Developing a fatigueless future

UPVISION FINAL REPORT

UPVision: A Vision System for Identifying Forklift Operator Fatigue

University of Portland EGR 484: Multidisciplinary Capstone II

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Executive Summary

Objective

The objective of this project is to ensure that a company's forklift operators will be out of harm's way by preventing accidents that would be caused by an operator if they are fatigued. Not only will the employees' safety be ensured, but also, their merchandise's safety will be protected. By preventing accidents by an operator, our system can reduce injuries and also save lives. This system will also prevent inventory loss to a company which will thereby reduce unnecessary spending and increase net income.

Product Description

UPVision is an operator fatigue monitoring system for forklifts, and potentially other material handling machinery in Hyster-Yale's expansive lineup. The system runs on a Raspberry Pi 3 model B makes use of a single camera connected by a cord for easy mounting purposes. In addition, three LED lights (red, yellow, green) and a button, provide a visual representation and control of the software. The software is written in C++ and makes use of two open-source computer vision libraries, OpenCV and Dlib. The software relies on a confidence level that determines how "sure" the algorithm is. The team firmly believes that this system is the first step in putting a stop to operator fatigue in the workplace.

Design Process

The product was designed with the intention of making a modular system that can be added to any vehicle. This would then allow Hyster-Yale the ability to add this system to a majority of their product line or sold as a separate entity. Having the product be sold as a separate entity would then allow the product to be available to all prior customers that purchased

vehicles from Hyster-Yale. To create this modular system, the product was built with multiple pieces.

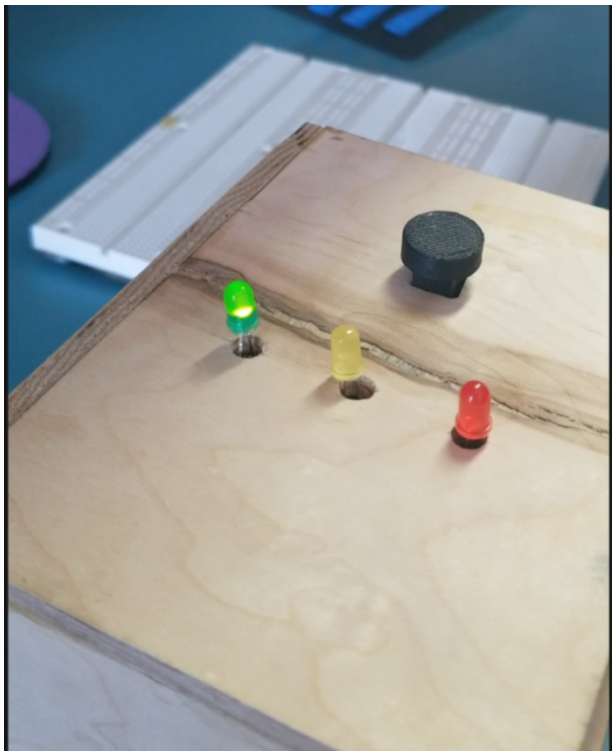


Figure 1: Photo of Product with LEDs and Button

The pieces used to create the system included a Raspberry Pi 3 Model B, Raspberry Pi Camera V2 module, three LEDs (red, yellow, green), two breadboards, and a button. These pieces were decided on due to their small form factors and their compatibility. The design of the physical system is to have the Raspberry Pi processing the information while the camera feeds it the information. The LEDs would give the operator a visual of where their confidence level currently is. The setup of the hardware is shown in Fig. 1. Finally, the button would allow the operator to interact with the system incase their confidence level is incorrect and to determine if they are awake. These pieces then interact with the software that determines fatigue.

Decisions made to create a system that can detect fatigue required the utilization of existing libraries, OpenCV and Dlib. These libraries were used to receive visual data to observe the multiple factors that are related to fatigue. These factors included the measurement of the head's orientation, movement, and eye blinking rate. Each of these variables are then measured and compared to thresholds that represent fatigue. These measurements will then dictate the operator's fatigue confidence level and determine if they are or are not fatigued.

Examples of the system running and determining fatigue are shown in Fig. 2 and Fig. 3. Fig. 1 shows an operator whose confidence level was increasing while not actually being fatigued. The operator then pressed the button which resulted in the confidence level reducing and determining that the operator is not fatigued. Fig. 2 shows an operator who is fatigued which resulted in their confidence level determining they are fatigued.

Example Graphs of Confidence Level Progression

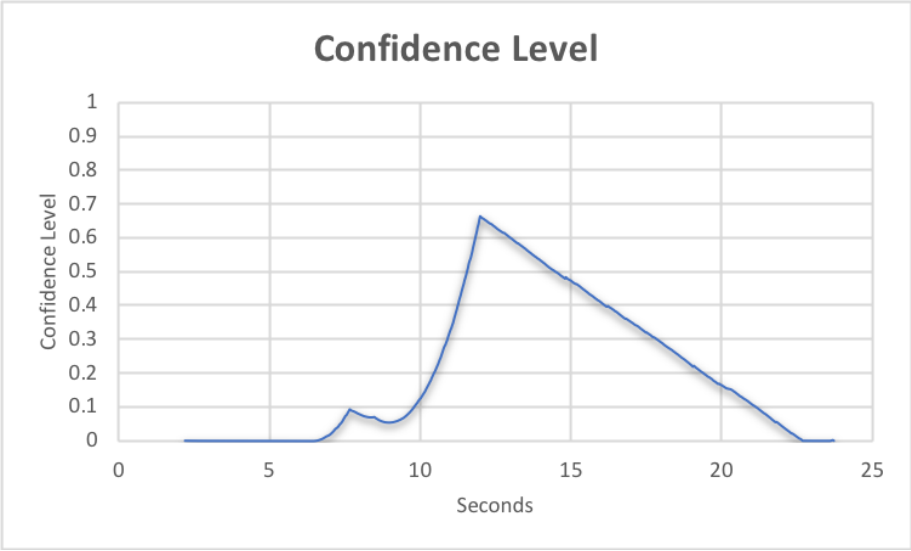


Figure 2: System believed that the operator was fatigued around second 12, operator pushed the button, confidence dropped off for the rest of the shift.

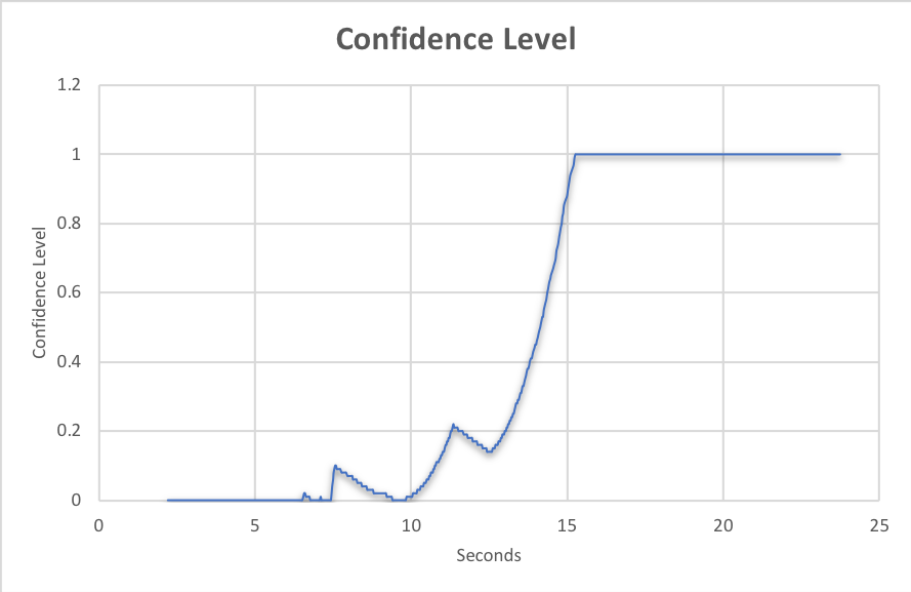


Figure 3: System noticed as the operator became fatigued over time. At second 15, the operator was too tired to work, and the system took action.

Results/Conclusion

The final product still has some issues that have not been resolved. One of the remaining issues is that glasses cause a problem with face detection. The main issue is with the glare that results from bright light hitting the eyeglass lenses. This causes the algorithm to inaccurately calculate the eye-blinking rate and as a result produce a false output. To solve this issue, one could figure out a way to reduce extreme contrast either by reducing the brightness of the light source or increasing the brightness of its surroundings.

In addition to glare from glasses, performance is also another issue. The system is currently running on a Raspberry Pi 3 Model B, which has a quad-core processor and 1.4GHz CPU. With these specifications, the system is currently able to provide only around 17 frames per second. A future enhancement to the performance and the frame rate would be using an accelerated hardware and optimization such as multi-threading.

Another issue is that the system cannot detect a face in a low-light environment. Unless an adequate lighting is provided, the algorithm would not be able to detect an operator's face. In addition, sometimes the background brightness would be greater than the foreground brightness. In this case, the camera would focus on the brighter portion of the frame and dim the other portions of the frame with less brightness causing the algorithm to lose track of the operator's face. A potential enhancement is to add automatic light adjustment. This will cause the light intensity of the background to decrease and instead redirect the light at the operator's eyes.

Introduction

The objective of this project is to create a system that will implement the use of facial detection to determine whether a forklift operator is or is not fatigued. This system will not only protect the lives of forklift operators but also the longevity of the goods that they are working with.

Background

According to a study conducted by the United States Department of Labor, there are 96,700 forklift accidents yearly, 34,900 of them resulted in serious injury while the rest resulted in merchandise loss.[1] To help circumvent accidents, a system that tracks operator fatigue level is necessary. Many passenger cars currently contain a system that can track the driver fatigue and alert the driver if they fall asleep. Such systems are essential to prevent accidents in the workplace.

Discussion

Fatigue detection is nothing new to the vehicle market. However, fatigue detection on a forklift requires extra thought. As oppose to a regular vehicle, the motion of a forklift is unpredictable. It depends sole on the task that the forklift is doing. As a result, the typical fatigue detection schemes simply won't work. It is also important to note that a forklift introduces a new set of concerns that needs to be kept in mind when designing a fatigue detection system. First, the forklift cockpit is typically packed with gadgets, therefore the system must be minimal in size in order to lessen the impact of adding a new gadget. Also, view is important to a forklift driver,

[1] Powered Industrial Truck Operator Training | Occupational Safety and Health Administration, DEPARTMENT OF LABOR, 14 Mar. 1995, www.osha.gov/laws-regs/federalregister/1995-03-14.

therefore the system must not block the drivers view. In addition, most forklifts are durable which means they have a high life time usage, this means that it would be preferable if the system can be backward compatible in terms of forklift, as in it can be used on older models of forklifts. Lastly, the system must not hinder or distract the forklift operator in any manner. Therefore, it is necessary to make the system non-intrusive and non-distractive.

Our goal is to design a fatigue detection system that is flexible, non-intrusive and non-distractive. This means that we expect the system to be a standalone device with no need to interact with anything else. Also, we expect the system to have little to no interaction with the operator. Finally, we plan on minimizing the need for human input to fully utilize the system.

Design Element	**Consideration**
Economic	The unit cost doesn't exceed $100
Environmental	The system is light and small and will not produce waste.
Social	The system might be stressful to operators and could have an effect on the work environment
Political	The system must conform to the privacy laws.
Ethical	The system needs to give the operator a chance to manually indicate that they are awake.
Health and safety	The system must not distract the operator for a long period of time.
Manufacturability	The system has to be mass produced with every production of a forklift
Sustainability	The camera and pi will probably need to be replaced every 5 to 10 years depending on the use.

Table 1: Design considerations

There multiple elements that needs to be considered before designing the system. The system was designed to be cost efficient for mass production. Also, it was designed to be very small and produce little to no heat. The system was also designed with led lights to convey the

confidence level to the operator and then give him a chance to manually indicate he is awake. As a result, operators won't have to be under constant stress in that regards. Also, the system doesn't store any data on the operator, this will hopefully make the system avoid breaking any privacy laws. The button was also added to give operator a chance to dispute a false positive. Finally, the system gives the operator 7 seconds to react in hopes to avoid any dangers to the operator.

Design Criteria	Description	Comment
Accuracy	How accurate is the system? What might cause inaccuracy	The system riles on face detection and framerate. The better these two metrics are the better the overall algorithm.
Size	How big is the system?	The system is designed to have two separate parts, the camera and the raspberry pi.
Method of detection	Is the system intrusive?	The system uses a camera to avoid any contact or intrusion
Backward compatibility	How well does the system perform on older models?	The system is self-contained and doesn't need any outside parts to function (except for power)
Distraction	Does the system cause distractions?	The system only requires input from the operator at the suspicion part (the 50%-80% confidence level).

Table 2: Design criteria

There are five major criteria that the design must adhere to. First, the system needs to be accurate. Second, the vision system offers the ability for improvement. Third, the better the face detection is the more accurate the system is. Fourth, observing how the framerate, which is the number of processed images in a second, plays a part in the accuracy of the system. Finally, the size of the system needs to be put into consideration.

The system was designed in two separate parts, the camera and the logic unit. The camera feeds information into the logic unit and can be placed anywhere and also be reduced in size as much as needed.

The system makes use of a camera and then tracks the facial features of the operator. Using these landmarks, the system then calculates the confidence level based on that. This method is un-intrusive, quick and flexible. The system was designed to be self-reliant, as long as power is provided to the system and does not require any specific piece to run. Therefore, the system is backward compatible with any vehicle if it is mounted in the correct angle. Finally, the only time that the system requires the driver's attention is when it is in the suspicion region. At that time the system expects the operator to either press a button to indicate he is awake or it will report drowsiness.

There were two other alternative methods suggested. The first method is a pulse rate-based system. Under that system, the operator will have to come in direct contact with a pulse sensor somehow. The system will then use that pulse rate to determine whether the operator is drowsy. This will be done by observing how the pulse rate becomes regulated when someone is about to fall asleep as the heart starts to relax and take longer periods. The issue with the suggested system is that it is intrusive, and the operator can elect not to wear or touch the pressure sensor. It is also quite demanding in terms of hardware. Hyster-Yale might have to replace parts of the forklift to accommodate the pulse rate sensor, for example the steering wheel.

