square inches, with mounting pole not less than 5 feet height.
1.4	The Light Saver should have engineer grade reflective aluminum wrap, to enhance visibility throughout 24 hours.
1.5	The Light Saver will operate with low power mode, engaging in CV only when it detects pedestrians.
1.6	The Light Saver computer vision will analyze when the Crosswalk sign is in walk state, and alert vehicle of pedestrian presence

Table 1: Project Requirements with Demonstrable Parameters

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House of quality

Key Table	
↓	negative correlation
↓↓	strong negative correlation
↑	positive correlation
↑↑	strong positive correlation
◦	no correlation
+	Positive polarity
-	Negative polarity

			Engineering Requirements					
			Power Output	Cost	Range of Sensor	Response time	Size	weatherproof
			-	-	+	-	+	+
User Requirements	Cost	-	↑↑	↑↑	↑	↓	↓	↓
	Maintenance	-	◦	↓	◦	◦	◦	↓
	Ease of Installation	+	◦	↓	↑	◦	↓↓	◦
	Power consumption	-	↑↑	↑↑	↑	◦	◦	◦
	Interaction	-	↑	↑	↑	↓	↑	◦
	Target		**< 100W**	**< 560**	**~5 ft**	**< 1 sec**	**Pole Height > 5ft, Sign < 600 in^2**	**IP65**

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Block Diagram

Group Breakdown
Green = Esteban Pizarro , Joe McCoy
Red = Dilpreet Johal, Daniel Guerry

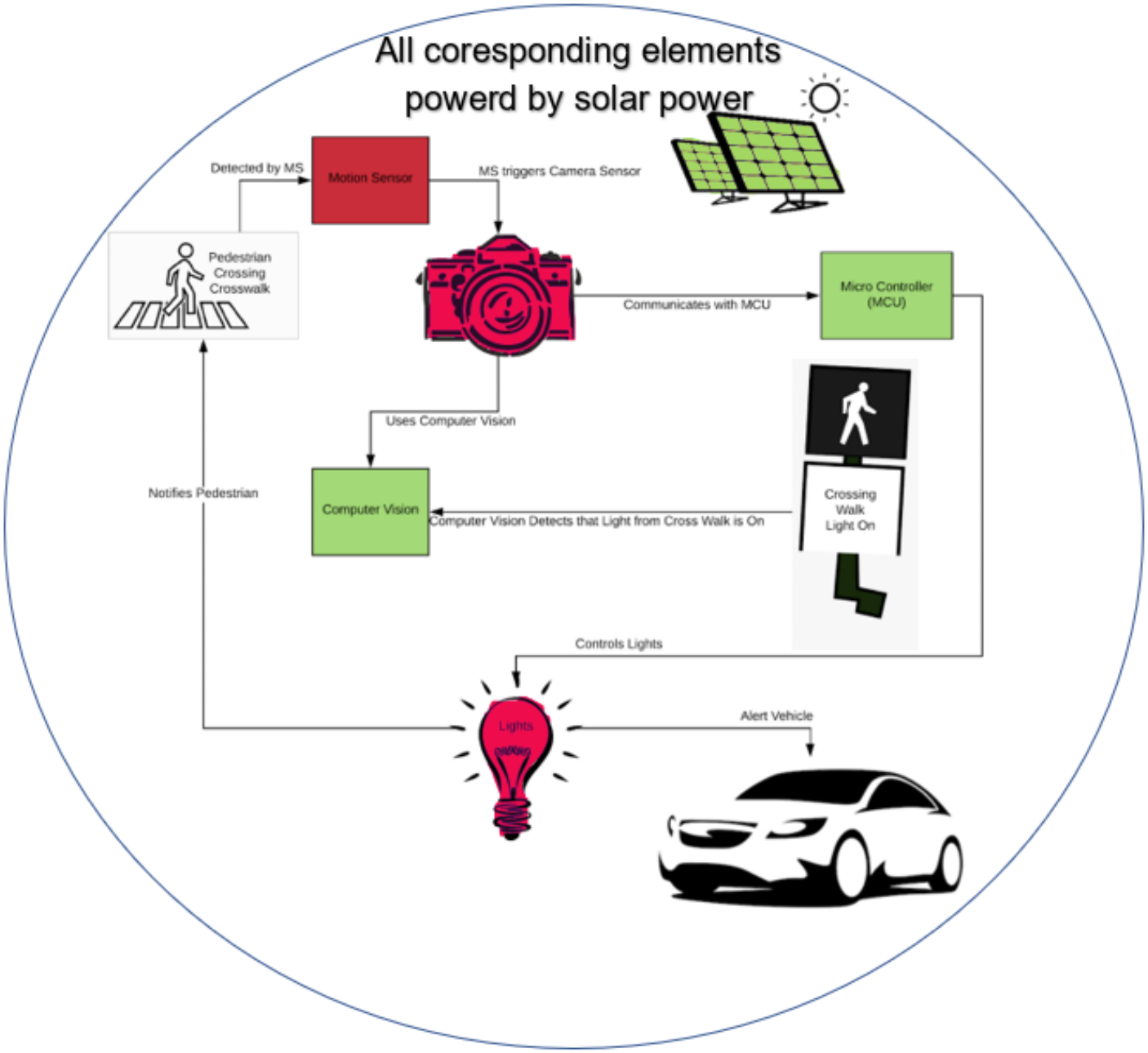

Figure 8: Block Diagram with Group Role Breakdown

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Budget and Funding

Our project will be self-funded. The estimates of price breakdown based on project sections and parts is given below. This is excluding any malfunctions or damages.

ITEM	QUANTITY	PRICE ESTIMATE
Aluminum Backsign	1	$40-$100
Mounting Pole	1	<=$15
Mounting Hardware	1	$25-$35
LED mounted lights	4	$20-$30
LED Light strip	1	$10-$20
Solar Panel (12V) 100W	1	$115-$170
Battery (rechargeable)	4	$10-$30
Motion Sensors	2	<=$10
Microcontroller	1	$5-$35
PCB	1	$50-$100
Camera for CV	1	$20-$50
Custom Enclosure	1	$40-$50
TOTAL (Estimated Range)		~$360-$556

Table 2: Budget Breakdown of Prototype

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Project Milestones

Number	Milestone	Planned completion Week
1	Design sign prototype	6
2	Study location environment for sign	7
3	Define power requirements	8
4	Design circuit layout, with voltage restrictions	8-11
5	Software Language and Computer vision implementation	10-14
6	Order Parts based on entire schematic	12-14
9	Build prototype	15-17
10	Debug/Test prototype	18-20
11	Fabricate PCB	21-23
12	Build Final working device	23-25
13	Test/Implement Final Device	26-28

Table 3: Project Milestone and Weekly Breakdown