Another alternative that was suggested is using the respiratory rate. The respiratory system relies on turning the respiratory rate into a pulse rate. This system is less intrusive since the respiratory rate can be detected with an RGB-D camera or a seat pressure sensor. However, the system is still intrusive. Another major issue is that the respiratory rate is in seconds while the pulse rate is in milliseconds which means the actual calculation will lag by multiple seconds.

This could have a catastrophic result. Therefore, it was decided that a simple vision system will be used as oppose to the two previous suggestions.

Before implementing and setting software specifications, hardware specifications needed to be decided on. Keeping in mind of the requirements of the system, the Raspberry Pi 3 Model B was chosen due to its size and ability to be mountable and modular. This Raspberry Pi was also chosen due to it being the latest Raspberry Pi paired with a recent processor when compared to the other models. This increase in performance would assist in computer vision due to computer vision being very demanding.

This project is vision based which means a camera was required to get vision information. The camera that was decided on was the Quimat QSC16 but was later changed to the Raspberry Pi V2 camera due to better image clarity and color reproduction. The system would also need to give visual feedback since the hardware won't be connected to a screen.

To give visual feedback of the system working, three LEDs (red, yellow, and green) and a button are included. These pieces allow the operator to see the system's confidence level by each LED indicating where their confidence level is at. Green, yellow, and red respectively represents a confidence level of 0-50, 50-85, and 85-100 percent. The button allows the operator to interact with the system in case the system malfunctions by determining an incorrect confidence level. For example, the system has a confidence level of 70 and the operator is not fatigued. The operator would be able to press the button which will decrease the confidence level. After setting the hardware specifications, the software to detect fatigue was then implemented.

To create a software that detects fatigue, existing computer vision libraries needed to be utilized to reduce the amount of time dedicated to face detection. OpenCV and Dlib were decided upon due to both being open source and having large communities for support. Dlib's face detection is utilized due to its reliability at detecting faces by observing 68 points on a face. These 68 points represent key facial features such as eyes, eyebrows, nose, mouth, and jaw. While Dlib is used for face detection, OpenCV is utilized to observe the operator's head orientation. With the face detection completed, actions that dictate what is and is not fatigue needed to be implemented next.

For the software to recognize what fatigue is, three factors are taken into consideration. One of which is the orientation of the operator's head. The orientation of the head is acquired using the Levenberg–Marquardt method which takes a two-dimensional image and gives three-dimensional rotational-measurements for the x, y, and z axes of the head. These orientation measurements are then compared to thresholds that represent what fatigue does and does not look like. For example, an operator leans their head on their shoulder as though they are sleeping. The software would identify that the operator's head orientation is in a position that represents fatigue by comparing these values to the thresholds. The operator's head orientation is not the only factor that is monitored but also the operator's eyes.

The second factor that the software takes into consideration is the blinking rate of the eyes. Observing the eyes is a great method to determine if a person is fatigued. The software measures the blinking rate and determines if they are within the thresholds that represent fatigue. An operator whose eyes are observed to have a lower blinking rate could possibly mean they are fatigued. While observing the eyes is a great way to observe fatigue, another great indicator of fatigue is head movement.

The final factor for determining fatigue is observing head movement. An operator's head movement can assist the previous systems in determining if they are fatigued or not. When operating a forklift, an operator typically needs to move their head often because they always check their surroundings. By checking their surroundings and moving, this inherently means that they are awake. This implementation was included as a final verification if the confidence level increases while the person is not fatigued. Combining the measurements from the head orientation, movement and eye blinking rate, the system can determine if an operator is fatigued.

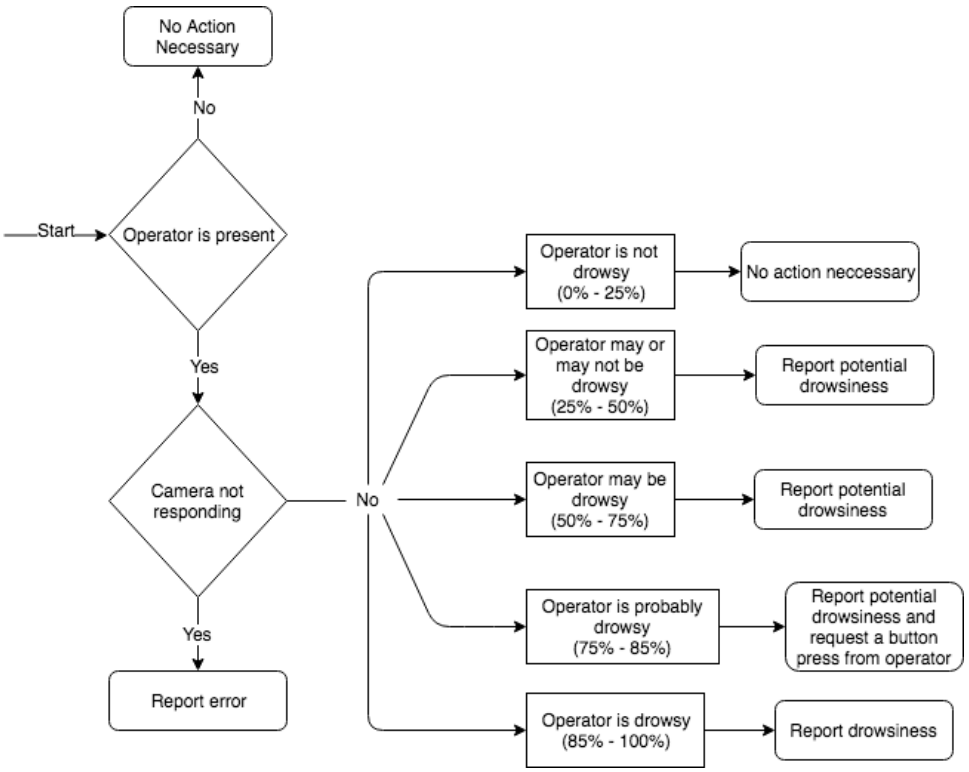


Figure 4:Basic flow chart of the algorithm

Based on these measurements, the system was designed to increase or decrease the confidence level. Fig. 4 shows a basic flow chart of the algorithm and what each confidence level percentage block represents. For example, an operator who is leaning their head on their shoulder with their eyes slightly closed and is not moving. The software would observe the operator's head orientation, eye diameter, and movement to determine if these values are within the

threshold that represent fatigue. Due to the operator's head, eyes, and movement being within the threshold, the software would then report that they are fatigued. After creating the software, multiple cases needed to be tested to observe the optimal working conditions and what required improvement.

Testing of the software involved observing an operator's movement, surroundings and what is worn on their face. For example, an operator will most likely wear safety glasses which will obstruct the face and possibly impair the software's face detection. A test shown in Fig. 5 shows the face detection working with safety glasses. Other tests involving safety glasses was to observe the effects of glare and how it affects the face detection. The effects of glare are shown in Fig. 6 where the software cannot determine the exact location of the eyes.

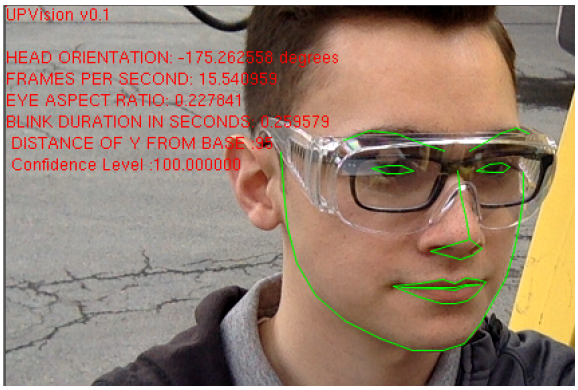


Figure 5: Face detection with Safety glasses

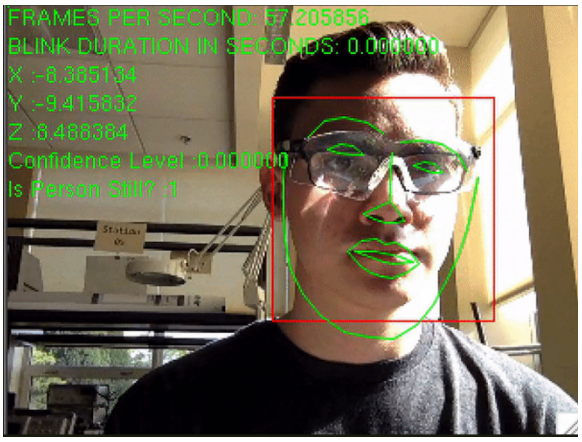


Figure 6: Effects of glare and lighting

With the intentions of testing the operator's surroundings, the system was tested in different lighting scenarios. This included the background being and not being brighter than the operator. The effects of lighting are shown in Fig. 5 where one side of the face is brighter than the other. The system encounters difficulty when trying to recognize the chin and jaw thereby making the other facial features, such as the eyes and eyebrows, mapped incorrectly.

Engineering Standards

Our Raspberry Pi utilizes a 5V (volt) power source and outputs 3.3V to the button and three LED lights. The green light requires 3V compared to the yellow and red that require 1.7V. All the LEDs ran on 20 mA (amps) of current. The resistors used in the circuit had the following resistance (Ω) values: 1k Ω, 10k Ω, 150 Ω, and two 100 Ω. The design of the circuit is shown in Fig. 7.

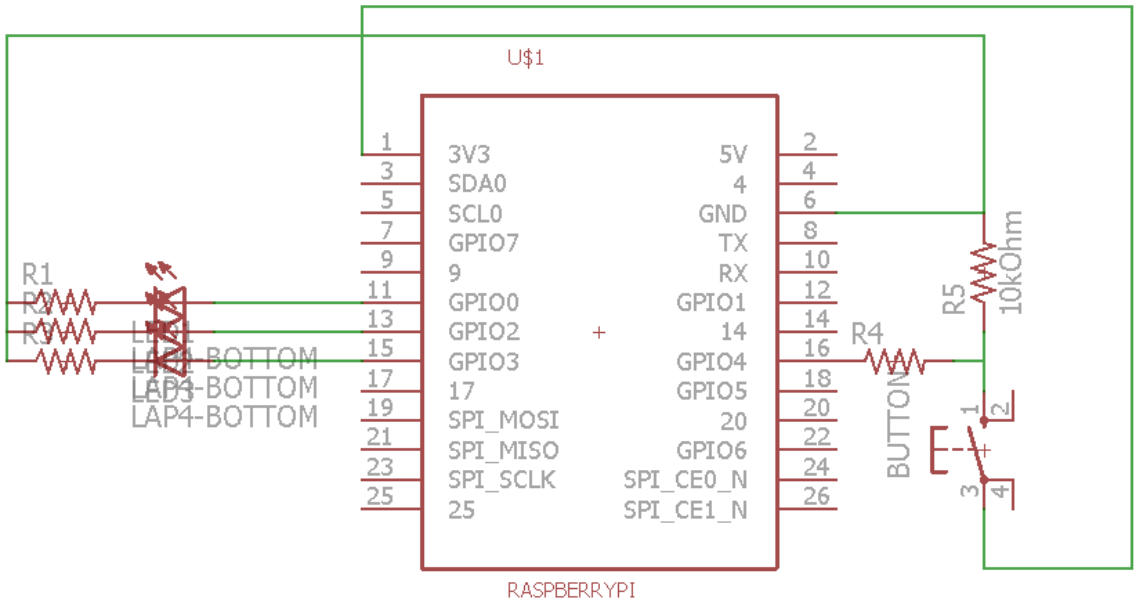


Figure 7 Circuit Diagram

Professional Responsibility

This project relates to ethical responsibility because the system promotes the safety of the operator. While the system's purpose is to protect the well-being of the operator, the system can also be viewed negatively. This is due to system constantly keeping close surveillance over the operator. This constant surveillance could make employees feel as though they are not trustworthy even though the system's intended purpose is to make sure the employees are safe.

While the argument about privacy is valid, many places that require the use of forklifts, such as warehouses, already have surveillance cameras within the building. Ethically, this project promotes a safer work environment and better working conditions by ensuring that all operators are awake and alert.

Budget and Pro Forma

This project's finances were not focused so much on what our team spent, rather, the focus was more around what would be Hyster-Yale's costs and what kind of profit they could make. Since this project was a heavily coded project, the only expenses materials were the hardware components which included the raspberry pi, camera, breadboards, button, and LEDs. In total, the material cost came to $217 as shown in figure 13. The real cost to this project was in the 830 hours spent researching, coding, building, and testing this project. At an entry-level salary of $20 per hour, these hours equate to just short of $30,000 in pro-bono labor cost.

To determine the total labor spent, an hour tracking sheet was created for each member. Within the hour tracking sheets in figures 14-23, I separated the hours spent on this project into three categories: Overhead (OH), Direct Labor (DL), and Raw Material (RM). Direct labor were the hours that were directly associated with developing the product which includes tasks such as programming the software and building the case. The overhead expenses included all other tasks not directly related to the developing the product such as time spent at meetings and traveling. The raw material was any of the hardware or software that was bought.

This information gathered above combined with the financial statements found on Hyster-Yale's website, allowed for the creation of the pro-forma income statement and balance sheet which can be found in figure 9 and 10 respectively. Looking at Hyster-Yale's income

statement, their total forklifts sold was about 85,000 in 2016. Using this number, it was estimated that our product could be added to 20% of their sold forklifts which would equate to about 17000 units of our product sold for one year. From the number of units sold, total DL and OH were each divided by 17000 to find the DL cost per unit and OH cost per unit. The DL/unit ($.30) + OH/unit ($1.33) + materials used ($52.70) equals $54.33, the minimum selling price of the product. All figures can be found in the table of figures on page iv.

UP Vision System Budget
Fall 2017 / Spring 2018

Memebers: Michael Waitt Hashim AlJawad Kurtis Davidson Ibrahim Almubarak Matthew Erhardt

Funds

Date	Source	Amount
	University of Portland	$ 400.00
	Total	$ 400.00

Spending

Vendor	Item Description	Quantity	Budgeted Price/Unit	Budget
Amazon	Raspberry Pi Camera Module V2 - 8 Megapixel, 1080p	3	$ 26.45	$ 79.35
Amazon	Raspberry PI 3 Model B 1.2 GHz 64-bit quad-core ARMv8 CPU, 1 GB RAM	2	$ 35.22	$ 70.44
Amazon	CanaKit 5V 2.5A Raspberry Pi 3 Power Supply/Adapter/Charger (UL Listed)	2	$ 9.99	$ 19.98
Amazon	50 Ft 12 Gauge Copper Wire	1	$ 12.98	$ 12.98
Amazon	Quimat for Raspberry Pi3 Night Vision Camera Module, Mini 5MP 1080P HD Video	2	$ 25.99	$ 51.98
Amazon	CanaKit Raspberry Pi 3 Complete Starter Kit - 32 GB Edition	1	$ 69.99	$ 69.99
Home Depot	Duct Tape	1	$ 9.01	$ 9.01
Home Depot	Screws (Pack of 100)	1	$ 5.74	$ 5.74
Home Depot	Velcro Strips (5' x 3/4")	1	$ 7.47	$ 7.47
			TOTAL	$326.94

Figure 8 Budget Sheet

Purchases						
Purchase Date	Vendor	Brief Description	Quantitiy	Cash Flow Type	Debits	Credts
10/23/2017	University of Portland	Initial Funding	1	Cash	$ 400.00	
11/2/2017	Amazon	Raspberry Pi 3 Kit	1	Hardware Expense		$ 69.99
11/14/2017	Amazon	Raspberry Pi 3 Camera	1	Hardware Expense		$ 25.99
02/15/18	Amazon	5mm LEDs Breadboards Buttons	1	Hardware Expense		$ 25.86
04/05/18	Amazon	Raspberry Pi 3 Kit	1	Hardware Expense		$ 69.99
		Raspberry Pi Camera Module V2	1	Hardware Expense		$ 25.32

Figure 9 Purchases

Pro Forma Income Statement

	YR 1	YR 2	YR 3	YR 4	YR 5
Projected Revenues					
Sales	1,105,820.40	1,382,275.50	1,658,730.60	552,910.20	829,365.30
Number of Units Sold	16,960.00 [I]	21,200.00 [II]	25,440.00 [III]	8,480.00 [IV]	12,720.00 [V]
Sale Price Per Unit	$ 65.20	$ 65.20	$ 65.20	$ 65.20	$ 65.20
Total Revenues	$ 1,105,820.40	$ 1,382,275.50	$ 1,658,730.60	$ 552,910.20	$ 829,365.30
Projected Expenses					
Direct Labor Expenses	5,135.00	5,135.00	5,135.00	5,135.00	5,135.00
Overhead Expenses	22,590.00	22,590.00	22,590.00	22,590.00	22,590.00
Cost of Goods Sold	921,517.00	1,151,896.25	1,382,275.50	460,758.50	691,137.75
Cost Per Unit	54.33	54.33	54.33	54.33	54.33
Total Expenses	$ 949,242.00	$ 1,179,621.25	$ 1,410,000.50	$ 488,483.50	$ 718,862.75
Projected Net Income	$ 156,578.40	$ 202,654.25	$ 248,730.10	$ 64,426.70	$ 110,502.55

Figure 10 Pro-Forma Income Statement

NOTES

[I] Number of units sold is based off of 20% of Hyster Yale's 2016 units shipped which was 84,800 units.

[II] Number of units sold is based off of 25% of Hyster Yale's 2016 units shipped which was 84,800 units.

[III] Number of units sold is based off of 30% of Hyster Yale's 2016 units shipped which was 84,800 units.

[IV] Number of units sold is based off of 20% of Hyster Yale's 2016 units shipped which was 84,800 units.

[V] Number of units sold is based off of 20% of Hyster Yale's 2016 units shipped which was 84,800 units.

Pro Forma Balance Sheet

	YR 1	YR 2	YR 3	YR 4	YR 5
ASSETS					
Cash	291,779.20	3,996,850.07	6,561,543.65	7,697,885.88	8,384,988.57
Inventory	3,675,201.05	2,523,304.80	1,141,029.30	680,270.80	-10,866.95
Total Current Assets	$ 3,966,980.25	$ 6,520,154.87	$ 7,702,572.95	$ 8,378,156.68	$ 8,374,121.62
Total Assets	$ 3,966,980.25	$ 6,520,154.87	$ 7,702,572.95	$ 8,378,156.68	$ 8,374,121.62
LIABILITIES					
Current Liabilities	$ -	$ -	$ -	$ -	$ -
Total Liabilities	$ -	$ -	$ -	$ -	$ -
STOCKHOLDER'S EQUITY					
Contributed Capital	291,779.20	0	0	0	0
Retained Earnings	3,966,980.25	6,520,154.87	7,702,572.95	8,378,156.68	8,374,121.62
Total Stockholer's Equity	$ 4,258,759.45	$ 6,520,154.87	$ 7,702,572.95	$ 8,378,156.68	$ 8,374,121.62
Total Liabilities and Stockholder's Equity	$ 4,258,759.45	$ 6,520,154.87	$ 7,702,572.95	$ 8,378,156.68	$ 8,374,121.62

Figure 11 Pro Forma Balance Sheet

Task Expenditures

SPRINT 0									
MEMBER	LABOR HRS		DL COST		RM COSTS		OH COSTS		TOTAL COST
ALJAWAD	80.50	$	340.00	$	-	$	3,810.00	$	4,150.00
ALMUBARAK	79.50	$	400.00	$	-	$	3,570.00	$	3,970.00
DAVIDSON	85.50	$	340.00	$	-	$	4,110.00	$	4,450.00
ERHARDT	175.48	$	260.00	$	95.98	$	3,990.00	$	4,345.98
WAITT	82.50	$	460.00	$	-	$	3,570.00	$	4,030.00
SUBTOTALS	**503.48**	**$**	**1,800.00**	**$**	**95.98**	**$**	**19,050.00**	**$**	**20,945.98**

SPRINT 1									
MEMBER	LABOR HRS		DL COST		RM COSTS		OH COSTS		TOTAL COST
ALJAWAD	2.50	$	80.00	$	-	$	10.00	$	90.00
ALMUBARAK	0.50	$	-	$	-	$	10.00	$	10.00
DAVIDSON	0.25	$	5.00	$	-	$	-	$	5.00
ERHARDT	4.00	$	40.00	$	-	$	40.00	$	80.00
WAITT	0.50	$	-	$	-	$	10.00	$	10.00
SUBTOTALS	**7.75**	**$**	**125.00**	**$**	**-**	**$**	**70.00**	**$**	**195.00**

SPRINT 2									
MEMBER	LABOR HRS		DL COST		RM COSTS		OH COSTS		TOTAL COST
ALJAWAD	2.50	$	40.00	$	-	$	10.00	$	50.00
ALMUBARAK	2.50	$	40.00	$	-	$	20.00	$	60.00
DAVIDSON	3.50	$	60.00	$	-	$	10.00	$	70.00
ERHARDT	7.50	$	40.00	$	-	$	110.00	$	150.00
WAITT	1.50	$	20.00	$	-	$	10.00	$	30.00
SUBTOTALS	**17.5**	**$**	**200.00**	**$**	**-**	**$**	**160.00**	**$**	**360.00**

SPRINT 3									
MEMBER	LABOR HRS		DL COST		RM COSTS		OH COSTS		TOTAL COST
ALJAWAD	2.00	$	20.00	$	-	$	20.00	$	40.00
ALMUBARAK	9.50	$	140.00	$	-	$	50.00	$	190.00
DAVIDSON	2.50	$	-	$	-	$	50.00	$	50.00
ERHARDT	8.00	$	40.00	$	-	$	120.00	$	160.00
WAITT	4.00	$	30.00	$	-	$	50.00	$	80.00
SUBTOTALS	**26.00**	**$**	**230.00**	**$**	**-**	**$**	**290.00**	**$**	**520.00**

SPRINT 4									
MEMBER	LABOR HRS		DL COST		RM COSTS		OH COSTS		TOTAL COST
ALJAWAD	6.00	$	120.00	$	-	$	40.00	$	160.00
ALMUBARAK	9.00	$	180.00	$	-	$	30.00	$	210.00
DAVIDSON	0.00	$	-	$	-	$	-	$	-
ERHARDT	14.00	$	280.00	$	-	$	140.00	$	420.00
WAITT	2.50	$	50.00	$	-	$	40.00	$	90.00
SUBTOTALS	**31.50**	**$**	**630.00**	**$**	**-**	**$**	**250.00**	**$**	**880.00**

Figure 12 Task Expenditures 1/3

SPRINT 5					
MEMBER	LABOR HRS	DL COST	RM COSTS	OH COSTS	TOTAL COST
ALJAWAD	3.00	$ 60.00	$ -	$ -	$ 60.00
ALMUBARAK	6.00	$ 80.00	$ -	$ 40.00	$ 120.00
DAVIDSON	3.00	$ 60.00	$ -	$ -	$ 60.00
ERHARDT	9.00	$ 60.00	$ 25.86	$ 120.00	$ 205.86
WAITT	3.50	$ 70.00	$ -	$ -	$ 70.00
SUBTOTALS	**24.50**	**$ 330.00**	**$ 25.86**	**$ 160.00**	**$ 515.86**

SPRINT 6					
MEMBER	LABOR HRS	DL COST	RM COSTS	OH COSTS	TOTAL COST
ALJAWAD	8.00	$ 120.00	$ -	$ 40.00	$ 160.00
ALMUBARAK	19.00	$ 340.00	$ -	$ 40.00	$ 380.00
DAVIDSON	11.00	$ 180.00	$ -	$ 40.00	$ 220.00
ERHARDT	9.00	$ 100.00	$ -	$ 80.00	$ 180.00
WAITT	11.00	$ 180.00	$ -	$ 40.00	$ 220.00
SUBTOTALS	**58.00**	**$ 920.00**	**$ -**	**$ 240.00**	**$ 1,160.00**

SPRINT 7					
MEMBER	LABOR HRS	DL COST	RM COSTS	OH COSTS	TOTAL COST
ALJAWAD	7.50	$ 80.00	$ -	$ 70.00	$ 150.00
ALMUBARAK	11.50	$ 160.00	$ -	$ 70.00	$ 230.00
DAVIDSON	6.50	$ 60.00	$ -	$ 70.00	$ 130.00
ERHARDT	10.50	$ 100.00	$ -	$ 110.00	$ 210.00
WAITT	11.50	$ 140.00	$ -	$ 90.00	$ 230.00
SUBTOTALS	**47.50**	**$ 540.00**	**$ -**	**$ 410.00**	**$ 950.00**

SPRINT 8					
MEMBER	LABOR HRS	DL COST	RM COSTS	OH COSTS	TOTAL COST
ALJAWAD	4.00	$ 40.00	$ -	$ 40.00	$ 80.00
ALMUBARAK	4.00	$ 40.00	$ -	$ 40.00	$ 80.00
DAVIDSON	4.00	$ -	$ -	$ 80.00	$ 80.00
ERHARDT	6.00	$ 40.00	$ -	$ 80.00	$ 120.00
WAITT	10.00	$ 160.00	$ -	$ 40.00	$ 200.00
SUBTOTALS	**28.00**	**$ 280.00**	**$ -**	**$ 280.00**	**$ 560.00**

SPRING SPRINT					
MEMBER	LABOR HRS	DL COST	RM COSTS	OH COSTS	TOTAL COST
ALJAWAD	0.00	$ -	$ -	$ -	$ -
ALMUBARAK	0.00	$ -	$ -	$ -	$ -
DAVIDSON	0.00	$ -	$ -	$ -	$ -
ERHARDT	0.00	$ -	$ -	$ -	$ -
WAITT	0.00	$ -	$ -	$ -	$ -
SUBTOTALS	**0.00**	**$ -**	**$ -**	**$ -**	**$ -**

Figure 13 Task Expenditures 2/3

SPRINT 9					
MEMBER	LABOR HRS	DL COST	RM COSTS	OH COSTS	TOTAL COST
ALJAWAD	5.00	$ -	$ -	$ 100.00	$ 100.00
ALMUBARAK	1.00	$ -	$ -	$ 20.00	$ 20.00
DAVIDSON	0.00	$ -	$ -	$ 80.00	$ 80.00
ERHARDT	8.00	$ -	$ 95.31	$ 160.00	$ 255.31
WAITT	6.00	$ 20.00	$ -	$ 100.00	$ 120.00
SUBTOTALS	**20.00**	**$ 20.00**	**$ 95.31**	**$ 460.00**	**$ 575.31**

SPRINT 10					
MEMBER	LABOR HRS	DL COST	RM COSTS	OH COSTS	TOTAL COST
ALJAWAD	5.00	$ -	$ -	$ 100.00	$ 100.00
ALMUBARAK	4.00	$ -	$ -	$ 80.00	$ 80.00
DAVIDSON	4.00	$ -	$ -	$ 80.00	$ 80.00
ERHARDT	8.00	$ 60.00	$ -	$ 100.00	$ 160.00
WAITT	5.00	$ -	$ -	$ 100.00	$ 100.00
SUBTOTALS	**26.00**	**$ 60.00**	**$ -**	**$ 460.00**	**$ 520.00**

SPRINT 11					
MEMBER	LABOR HRS	DL COST	RM COSTS	OH COSTS	TOTAL COST
ALJAWAD	6.00	$ -	$ -	$ 120.00	$ 120.00
ALMUBARAK	14.00	$ -	$ -	$ 280.00	$ 280.00
DAVIDSON	3.00	$ -	$ -	$ 60.00	$ 60.00
ERHARDT	6.00	$ -	$ -	$ 120.00	$ 120.00
WAITT	9.00	$ -	$ -	$ 180.00	$ 180.00
SUBTOTALS	**38.00**	**$ -**	**$ -**	**$ 760.00**	**$ 760.00**

PROJECT TOTALS	**828.23**	**$ 5,135.00**	**$ 217.15**	**$ 22,590.00**	**$ 27,942.15**

Figure 14 Task Expenditures 3/3

Member: Matthew Erhardt
Major(s): EE
Role: CFO

UP Vision

Hours Tracker

Code Legend
OH - Overhead
DL - Direct Labor
RM - Raw Materials

SPRINT	TASK	DL (HRS)	RM ($)	OH (HRS)	Total Hours (DL+OH)	TOTAL COST*
SPRINT 0	**FALL 2017 WORK**	**13**	**95.98**	**66.5**	**175.48**	**$ 1,685.98**
	Product Research	3				$ 60.00
	Ordered Pi		69.99			$ 69.99
	Ordered Pi Camera		25.99			$ 25.99
	Flow Chart	1				$ 20.00
	Weekly-Reports			0.5		$ 10.00
	Poster Project	5				$ 100.00
	Budgeting			8		$ 160.00
	Schematics	2				$ 40.00
	Diagrams	2				$ 40.00
	Research Paper			5		$ 100.00
	Advisor Meetings			1.5		$ 30.00
	Team Meetings			50		$ 1,000.00
	Travel			1.5		$ 30.00
SPRINT 1	**Reading from Camera**	**2**	**0**	**2**	**4**	**$ 80.00**
	Getting Familiar with CAD software	2				$ 40.00
	Meet with Tribelhorn			0.5		$ 10.00
	Worked on Budget			1.5		$ 30.00
SPRINT 2	**Facial Recognition with specific outlining (head vs eye)**	**2**	**0**	**5.5**	**7.5**	**$ 150.00**
	CAD Drawing	2				$ 40.00
	Update Financial Statement			5		$ 100.00
	Meet with Tribelhorn			0.5		$ 10.00
SPRINT 3	**Gathering data from facial recognition**	**2**	**0**	**6**	**8**	**$ 160.00**
	Budget			3.5		$ 70.00
	CAD Drawing	2				$ 40.00
	Meet with Brett			1.5		$ 30.00
	Meet with Tribelhorn			1		$ 20.00
SPRINT 4	**Confidence level assessment**	**7**	**0**	**7**	**14**	**$ 280.00**
	Update Financial Statement			5		$ 100.00
	CAD Drawing Draft 1	7				$ 140.00
	Meet with Brett			1		$ 20.00
	Meet with Tribelhorn			1		$ 20.00
SPRINT 5	**Optimization of algorithms**	**3**	**25.86**	**6**	**9**	**$ 205.86**
	Update Financial Statement			6		$ 120.00
	Ordered Circuit Hardware		25.86			$ 25.86
	Head Orientation	3				$ 60.00
SPRINT 6	**Outputting result**	**5**	**0**	**4**	**9**	**$ 180.00**
	Update Financial Statement			2		$ 40.00
	Build Circuit	5				$ 100.00
	Meet with Brett			1		$ 20.00

*COST DETERMINED AT $20/HR

Figure 15 Erhardt Hours Tracker 1/2

Member: Matthew Erhardt
Major(s): EE
Role: CFO

UP Vision

Hours Tracker

Code Legend
OH - Overhead
DL - Direct Labor
RM - Raw Materials

	Meet with Tribelhorn			1		$	20.00
SPRINT 7	**Buffer (in case of a delay)**	**5**	**0**	**5.5**	**10.5**	**$**	**210.00**
	Test out different angles	3				$	60.00
	Build Circuit	2				$	40.00
	Update Financial Statement			2		$	40.00
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Travel			1.5		$	30.00
SPRINT 8	**Image Stabilization**	**2**	**0**	**4**	**6**	**$**	**120.00**
	Update Financial Statement			2		$	40.00
	Got imageCapture to work on computer	2				$	40.00
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
SPRING SPRINT	**Spring Break**	**0**	**0**	**0**	**0**	**$**	**-**
						$	-
SPRINT 9	**PowerPoint slides**	**0**	**95.31**	**8**	**8**	**$**	**255.31**
	Meet with Tribelhorn			1		$	20.00
	Update Financial Statement			3		$	60.00
	Get Access to 3D printer			1		$	20.00
	PowerPoint slides			2		$	40.00
	Fix Poster			1		$	20.00
	Bought Hardware		95.31			$	95.31
SPRINT 10	**Presentation rehearsal. - Final report draft 1**	**3**	**0**	**5**	**8**	**$**	**140.00**
	Meeting with Brett			1		$	20.00
	Meeting with Tribelhorn			1			
	Fix Slides			2		$	40.00
	Update Financial Statement			1		$	20.00
	Case Building	3				$	60.00
SPRINT 11	**Buffer (in case of a delay) / draft 2**	**0**	**0**	**6**	**6**	**$**	**120.00**
	Meeting with Brett			1		$	20.00
	Meeting with Tribelhorn			1		$	20.00
	Presentation Dry Run			1		$	20.00
	Final Report			3		$	60.00
TOTALS		**44**	**217.15**	**125.5**	**265.48**	**$**	**3,587.15**

*COST DETERMINED AT $20/HR

Figure 16 Erhardt Hours Tracker 2/2

Member: Ibrahim Almubarak
Major(s): EE, CS
Role: Spring Team Leader

UP Vision
Hours Tracker

Code Legend
Overhead - OH
Direct Labor - DL
Raw Materials - RM

SPRINT	TASK	DL (HRS)	RM ($)	OH (HRS)	Total Hours (DL+OH)	TOTAL COST*
SPRINT 0	**FALL 2017 WORK**	**20**	**0**	**59.5**	**79.5**	**$ 1,590.00**
	Product Rearch	6				$ 120.00
	UML Diagram	5				$ 100.00
	Weekly-Reports			1.5		$ 30.00
	Poster Project	5				$ 100.00
	Schematics	2				$ 40.00
	Diagrams	2				$ 40.00
	Research Paper			5		$ 100.00
	Advisor Meetings			1.5		$ 30.00
	Team Meetings			50		$ 1,000.00
	Travel			1.5		$ 30.00
SPRINT 1	**Reading from Camera**	**0**	**0**	**0.5**	**0.5**	**$ 10.00**
	Capture image from a camera and store in variable					$ -
	Meet with Tribelhorn			0.5		$ 10.00
SPRINT 2	**Facial Recognition with specific outlining (head vs eye)**	**4**	**0**	**1**	**5**	**$ 100.00**
	Face Box	2				$ 40.00
	CAD Drawing	2				$ 40.00
	Meet with Tribelhorn			1		$ 20.00
SPRINT 3	**Gathering data from facial recognition**	**7**	**0**	**2.5**	**9.5**	**$ 190.00**
	Dlib working with video streaming	5				$ 100.00
	Meet with Tribelhorn			1		$ 20.00
	Meet with Brett			1.5		$ 30.00
	Get familiar with Dlib	2				$ 40.00
SPRINT 4	**Confidence level assessment**	**7**	**0**	**2**	**9**	**$ 540.00**
	Meet with Brett			1		$ 60.00
	Meet with Tribelhorn			1		$ 60.00
	First Draft of CAD	7				$ 420.00
SPRINT 5	**Optimization of algorithms**	**4**	**0**	**2**	**6**	**$ 240.00**
	Measuring Confidence Level	1				$ 60.00
	Head Orientation	3				$ 180.00
SPRINT 6	**Outputting result**	**17**	**0**	**2**	**19**	**$ 1,140.00**
	Calculate weights	3				$ 180.00
	Build Circuit	5				$ 300.00
	2D to 3D Face Modeling	9				$ 540.00
	Meet with Brett			1		$ 60.00
	Meet with Tribelhorn			1		$ 60.00
SPRINT 7	**Buffer (in case of a delay)**	**8**	**0**	**3.5**	**11.5**	**$ 550.00**
	Test out different angles	3				$ 180.00
	Build Circuit	2				$ 120.00

*COST DETERMINED AT $20/HR

Figure 17 Almubarak Hours Tracker 1/2

Member: Ibrahim Almubarak
Major(s): EE, CS
Role: Spring Team Leader

UP Vision
Hours Tracker

Code Legend
Overhead - OH
Direct Labor - DL
Raw Materials - RM

	Normalize Y-Axis	3				$	180.00
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Travel			1.5		$	30.00
SPRINT 8	**Image Stabilization**	**2**	**0**	**2**	**4**	**$**	**80.00**
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Clean Code	2				$	40.00
SPRING SPRINT		**0**	**0**	**0**	**0**	**$**	-
						$	-
SPRINT 9	**PowerPoint slides**	**0**	**0**	**1**	**1**	$	20.00
	Meet with Tribelhorn			1		$	20.00
	PowerPoint slides			3		$	60.00
	Fix Poster			1		$	20.00
SPRINT 10	**Presentation rehearsal. - Final report draft 1**	**0**	**0**	**4**	**4**	**$**	**80.00**
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Fix the Slides			2		$	40.00
SPRINT 11	**Buffer (in case of a delay) / draft 2**	**0**	**0**	**14**	**14**	**$**	**120.00**
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Hardware communicate with software			3		$	60.00
	Final Report			3			
	Neural Network			5			
	Presentation Dry Run			1		$	20.00
TOTALS		**69**	**0**	**94**	**163**	**$**	**4,660.00**

*COST DETERMINED AT $20/HR

Figure 18 Almubarak Hours Tracker 2/2

Member: Hashim Al-jawad
Major(s): CS
Role: Project Manager

UP Vision
Hours Tracker

Code Legend
Overhead - OH
Direct Labor - DL
Raw Materials - RM

SPRINT	TASK	DL (HRS)	RM ($)	OH (HRS)	Total Hours (DL+OH)	TOTAL COST*
SPRINT 0	**FALL 2017 WORK**	**17**	**0**	**63.5**	**80.5**	**$ 1,610.00**
	Product Research	3				$ 60.00
	UML Diagram	10				$ 200.00
	Weekly-Reports			0.5		$ 10.00
	Poster Project			5		$ 100.00
	Schematics	2				$ 40.00
	Diagrams	2				$ 40.00
	Research Paper			5		$ 100.00
	Advisor Meetings			1.5		$ 30.00
	Team Meetings			50		$ 1,000.00
	Travel			1.5		$ 30.00
SPRINT 1	**Reading from Camera**	**2**	**0**	**0.5**	**2.5**	**$ 50.00**
	Capture image from a camera and store in variable	2				$ 40.00
	Meet with Tribelhorn			0.5		$ 10.00
SPRINT 2	**Facial Recognition with specific outlining (head vs eye)**	**2**	**0**	**0.5**	**2.5**	**$ 50.00**
	Face Box	2				$ 40.00
	Meet with Tribelhorn			0.5		$ 10.00
SPRINT 3	**Gathering data from facial recognition**	**1**	**0**	**1**	**2**	**$ 40.00**
	Eye Tracking/ Blinking Rate					$ -
	Get familiar with Dlib	1				$ 20.00
	Meet with Tribelhorn			1		$ 20.00
SPRINT 4	**Confidence level assessment**	**4**	**0**	**2**	**6**	**$ 120.00**
	Meet with Tribelhorn			1		$ 20.00
	Meet with Brett			1		$ 20.00
	Blinking Rate	4				$ 80.00
	Test on the Pi	2				$ 40.00
SPRINT 5	**Optimization of algorithms**	**3**	**0**	**0**	**3**	**$ 120.00**
	Head Orientation	3				$ 60.00
	Time of each blink	3				$ 60.00
SPRINT 6	**Outputting result**	**6**	**0**	**2**	**8**	**$ 160.00**
	Optimization Part 3	5				$ 100.00
	Meet with Brett			1		$ 20.00
	Meet with Tribelhorn			1		$ 20.00
	Test code on pi	1				$ 20.00
SPRINT 7	**Buffer (in case of a delay)**	**4**	**0**	**3.5**	**7.5**	**$ 150.00**
	Test out different angles	3				$ 60.00
	Print output to file w/ timestamp	1				$ 20.00
	Meet with Brett			1		$ 20.00
	Meet with Tribelhorn			1		$ 20.00

*COST DETERMINED AT $20/HR

Figure 19Al-Jawad Hours Tracker 1/2

Member: Hashim Al-jawad
Major(s): CS
Role: Project Manager

UP Vision
Hours Tracker

Code Legend
Overhead - OH
Direct Labor - DL
Raw Materials - RM

	Travel			1.5		$	30.00
SPRINT 8	**Image Stabilization**	**2**	**0**	**2**	**4**	**$**	**80.00**
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Clean Code	2				$	40.00
SPRING SPRINT		**0**	**0**	**0**	**0**	**$**	**-**
						$	-
SPRINT 9	**PowerPoint slides**	**0**	**0**	**5**	**5**	**$**	**100.00**
	Meet with Tribelhorn			1		$	20.00
	PowerPoint slides			3		$	60.00
	Fix Poster			1		$	20.00
SPRINT 10	**Presentation rehearsal. - Final report draft 1**	**0**	**0**	**5**	**5**	**$**	**100.00**
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Fix Slides			2		$	40.00
	Generate Data for presentation			1		$	20.00
SPRINT 11	**Buffer (in case of a delay) / draft 2**	**0**	**0**	**6**	**6**	**$**	**120.00**
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Hardware communicate with software			3		$	60.00
	Presentation Dry Run			1		$	20.00
	Final Report			3			
TOTALS		**41**	**0**	**91**	**132**	**$**	**2,700.00**

*COST DETERMINED AT $20/HR

Figure 20 Al-Jawad Hours Tracker 2/2

Member: Kurtis Davidson
Major(s): CS
Role: IT Managers

UP Vision

Hours Tracker

Code Legend
Overhead - OH
Direct Labor - DL
Raw Materials - RM

SPRINT	TASK	DL (HRS)	RM ($)	OH (HRS)	Total Hours (DL+OH)	TOTAL COST*
SPRINT 0	**FALL 2017 WORK**	**17**	**0**	**68.5**	**85.5**	**$ 1,710.00**
	Product Research	3				$ 60.00
	UML Diagram	10				$ 200.00
	Weekly-Report			0.5		$ 10.00
	Poster Project			5		$ 100.00
	Website			5		$ 100.00
	Schematic	2				$ 40.00
	Diagrams	2				$ 40.00
	Research Paper			5		$ 100.00
	Advisor Meetings			1.5		$ 30.00
	Team Meetings			50		$ 1,000.00
	Travel			1.5		$ 30.00
SPRINT 1	**Reading from Camera**	**0.25**	**0**	**0**	**0.25**	**$ 5.00**
	Capture image from a camera and store in variable					$ -
	Meet with Tribelhorn	0.25				$ 5.00
SPRINT 2	**Facial Recognition with specific outlining (head vs eye)**	**3**	**0**	**0.5**	**3.5**	**$ 70.00**
	Orentation Box	3				$ 60.00
	Meet with Tribelhorn			0.5		$ 10.00
SPRINT 3	**Gathering data from facial recognition**	**0**	**0**	**2.5**	**2.5**	**$ 50.00**
	Meet with Tribelhorn			1		$ 20.00
	Meet with Brett			1.5		$ 30.00
	Get familiar with dlib					$ -
SPRINT 4	**Confidence level assessment**	**0**	**0**	**0**	**0**	**$ -**
	Head Orientation Algorithm					$ -
SPRINT 5	**Optimization of algorithms**	**3**	**0**	**0**	**3**	**$ 60.00**
	Head Orientation	3				$ 60.00
SPRINT 6	**Outputting result**	**9**	**0**	**2**	**11**	**$ 220.00**
	2D to 3D Face Modeling	9				$ 180.00
	Meet with Brett			1		$ 20.00
	Meet with Tribelhorn			1		$ 20.00
SPRINT 7	**Buffer (in case of a delay)**	**3**	**0**	**3.5**	**6.5**	**$ 130.00**
	Test out different angles	3				$ 60.00
	Meet with Brett			1		$ 20.00
	Meet with Tribelhorn			1		$ 20.00
	Travel			1.5		$ 30.00
SPRINT 8	**Image Stabilization**	**0**	**0**	**4**	**4**	**$ 80.00**
	Meet with Brett			1		$ 20.00
	Meet with Tribelhorn			1		$ 20.00
	Choose new camera			2		$ 40.00

*COST DETERMINED AT $20/HR

Figure 21 Davidson Hours Tracker 1/2

Member: Kurtis Davidson
Major(s): CS
Role: IT Managers

UP Vision

Hours Tracker

Code Legend
Overhead - OH
Direct Labor - DL
Raw Materials - RM

SPRING SPRINT		**0**	**0**	**0**	**0**	**$**	**-**
						$	-
SPRINT 9	**PowerPoint slides**	**0**	**0**	**4**	**4**	**$**	**80.00**
	Meet with Tribelhorn			1		$	20.00
	PowerPoint slides			2		$	40.00
	Fix Poster			1		$	20.00
SPRINT 10	**Presentation rehearsal. - Final report draft 1**	**0**	**0**	**4**	**4**	**$**	**80.00**
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Fix Slides			2		$	40.00
SPRINT 11	**Buffer (in case of a delay) / draft 2**	**0**	**0**	**3**	**3**	**$**	**60.00**
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Presentation Dry Run			1		$	20.00
	Final Report			3			
	Testing			3			
TOTALS		**35.25**	**0**	**92**	**127.25**	**$**	**2,545.00**

*COST DETERMINED AT $20/HR

Figure 22 Davidson Hours Tracker 2/2

Member: Michael Waitt
Major(s): CS
Role: Fall Team Leader

UP Vision

Hours Tracker

Code Legend
Overhead - OH
Direct Labor - DL
Raw Materials - RM

SPRINT	TASK	DL (HRS)	RM ($)	OH (HRS)	Total Hours (DL+OH)	TOTAL COST*
SPRINT 0	**FALL 2017 WORK**	**23**	**0**	**59.5**	**82.5**	**$ 1,650.00**
	Product Research	3				$ 60.00
	Flow Chart	1				$ 20.00
	Beta	10				$ 200.00
	Weekly-Reports			0.75		$ 15.00
	Poster Project	5				$ 100.00
	Schematics	2				$ 40.00
	Diagrams	2				$ 40.00
	Research Paper			5		$ 100.00
	Customer Updates			0.75		$ 15.00
	Advisor Meetings			1.5		$ 30.00
	Team Meetings			50		$ 1,000.00
	Travel			1.5		$ 30.00
SPRINT 1	**Reading from Camera**	**0**	**0**	**0.5**	**0.5**	**$ 10.00**
	Capture image from a camera and store in variable					$ -
	Meet with Tribelhorn			0.5		$ 10.00
SPRINT 2	**Facial Recognition with specific outlining (head vs eye)**	**1**	**0**	**0.5**	**1.5**	**$ 30.00**
	Eyes Box	1				$ 20.00
	Meet with Tribelhorn			0.5		$ 10.00
SPRINT 3	**Gathering data from facial recognition**	**1.5**	**0**	**2.5**	**4**	**$ 80.00**
	Head Orientation					$ -
	Meet with Tribelhorn			1		$ 20.00
	Meet with Brett			1.5		$ 30.00
	Get Familiar with Dlib	1.5				$ 30.00
SPRINT 4	**Confidence level assessment**	**0.5**	**0**	**2**	**2.5**	**$ 50.00**
	Meet with Brett			1		$ 20.00
	Meet with Tribelhorn			1		$ 20.00
	Optimization	0.5				$ 10.00
SPRINT 5	**Optimization of algorithms**	**3.5**	**0**	**0**	**3.5**	**$ 70.00**
	Optimization Part2	0.5				$ 10.00
	Head Orientation	3				$ 60.00
SPRINT 6	**Outputting result**	**9**	**0**	**2**	**11**	**$ 220.00**
	2D to 3D Face Modeling	9				$ 180.00
	Meet with Brett			1		$ 20.00
	Meet with Tribelhorn			1		$ 20.00
SPRINT 7	**Buffer (in case of a delay)**	**7**	**0**	**4.5**	**11.5**	**$ 230.00**
	Test out different angles	3				$ 60.00
	Minor GUI Updates	1				$ 20.00
	Normalize Y-Axis	3				$ 60.00

*COST DETERMINED AT $20/HR

Figure 23 Waitt Hours Tracker 1/2

Member: Michael Waitt
Major(s): CS
Role: Fall Team Leader

UP Vision

Hours Tracker

Code Legend
Overhead - OH
Direct Labor - DL
Raw Materials - RM

	Research			1		$	20.00
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Travel			1.5		$	30.00
SPRINT 8	**Image Stabilization**	**8**	**0**	**2**	**10**	**$**	**200.00**
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Improve Face Detection	8				$	160.00
SPRING SPRINT		**0**	**0**	**0**	**0**	**$**	**-**
						$	-
SPRINT 9	**PowerPoint slides**	**1**	**0**	**5**	**6**	**$**	**120.00**
	Meet with Tribelhorn			1		$	20.00
	PowerPoint slides			3		$	60.00
	Fix Poster			1		$	20.00
	Activity Monitoring	1				$	20.00
SPRINT 10	**Presentation rehearsal. - Final report draft 1**	**0**	**0**	**5**	**5**	**$**	**100.00**
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Fix Slides			2		$	40.00
	Generate Data for Presentation			1		$	20.00
SPRINT 11	**Buffer (in case of a delay) / draft 2**	**0**	**0**	**9**	**9**	**$**	**120.00**
	Meet with Brett			1		$	20.00
	Meet with Tribelhorn			1		$	20.00
	Final Report			3		$	60.00
	Testing			3			
	Presentation Dry Run			1		$	20.00
TOTALS		**54.5**	**0**	**92.5**	**147**	**$**	**2,880.00**

*COST DETERMINED AT $20/HR

Figure 24 Waitt Hours Tracker 2/2

Conclusions and Recommendations

In conclusion, the team firmly believes that they have succeeded in everything that they set out to accomplish in this project. UPVision is now a fully functional fatigue-detection prototype that Hyster-Yale can improve upon and eventually implement as an option on their lineup of material-handling machinery. Some future improvements may include:

- Implementation of machine learning to train a face detection dataset that can ignore glare from safety glasses, detect partial faces, and better adapt to varied lighting conditions.
    - In this context, "partial faces" is simply referring to part of the face being in frame. UPVision currently requires all 68 points of the facial detection model to be in frame for any detection to reliably occur.
- Taking different facial structures into consideration, which can also be done with machine learning or adjustment of the software.
    - People who naturally have smaller eyes may be more susceptible to their fatigue level increasing.
- Try premium face detection libraries, such as Face++.
- Make use of accelerated hardware purpose-built for image processing, such as Intel Movidius.
- Closer integration with the existing Hyster-Yale forklift architecture to intervene in forklift operation if needed; and/or make use of Controller Area Network bus communication to directly communicate fatigue to a suprvisor.

Through this project the team learned many lessons, chief among which is the age-old cliché "don't reinvent the wheel." The team found that for many difficult aspects of the project,

specifically regarding face detection, it was much more simplistic to make use of pre-existing libraries rather than custom-building a computer vision system from scratch. Through leveraging wonderful tools such as Dlib, OpenCV, CMake, and among others, the team was able to create this prototype system with relative ease.

References

{In addition to references in the footnotes}

OpenCV - https://opencv.org/

Dlib - http://dlib.net/

Raspberry Pi Docs - https://www.raspberrypi.org/

Appendices

Appendix I – A3 Project Plan

A3 Project Plan	Project Title:	Team Members/Majors:		Faculty Advisor:	Industry Advisor:	Instructor:	REV NO./DATE
EGR 484	UP Vision Systems	Michael Waitt/Computer Science Kurtis Davidson/Computer Science Hashim Al Jawad/Computer Science Ibrahim Almubarak/Computer Science & Electrical Engineering Matt Erhardt/Electrical Engineering		Dr. Ben Tribelhorn	Jimmy Anderson, Brett Dunscomb of Hyster-Yale Group (Also our clients)	Christopher Galati	3, Jan 19, 2018

PROJECT DEFINITION: Vision System for Identifying and Escalating Forklift Operator Fatigue
Forklift operators work long shifts that are usually between 5-8 hours. They also must navigate small and sometimes packed spaces. This means that any mistake that the operator does could result in a major loss of merchandise and sometimes lives. To avoid such problems Hyster-Yale wants to take steps to aid the operators by making sure the operators are fit to operate the forklift. Our goal in doing this project is to minimize the potential for forklift collisions with merchandise and people, which will in result ensure the safety of both the operators and the merchandise.

ANALYSIS OF CURRENT CONDITION
Currently, supervisors of forklift operators have no way of assessing the fatigue levels of the operators that they are overseeing. Currently, there are some cars that consider the fatigue levels of the driver. When the car detects operator fatigue the steering wheel starts to vibrate in hopes of waking the operator. This is accomplished by sensing the cars movement through the road rather than focusing on the operator themselves. We hope to provide a framework for a solution to both problems by successfully providing a system for identifying and reporting operator fatigue.

PROJECT GOALS
We are going to provide various forms of cited research on similar modern systems, documentation of a framework for our solution, as well as a basic prototype of our solution by the end of the project. We also plan to explore some of the more ambitious solutions to the problem such as Artificial Intelligence or Computer Vision. Our main goal is not only to find a solution to the problem. but offer Hyster-Yale new areas in which they could further improve the product.
To measure the success of our driver fatigue assessment system, we will run various quality assurance tests to assure that our system identifies fatigue correctly and takes proper action to remedy the situation. Certain tests may include feeding the program imagery of different facial expressions and having it determine whether the person is fatigued or not. The tests suggested are not set in stone, the team might feel a different method of testing is more appropriate down the road.

RESOURCES REQUIRED
- Software framework for interaction with the basic functionality of a forklift
- a camera that is capable of recognizing facial features in scenarios with varied lighting
- Access to a forklift on-site at Hyster-Yale for use in testing the software
- **Proposed Budget: $600. Note that this is a rough estimate, and is largely subject to change**

ACTION PLAN (ACTIVITIES AND MILESTONES)

Project Goals/Deliverables	Actions/Metrics	Who	When
#1 – Alpha of Prototypes • An early draft of our software	• Ability to determine basic facial features reminiscent of fatigue • Testing methodology on how we will be performing our tests, and how we will be recording our observations	EE's handle electrical components CS handles software implementation	2/23/2018
#2 – Beta of Prototypes • An unpolished, but near complete, version of our software	• Ability to determine, and communicate in response to facial features reminiscent of fatigue • Defining safety parameters • Procedure and cost for implementation	EE's handle electrical components CS handles software implementation	3/25/2018
#3— Final Prototypes • The final polished version of our software	• Ability to determine, and communicate in response to facial features reminiscent of fatigue. Without fear of major software or electrical bugs.	EE's handle electrical components CS handles software implementation	4/3/2018

UNRESOLVED ISSUES
- The physical structure of a forklift differs from a car; Therefore, finding the optimal location for the camera and associated hardware is currently an unresolved issue.
- Whether to include machine learning when assessing the operator's eyes and head movement.
- The inclusion of a physical stabilization system.
- The number and types of cameras needed.

RESOLVED
- We are still unsure if we are designing something that will work on every forklift, or a specific model of forklift being tested on.
- Whether the forklifts have an API to interact with basic forklift functionality. If so, what is the required programming language? - -
- Also, do we want to control the forklift, or just have visual or audible indicator.
- If Hyster-Yale wishes to further improve on the product it can use the prototype provided as a basic framework and expand on it as needed, with higher complexity. For example, Hyster-Yale could also use our design, which is most likely going to be specific

FOLLOW-UP AND REVIEW
We will have measured the success of our finished product based off the client's satisfaction with the quality of our deliverables for both systems. A working prototype should be able to, at minimum, determine and report the fatigue level of the operator. Optimal feedback would be from forklift operators, since they are the target demographic. We hope to offer them incremental updates so that we could adjust appropriately to feedback. Another important metric is how intrusive the device is. We want to avoid making the operators uncomfortable by the device, because that could potentially lead to a worse working environment.

Appendix II – Team Weekly Reports Fall

Weekly Report 1

UP Vision Systems Check-in #1

This Week

This week's check-in will be brief, as we essentially have just laid the foundation for what's to come. This week, we have selected our team's personnel, and have begun initial contact with our industry/faculty advisors. Also, we have set up times with our faculty advisor to meet weekly. Our personnel is as follows:

Team Lead (Fall): Michael Waitt
Team Lead (Spring): Ibrahim Almubarak
Chief Operations Officer: Hashim Al Jawad
Chief Financial Officer: Matt Erhardt
Director of Information Technology: Kurtis Davidson

Next Week

By next week's check-in, we hope to have an initial meeting scheduled with our clients/Industry Advisors at Hyster-Yale to discuss the project scope. This meeting will be key to officially beginning work on this project. Also, we will be working closely with our CFO Matt Erhardt to get the first draft of a budget completed.

We are on-budget, and the project is certainly on the right track.

Signed,
Michael Waitt
Fall Team Lead
UP Vision Systems

Weekly Report 2

University of Portland

Name Ibrahim Team Vision system

Weekly Report-Out

Today's Date: 9/15/2017

1 What commitments have you completed since our last check-in?
(let others know you've kept your commitments, declare work "done" so it can be accepted)

Customer	Commitment/Hours Expended
NA	Coming up with a team name, and a site domain. 1 H
NA	Design a website. 2-6 Hours
NA	Picked a team leader and assigned roles
NA	Met with our faculty Advisor. 2
NA	Contacted the Industry advisor to set up a meeting

2 What work will you complete this week (by our next session)?
(let others know what they can depend on)

Customer	Commitment/Hours Anticipated
NA	Meet with Industry advisor.
NA	Decide on the scope of the project
NA	Make a budget.
NA	Come up with functional specs if possible

3 What constraints are keeping you from getting your work done?
(ask for help, declare a breakdown, raise concerns...)

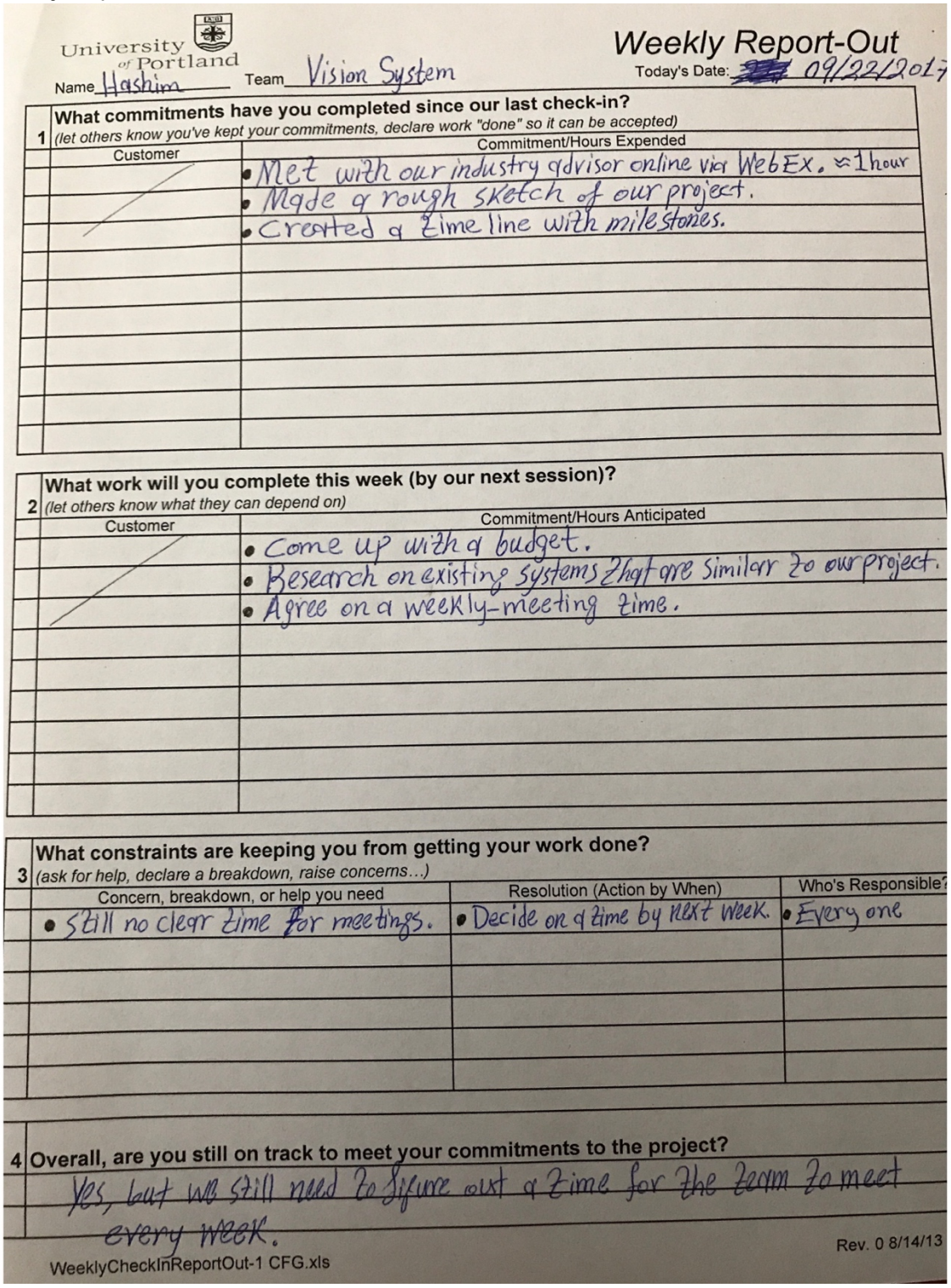
Concern, breakdown, or help you need	Resolution (Action by When)	Who's Responsible?
- No clear time for meetings	Come up with a time	Everyone
- Meeting with Industry Advisor ASAP	Video Confrence by Friday	Everyone

4 Overall, are you still on track to meet your commitments to the project?

Yes, but we need to communicate more, and find a time to meet every week

WeeklyCheckInReportOut-1 CFG Rev. 08/14/13

Weekly Report 3



University of Portland

Name Hashim Team Vision System

Weekly Report-Out

Today's Date: 09/22/2017

1 What commitments have you completed since our last check-in?
(let others know you've kept your commitments, declare work "done" so it can be accepted)

Customer	Commitment/Hours Expended
	• Met with our industry advisor online via WebEx. ≈1hour
	• Made a rough sketch of our project.
	• Created a time line with milestones.

2 What work will you complete this week (by our next session)?
(let others know what they can depend on)

Customer	Commitment/Hours Anticipated
	• Come up with a budget.
	• Research on existing systems that are similar to our project.
	• Agree on a weekly-meeting time.

3 What constraints are keeping you from getting your work done?
(ask for help, declare a breakdown, raise concerns…)

Concern, breakdown, or help you need	Resolution (Action by When)	Who's Responsible?
• Still no clear time for meetings.	• Decide on a time by next week.	• Every one

4 Overall, are you still on track to meet your commitments to the project?

Yes, but we still need to figure out a time for the team to meet every week.

WeeklyCheckInReportOut-1 CFG.xls Rev. 0 8/14/13

Weekly Report 4

University of Portland

Weekly Report-Out

Name Kurtis Davidson Team Vision Systems Today's Date: 04/29/17

1 What commitments have you completed since our last check-in?
(let others know you've kept your commitments, declare work "done" so it can be accepted)

Customer	Commitment/Hours Expended
n/a	This week we looked into image processing libraries. We believe we will be using open source libraries for example possibly OpenCV or one of Intels other products that works with OpenCV. Both of the libraries are free since they are Open source. We also completed our budget and list of things that we'll be using to make our product. This includes our cameras, miniature computer and cables.

2 What work will you complete this week (by our next session)?
(let others know what they can depend on)

Customer	Commitment/Hours Anticipated
n/a	By our next session we will have met our industry advisor, Brett Dunscomb, have seen the Hyster-Yale facility and get an idea of where our product will be put due to us also looking at the forklifts as well. We will also be ready to purchase our tools and materials that will be in our product due to us finishing our budget.

3 What constraints are keeping you from getting your work done?
(ask for help, declare a breakdown, raise concerns...)

Concern, breakdown, or help you need	Resolution (Action by When)	Who's Responsible?
Meeting times are still hard to decide upon but we have an idea of a time that would work for mostly everyone.	Meeting on Thursday's in the morning around 9:30 a.m.. This will be resolved by the end of this week as we will have more time to discuss a time together	Everyone

4 Overall, are you still on track to meet your commitments to the project?

We believe we are still on track due to our communication with each other for individual research and work on the project.

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Weekly Report 5

Weekly Report-Out

Name Matt Erhardt Team Vision System Today's Date: 10/6/17

1 What commitments have you completed since our last check-in?
(let others know you've kept your commitments, declare work "done" so it can be accepted)

Customer	Commitment/Hours Expended
	• Toured Hyster facility and spoke with industry advisor about project ≈ 2 hrs
	• Checked-In with faculty advisor

2 What work will you complete this week (by our next session)?
(let others know what they can depend on)

Customer	Commitment/Hours Anticipated
	• Finalize Budget
	• Agree on a weekly-meeting time

3 What constraints are keeping you from getting your work done?
(ask for help, declare a breakdown, raise concerns...)

Concern, breakdown, or help you need	Resolution (Action by When)	Who's Responsible?
• No clear meeting time for group	• Decide by Fall Break	Whole Group

4 Overall, are you still on track to meet your commitments to the project?

Yes, our project is still following our schedule.

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Weekly Report 6

University of Portland

Name Michael Waitt Team UP Vision System Today's Date 10/11/17

1 What commitments have you completed since our last check-in?
(let others know you've kept your commitments, declare work "done" so it can be accepted)

Customer	Commitment/Hours Expended
	- Updated our A3 to reflect change in scope
	- Research on existing systems
	- Met with faculty advisor

2 What work will you complete this week (by our next session)?
(let others know what they can depend on)

Customer	Commitment/Hours Anticipated
	- Documentation of hardware/software requirements
	- Finalizing research on existing systems (All of us)
	- Begin experimenting with image processing libraries in C/C++. (All of us)
	- Work on finalizing the budget (Matt)

3 What constraints are keeping you from getting your work done?
(ask for help, declare a breakdown, raise concerns...)

Concern, breakdown, or help you need	Resolution (Action by When)	Who's Responsible?
Waiting on approval of budget	After fall break	SSOE
Finding a good meeting time	ASAP	The team

4 Overall, are you still on track to meet your commitments to the project?

Yes, we are absolutely on track, maybe even ahead of schedule.

WeeklyCheckInReportOut-1 CFG.xls Rev. 0 8/14/13

Weekly Report 7

University of Portland

Weekly Report-Out

Name Ibrahim Team Vision - System Today's Date: _____

1 What commitments have you completed since our last check-in?
(let others know you've kept your commitments, declare work "done" so it can be accepted)

Customer	Commitment/Hours Expended
	1- Created a document for the software/hardware requirement
	2- Ordered the parts for the project
	3- Contacted the industry advisor asking for specs
	4- Planned the exterior structure of the device

2 What work will you complete this week (by our next session)?
(let others know what they can depend on)

Customer	Commitment/Hours Anticipated
	- Design a UML diagram
	- Design an LED Array with a button
	- Start experimenting with image processing
	.

3 What constraints are keeping you from getting your work done?
(ask for help, declare a breakdown, raise concerns…)

Concern, breakdown, or help you need	Resolution (Action by When)	Who's Responsible?
Waiting on Amazon delivery		Amazon

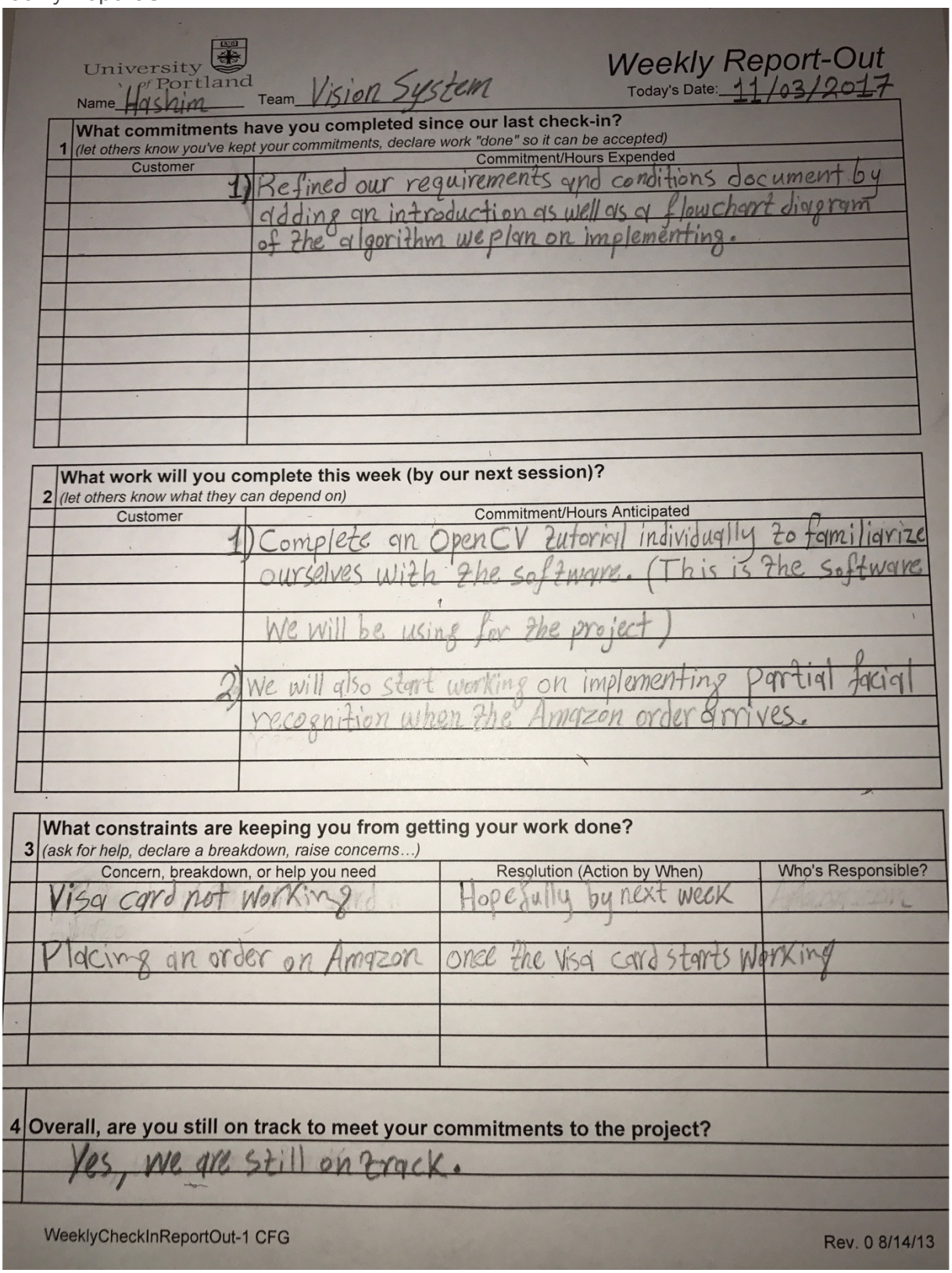
4 Overall, are you still on track to meet your commitments to the project?

Yes, we are actually ahead.

Rev. 0 8/14/13

WeeklyCheckInReportOut-1 CFG.xls

Weekly Report 8



University of Portland

Weekly Report-Out

Name Hashim Team Vision System Today's Date: 11/03/2017

1 What commitments have you completed since our last check-in?
(let others know you've kept your commitments, declare work "done" so it can be accepted)

Customer	Commitment/Hours Expended
	1) Refined our requirements and conditions document by adding an introduction as well as a flowchart diagram of the algorithm we plan on implementing.

2 What work will you complete this week (by our next session)?
(let others know what they can depend on)

Customer	Commitment/Hours Anticipated
	1) Complete an OpenCV tutorial individually to familiarize ourselves with the software. (This is the software we will be using for the project)
	2) We will also start working on implementing partial facial recognition when the Amazon order arrives.

3 What constraints are keeping you from getting your work done?
(ask for help, declare a breakdown, raise concerns…)

Concern, breakdown, or help you need	Resolution (Action by When)	Who's Responsible?
Visa card not working	Hopefully by next week	
Placing an order on Amazon	once the visa card starts working	

4 Overall, are you still on track to meet your commitments to the project?

Yes, we are still on track.

WeeklyCheckInReportOut-1 CFG Rev. 0 8/14/13

Weekly Report 9

University of Portland

Weekly Report-Out

Name Kurtis Davidson Team Vision system Today's Date: 11/10/17

1 What commitments have you completed since our last check-in?
(let others know you've kept your commitments, declare work "done" so it can be accepted)

Customer	Commitment/Hours Expended
1)	Tested OpenCV's facial recognition examples to learn how OpenCV works. Reviewed OpenCV API and learned how to replicate the examples by ourselves to get more accustomed to the API.
2)	Bought the Raspberry Pi board and have received the board which will soon be worked on to get it up and running.

2 What work will you complete this week (by our next session)?
(let others know what they can depend on)

Customer	Commitment/Hours Anticipated
1)	Setup Raspberry Pi board and get accustomed to using the Pi's interface since it uses Linux.
2)	Work with OpenCV more to get more adjusted to the API.

3 What constraints are keeping you from getting your work done?
(ask for help, declare a breakdown, raise concerns...)

Concern, breakdown, or help you need	Resolution (Action by When)	Who's Responsible?
Since the order arrived a bit later than we anticipated due to the visa card not working we must expedite our learning of the OpenCV API. This will then allow us to work on the Raspberry Pi.	Learn OpenCV's key API points by next week.	

4 Overall, are you still on track to meet your commitments to the project?

Yes we're still on track

Weekly Report 10

Weekly Report 11

University of Portland

Weekly Report-Out

Name Michael Waitt Team_UPVIsion___ Today's Date:_ 11/30/2017

	What commitments have you completed since our last check-in? *(let others know you've kept your commitments, declare work "done" so it can be accepted)*	
1	Customer	Commitment/Hours Expended
	UPVision Team	We have completed the second draft of our posterboard and are ready to present it this week.
	Everyone involved	We are going to get OpenCV installed on the Raspberry Pi tomorrow as a team.
	UPVision Team, Prof. Galati	We are very close to having a rough draft of our semester draft report.
	UPVision Team	Ordered and received our camera.

	What work will you complete this week (by our next session)? *(let others know what they can depend on)*	
2	Customer	Commitment/Hours Anticipated
	UPVision Team	We will have a working demo of facial recognition software to serve as a visual aid during our
		posterboard session, and to serve as the foundation for our software going forward.
	UPVision Team	We will have our semester draft report completed.

	What constraints are keeping you from getting your work done? *(ask for help, declare a breakdown, raise concerns…)*		
3	Concern, breakdown, or help you need	Resolution (Action by When)	Who's Responsible?
	Our camera is insuffficient, we need to order a better one	Next Semester	UPVision Team
	Vibration of camera/Image stabilization	Next Semester	UPVision Team

	Overall, are you still on track to meet your commitments to the project?
4	Absolutely. I have complete confidence in our team's ability to complete the project on time.

Appendix III – Team Weekly Reports Spring

Spring Weekly Report 1

Project Title: UP Vision System

Team Members: Michael Waitt, Kurtis Davidson, Hashim Aljawad, Matt Erhardt, Ibrahim Almubarak

Project Definition	Project Goals	Progress Against Goals	Comments
Forklift operators work long shifts that typically range between 8-12 hours. They also must navigate small, packed spaces. This means that any mistake that the operator does could result in injury or a major loss of merchandise. To avoid such problems, Hyster-Yale wants to take steps to aid the operators by making sure that they are fit to operate the forklift at all times. The goal of this project is to minimize the potential for forklift collisions with merchandise and people, which will, in result, ensure both the safety of forklift operators and the company's goods.	to provide various forms of cited research on similar modern systems, documentation of a framework for our solution, as well as a basic prototype of our solution by the end of the project. We also plan to explore some of the more ambitious solutions to the problem such as Artificial Intelligence or Computer Vision. Our main goal is not only to find a solution to the problem, but offer Hyster-Yale new areas in which they could further improve the product.	The biggest hurdle currently, is coming up with an algorithm for detecting specific parts of the face. This will need to be done by the end of February. Therefore, most of the resources are dedicated to that task specifically. The access to lab concern has been dealt with by team leader, which means the algorithm is the main concern at this point	The project seems to be progressing as planned. The team seems to be enthusiastic. Everyone has a specific task and knows exactly what and when are things due.

Goal/Deliverable	Activities	Responsible Performer	PTD Results (Dates) Target	Actual	Comments/Concerns	Next Steps
Getting access to the EE Lab	Meet with EE technician	Everyone	01/26/18	01/25/18	The team met with the EE lab technician and went through the safety procedures. Also, the team was able to get access to the lab. Therefore, this task is complete	Build the circuit for EE part of the project.
Facial Recognition software	Create a C++ Project. That can capture and store pictures from a camera	CS Team : Michael waitt - Hashim Aljawad - Kurtis Davidson - Ibrahim Almubarak	01/25/18	01/22/18	The CS team created the project and right now it is capable of recording pictures and videos and storing them. The team is ready for the next step	Outline facial features like eyes and head orientation.
Facial Recognition software	Outline facial features.	CS Team : Michael waitt - Hashim Aljawad - Kurtis Davidson - Ibrahim Almubarak	02/07/18		The team decided on splitting the facial recognition part into 3 parts. The first is outlining and detecting the face. The second part, tracking the eyes. Last part, determining the head orientation. All parts are being tackled by a member of the team. currently, Ibrahim &Hashim are working on the first part. While Michael is working on the eye tracking. Finally, Kurtis is working on the head orientation.	Calculating a confidence level for the drowsiness of the operator.
Meeting with Dr. Tribelhorn	First meeting with Dr.Tribelhorn	Everyone	01/26/18	01/28/18	The team met with Dr.Tribelhorn. In the meeting, the team discussed the structure of the software. The team decided to go with Dr. Tribelhorn's suggestion. Dr.Tribelhorn offered to help any group on a specific task if they ever need to. Finally, the meeting concluded with coming up with tasks for next week.	To meet with Dr.Tribelhorn next week on Wed.
CAD schematic for the exterior case	Use CAD to design an exterior case to ensure no outside interaction with the hardware	EE Team: Matt Erdhardt - Ibrahim Almubarak	02/07/18		The EE team needs to take into account, that the camera is going to be mounted somewhere on the forklift. Also, the button needs to be easily accessible in order not to cause accidents.	Physically building the exterior case.
Meeting with Dr. Tribelhorn	Second meeting with Dr.Tribelhorn	Everyone	02/31/18	02/31/18	In this meeting with Dr.Tribelhorn we discussed the following: 1- We are going to use a new API called Dlib to detect facial features. 2- We reviewed some ways to organize the team over Trello 3- We expressed our concerns in coming up with an efficient algorithm and Dr.Tribelhorn offered to help with offering resources. 4- He wanted us to keep track of the number of hours spent on any tasks, and to predict how much hours a task will take.	Learning Dlib quick enough to get back on schedule

Spring Weekly Report 2

Project Title: UP Vision System

Team Members: Michael Waitt, Kurtis Davidson, Hashim Aljawad, Matt Erhardt, Ibrahim Almubarak

Project Definition	Project Goals	Progress Against Goals	Comments
Forklift operators work long shifts that typically range between 8-12 hours. They also must navigate small, packed spaces. This means that any mistake that the operator does could result in injury or a major loss of merchandise. To avoid such problems, Hyster-Yale wants to take steps to aid the operators by making sure that they are fit to operate the forklift at all times. The goal of this project is to minimize the potential for forklift collisions with merchandise and people, which will, in result, ensure both the safety of forklift operators and the company's goods.	to provide various forms of cited research on similar modern systems, documentation of a framework for our solution, as well as a basic prototype of our solution by the end of the project. We also plan to explore some of the more ambitious solutions to the problem such as Artificial Intelligence or Computer Vision. Our main goal is not only to find a solution to the problem, but offer Hyster-Yale new areas in which they could further improve the product.	The current main obstacle is finding a way to improve the framerate. We are working on multiple solutions and have already involved the faculty advisor.	This week the group made a huge progress towards an alpha release. Everything seems to be going according to plan so far. There was a bit of a delay last week but that was resolved this week.

Goal/Deliverable	Activities	Responsible Performer	PTD Results (Dates) Target	PTD Results (Dates) Actual	Comments/Concerns	Next Steps
Building a circuit	Order the parts required	EE Team: Matt Erdhardt	02/12/18		The parts that we need are as follows: three led lights, a breadboard, and 3 resistors. Matt is already working on it. He is making sure that the parts we order fit out measurements for the CAD drawings. Since we are waiting for the final sketch this task might get pushed back a little bit longer	Physically build the circuit
Facial Recognition software	Connect Dlib with videosteaming	CS Team	02/07/18	02/05/18	Dlib is now connected to video streaming. The facial features are stored in a vector of rectangles. The system seems to be running at 8-10 frames per second which is troubling since blinking rate requires more frames	Use blinking rate to determine the level of fatigue
Facial Recognition software	Detecting blinking rate	CS Team : Hashim Aljawad - Ibrahim Almubarak	02/14/18	02/07/18	Due to the change in API, the team was given an extra week to work on this. The team is coming up with different ideas, but it seems that we underestimated the time we need. We are going to keep updating the schedule with the new deadline. Also, we split the task into two separate tasks. UPDATE(2/08/2018): Hashim was able to get the blinking rate to work, and to print out the results on the screen.	Calculating a confidence level for the drowsiness of the operator.
Facial Recognition software	Detecting Head orientation pt1	CS Team: Michael waitt - Kurtis Davidson	02/14/18	02/06/18	The head orientation part. Micael and Kurtis are working on a solution. They are considering scanners like algorithm, or through the distance between nose position and eyes and ears. UPDATE(02/08/2018): Michael was able to detect the orientation horizontally (left-right) He and Kurtis are now working on a vertical orientation(up and down). Kurtis also expressed the need to get the camera mounting position ASAP. This is due to the head orientation being very dependent on the angle of the camera.	Use head orientation to determine operator fatigue
CAD schematic for the exterior case	Use Solidworks to design an exterior case to ensure no outside interaction with the hardware	EE Team: Matt Erdhardt - Ibrahim Almubarak	02/07/18	02/06/18	The EE team needs to take into account, that the camera is going to be mounted somewhere on the forklift. Also, the button needs to be easily accessible in order not to cause accidents.	Physically building the exterior case.
Meeting with Faculty Advisor	Thrid Meeting with Dr.Tribelhorn	Everyone	02/07/18	02/07/18	Every team member needs to write a quick summary of what they accomplished over the week. Everyone will also need to do a quick stand up of what they did over the week. MEETING REPORT: In the meeting, we discussed the tasks that we completed. We also told Dr.Tribelhorn about the low framerate and he offered some guidance on how to deal with it. One idea he proposed was to scale it down and crop it. He also wanted a picture of the demo we are going to show to our industry advisor by Monday.	Meet with Dr.Tribelhorn
Meeting with Industry Advisor	First meeting with Industry Advisor	Everyone	02/05/18	02/05/18	The team met with the industry advisor in the meeting he expressed his willingness to help with the operation. The team updated him on the current state of the project and asked for feedback about the schedule and the weekly report. He expressed satisfaction at the pace the project is going he also wanted a demo by next Monday.	Meet with Industry advisor next Monday and show him a demo
Creating a Graphical User Interface	Create a simple userinterface	CS Team: Michael waitt	03/06/18	02/06/18	Michael was able to get a headstart on the GUI. He created a basic user interface that outputs information for the user. This gave us a huge boost in term of the overall completeness of the project. We will keep improving the UI with each iteration of the program	Improve the UI.

Project Title: UP Vision System			Team Members: Michael Waitt, Kurtis Davidson, Hashim Aljawad, Matt Erhardt, Ibrahim Almubarak			
Project Definition			Project Goals		Progress Against Goals	Comments
Forklift operators work long shifts that typically range between 8-12 hours. They also must navigate small, packed spaces. This means that any mistake that the operator does could result in injury or a major loss of merchandise. To avoid such problems, Hyster-Yale wants to take steps to aid the operators by making sure that they are fit to operate the forklift at all times. The goal of this project is to minimize the potential for forklift collisions with merchandise and people, which will, in result, ensure both the safety of forklift operators and the company's goods.			to provide various forms of cited research on similar modern systems, documentation of a framework for our solution, as well as a basic prototype of our solution by the end of the project. We also plan to explore some of the more ambitious solutions to the problem such as Artificial Intelligence or Computer Vision. Our main goal is not only to find a solution to the problem, but offer Hyster-Yale new areas in which they could further improve the product.		Even though this week we had a set back in terms of development due to the need to improve the frame rate, we are still on track to make every deadline. we will, however, need to dedicate extra development hours in the upcoming week to make up for the lost time. Secondly, we have dealt with the main constraint that would have caused us to miss our deadlines. Therefore, there are currently no constraints keeping us from our goals.	This week the group focused mainly on the frame rate and the CAD drawings. The frame rate issue has been dealt with and the CAD drawings are set for this upcoming Monday
Goal/Deliverable	Activities	Responsible Performer	PTD Results (Dates)		Comments/Concerns	Next Steps
			Target	Actual		
Building a circuit	Order the parts required	EE Team: Matt Erdhardt -Ibrahim Almubarak	02/12/18	02/15/18	The parts that we need are as follows: three led lights, a breadboard, and 3 resistors. Matt is already working on it. He is making sure that the parts we order fit out measurements for the CAD drawings. Since we are waiting for the final sketch this task might get pushed back a little bit longer. UPDATE(2/15/2018): There was a delay in ordering the parts because we needed to get the CAD drawings done first.	Physically build the circuit
Meeting with Industry Advisor	Second meeting with the Industry Advisor	Everyone	02/12/18	02/12/18	The team showed the industry advisor a live demo of the facial recognition. The team discussed the need to improve the frame rate in order to have better results. The industry advisor offered multiple suggestions on how optimize the software. These include the use of a thread in order to separate the drawing of the GUI from the actual face detection process. He also, offered to take a look at the actual code and possibly give us feedback in that regards.	Meet with industry advisor next Monday
Meeting with Faculty Advisor	Fourth Meeting with Dr.Tribelhorn	Everyone	02/14/18	02/14/18	The meeting was canceled by Dr.tribelhorn. However, we followed his advice from last week and improved the frame rate. We did however update Dr.Tribelhorn on the current state of the project through email.	Meet with Dr.Tribelhorn
CAD schematic for the exterior case	Use Solidworks to design an exterior case to ensure no outside interaction with the hardware	EE Team: Matt Erdhardt - Ibrahim Almubarak	02/16/18		The EE team needs to take into account, that the camera is going to be mounted somewhere on the forklift. Also, the button needs to be easily accessible in order not to cause accidents. UPDATE(2/15/2018): The design was not proportionally correct and had to be revised. This will be done by Monday.	Physically building the exterior case.
Facial Recognition software	Calculating the Confidence Level	CS Team : Ibrahim Almubarak	02/21/18		The software is able to detect blinking and head orientation. Both features are very basic at this point, but they can be used to complete the alpha stage of our program. In the meantime, EE parts should be ready for a complete alpha demo.	Improve the blinking detection and head orientation.
Optimization	Improve the framerate	CS Team : Michael Waitt	02/21/18	02/14/18	The software runs at 7 frames/seconds, which is lower than the minimum recommended amount for the detection of eye blinking. Therefore the software needs to be optimized to run at 10 frames/second or faster. UPDATE(2/15/2018) Michael was able to improve the framerate to around 17 frames/second. This also improved the eye blinking rate detection.	Calculating a confidence level for the drowsiness of the operator.
Facial Recognition software	Detecting Head orientation pt2	CS Team: Kurtis Davidson - Ibrahim Almubarak -Michael Waitt - Hashim Aljawad	02/21/18		The basic orientation detector is fairly simple in terms of orientation that it can detect. Part 2 will improve that by detecting the up and down orientations.	Use head orientation to determine operator fatigue
Creating a Graphical User Interface	Improving the user interface	CS Team:	03/05/18		This task was put on a hold this week because of the immediate need to improve the frame rate. It will, however, be addressed in the upcoming week. Note: This task is set for March so, we are way ahead of schedule.	Improve the UI.
Facial Recognition software	Calculating how long does each blink lasts	CS Team: Hashim Aljawad	03/21/18		After calculating the blinking rate, we need to determine the length of each blink. Blinking a lot is not a definite indicator of drowsiness. Therefore, we need to determine how long does each blink last.	Calculate the confidence level.

Spring Weekly Report 4

Project Title: UP Vision System

Team Members: Michael Waitt, Kurtis Davidson, Hashim Aljawad, Matt Erhardt, Ibrahim Almubarak

Project Definition	Project Goals	Progress Against Goals	Comments
Forklift operators work long shifts that typically range between 8-12 hours. They also must navigate small, packed spaces. This means that any mistake that the operator does could result in injury or a major loss of merchandise. To avoid such problems, Hyster-Yale wants to take steps to aid the operators by making sure that they are fit to operate the forklift at all times. The goal of this project is to minimize the potential for forklift collisions with merchandise and people, which will, in result, ensure both the safety of forklift operators and the company's goods.	to provide various forms of cited research on similar modern systems, documentation of a framework for our solution, as well as a basic prototype of our solution by the end of the project. We also plan to explore some of the more ambitious solutions to the problem such as Artificial Intelligence or Computer Vision. Our main goal is not only to find a solution to the problem, but offer Hyster-Yale new areas in which they could further improve the product.	When we completed the alpha stage, we realized we need to model the face in 3D in order to accurately determine orientation. The main problem is depth. When looking at a 2D image, it is common to focus on the x and y-direction while forgetting the z-direction. Depth is very important in our project because based on the movement of the operator our baseline for detecting head movement could be completely wrong. Therefore we can either consider this as a constraint and throw in the towel or convert the 2D face into a 3D model and use the 3D model to determine orientation.	This week the group reached a huge milestone. Alpha stage is officially complete. The software is able to detect the duration of each blink and the head orientation. Using this information the software is then able to calculate a confidence level of how drowsy the operator is.

Goal/Deliverable	Activities	Responsible Performer	PTD Results (Dates) Target	PTD Results (Dates) Actual	Comments/Concerns	Next Steps
Meeting with Industry Advisor	Third meeting with the Industry Advisor	Everyone	02/19/18	02/19/18	The meeting was postponed to next week.	Meet with industry advisor next Monday
CAD schematic for the exterior case	Use Solidworks to design an exterior case to ensure no outside interaction with the hardware	EE Team: Matt Erdhardt	02/16/18	02/19/18	The EE team needs to take into account that the camera is going to be mounted somewhere on the forklift. Also, the button needs to be easily accessible in order not to cause accidents. UPDATE(2/15/2018): The design was not proportionally correct and had to be revised. This will be done by Monday. UPDATE(2/22/18) The schematic is complete and will be presented to the industry advisor next week.	Physically building the exterior case.
Meeting with Faculty Advisor	Fourth Meeting with Dr. Tribelhorn	Everyone	02/21/18	02/21/18	The meeting was postponed to next week.	Meet with Dr. Tribelhorn
Facial Recognition software	Detecting Head orientation pt2	CS Team: Kurtis Davidson - Ibrahim Almubarak - Michael Waitt - Hashim Aljawad	02/21/18	02/21/18	The basic orientation detector is fairly simple in terms of orientation that it can detect. Part 2 will improve that by detecting the up and down orientations. UPDATE(02/22/18) Two major updates: first a basic version of the head orientation has been implemented and currently running. Second, the basic algorithm outlined the need to model this in 3D in order to take into account the depth.	Use head orientation to determine operator fatigue
Facial Recognition software	Calculating the Confidence Level	CS Team : Ibrahim Almubarak	02/21/18	02/21/18	The software is able to detect blinking and head orientation. Both features are very basic at this point, but they can be used to complete the alpha stage of our program. In the meantime, EE parts should be ready for a complete alpha demo. UPDATE(2/22/18) a very basic algorithm for detecting fatigue has been implemented which signals the end of the alpha stage and the beginning of the beta stage.	Improve the blinking detection and head orientation.
Facial Recognition software	Calculating how long does each blink lasts	CS Team: Hashim Aljawad	03/21/18	02/21/18	After calculating the blinking rate, we need to determine the length of each blink. Blinking a lot is not a definite indicator of drowsiness. Therefore, we need to determine how long does each blink last. UPDATE(02/22/18) Hashim has completed the task. The software is able to detect how long does each blink lasts and was used to calculate confidence level. This stage is done.	Calculate the confidence level.
Building a circuit	Building the circuit	EE Team: Matt Erdhardt -Ibrahim Almubarak	02/28/18		Since the parts have arrived and with current CAD Schematic done. The circuit is ready to be built. It is expected to be done next Wednesday	Test the Circuit
Optimization	Optimization Pt2	CS Team : Michael Waitt	02/28/18		The software still needs to be optimized since it runs extermely slow on a the raspberry pi. It also needs to take into account that we are looking into 2D to 3D face modeling which might be tasking on the cpu	Calculating a confidence level for the drowsiness of the operator.
Creating a Graphical User Interface	Improving the user interface	CS Team:	03/06/18		This task was but on a hold this week because of the immediate need to improve the frame rate. It will, however, be addressed in the upcoming week. Note: This task is set for March so, we are way ahead of schedule. UPDATE(2/22/2018) Task was is still on hold for the time being.	Improve the UI.
2D - 3D Face modeling	Convert a 2D face into a 3D face	CS Team: Kurtis Davidson - Ibrahim Almubarak	03/06/18		The group realized that in order to have a proper head orientation detection some parts of the face needs to be modeled in 3D. The first step is converting from 2D to 3D	Calculate rotation of the head.

Project Title: UP Vision System	Team Members: Michael Waitt, Kurtis Davidson, Hashim Aljawad, Matt Erhardt, Ibrahim Almubarak

Project Definition	Project Goals	Progress Against Goals	Comments
Forklift operators work long shifts that typically range between 8-12 hours. They also must navigate small, packed spaces. This means that any mistake that the operator does could result in injury or a major loss of merchandise. To avoid such problems, Hyster-Yale wants to take steps to aid the operators by making sure that they are fit to operate the forklift at all times. The goal of this project is to minimize the potential for forklift collisions with merchandise and people, which will, in result, ensure both the safety of forklift operators and the company's goods.	to provide various forms of cited research on similar modern systems, documentation of a framework for our solution, as well as a basic prototype of our solution by the end of the project. We also plan to explore some of the more ambitious solutions to the problem such as Artificial Intelligence or Computer Vision. Our main goal is not only to find a solution to the problem, but offer Hyster-Yale new areas in which they could further improve the product.	After having the case completed, the group will need to decide on a mounting position inside the forklift. The camera has to be mounted in a position that does not obstruct the forklift operator's path. However, our algorithm does not work properly unless it is placed in a position directly in front of the operator. Therefore, we need to ensure that our camera works from different angles by generating training data for detecting head and eye movement from different angles.	This week the group finished the CAD drawings for the case that will hold the Raspberry PI and camera, the buttons, and the LED lights. The group explored a few different options for making the case such as 3D printing or laser cutting a box out of wood or acrylic. The team also made progress towards increasing the accuracy of the head orientation algorithm. Everything seems to be going according to schedule even with minor setbacks stated below.

Goal/Deliverable	Activities	Responsible Performer	PTD Results (Dates)		Comments/Concerns	Next Steps
			Target	Actual		
Meeting with Industry Advisor	Fourth meeting with the Industry Advisor	Everyone	02/26/18	02/26/18	Met with Industry Advisor and gave a demo of the current alpha stage. The team also requested to visit the facility in order to do angle measurements related to facial recognition. The team also received feedback in regards to building a case for industrial usage.	Meet with industry advisor next Monday
Meeting with Faculty Advisor	Fourth Meeting with Dr.Tribelhorn	Everyone	02/28/18	02/28/18	In this meeting, the team gave a demo to Dr.Tribelhorn and he seemed to be pleased with the progress that was made. Dr.Tribelhorn offered suggestions in terms of how to improve the accuracy of the head orientation detection. He also offered advice on additional metrics for determining fatigue. He suggested that the confidence level calculation should be done through a machine learning of some sort.	Meet with Dr.Tribelhorn
Building a circuit	Building the circuit	EE Team: Matt Erdhardt -Ibrahim Almubarak	02/28/18	03/01/18	Since the parts have arrived, and with current CAD Schematic done, the circuit is ready to be built. It is expected to be done next Wednesday. UPDATE (03/1/2018): The circuit will be built on Friday 03/02/2018.	Test the Circuit
Optimization	Optimization Pt2	CS Team : Hashim Aljawad	03/07/18		The software still needs to be optimized since it runs extremely slow on a raspberry pi. It also needs to take into account that we are boking into 2D to 3D face modeling which might be tasking on the CPU. UPDATE(03/01/2018): With the suggestions from the faculty advisor, this was pushed another week in order to corporate the suggestion discussed in the meeting.	Improve the framerate even further
Creating a Graphical User Interface	Improving the user interface	CS Team:	03/05/18		This task was put on a hold this week because of the immediate need to improve the frame rate. It will, however, be addressed in the upcoming week. Note: This task is set for March so, we are way ahead of schedule. UPDATE(2/22/2018) Task was is still on hold for the time being. UPDATE(03/1/2018) This is becoming less and less of a priority unless someone volunteer to improve it. The task might be scraped completely	Improve the UI.
2D - 3D Face modeling	Convert a 2D face into a 3D face	CS Team: Kurtis Davidson - Ibrahim Almubarak	03/05/18		The group realized that in order to have a proper head orientation detection some parts of the face needs to be modeled in 3D. The first step is converting from 2D to 3D. UPDATE(03/1/2018): The team will move away from this task in favor of a faster and more efficient method.	Calculate rotation of the head.
Head orientation detection	Normalization of the face box	CS Team: Kurtis Davidson-Ibrahim Almubarak- Michael Waitt - Hashim Aljawad	03/07/18		In order to get more accurate data the calculated data for the movement of the head in the y-axis needs to be normalized in order to account for the z-direction.	Calculate a confidence level based on the normalized values
Calculating the confidence level	Print Time stamp analysis	CS Team : Michael Waitt - Ibrahim Almubarak - Hashim Aljawad - Kurtis Davidson	03/07/18		In order to be more accurate with the confidence level calculation and to account for more variables, the team is going to print out a text file that contains the time-stamped analysis of a video of someone falling asleep. In order to look into machine learning.	Run the test data through a machine learning algorithm
Mounting position	Visit Hyster-Yale's facility	Everyone	03/07/18		In order to pick the most optimal mounting position. The team will need to visit the Hyster-yale facility and test out the code in an actual forklift.	Modify the code to account for the new angle

Spring Weekly Report 6

Project Title: UP Vision System

Team Members: Michael Waitt, Kurtis Davidson, Hashim Aljawad, Matt Erhardt, Ibrahim Almubarak

Project Definition	Project Goals	Progress Against Goals	Comments
Forklift operators work long shifts that typically range between 8-12 hours. They also must navigate small, packed spaces. This means that any mistake that the operator does could result in injury or a major loss of merchandise. To avoid such problems, Hyster-Yale wants to take steps to aid the operators by making sure that they are fit to operate the forklift at all times. The goal of this project is to minimize the potential for forklift collisions with merchandise and people, which will, in result, ensure both the safety of forklift operators and the company's goods.	to provide various forms of cited research on similar modern systems, documentation of a framework for our solution, as well as a basic prototype of our solution by the end of the project. We also plan to explore some of the more ambitious solutions to the problem such as Artificial Intelligence or Computer Vision. Our main goal is not only to find a solution to the problem, but offer Hyster-Yale new areas in which they could further improve the product.	Right now the project seems to be in a good spot. The only thing that is an immediate concern is improving the face detection algorithm so that the confidence level calculation is accurate.	The project seems to be progressing well. With that being said it is important that we don't get comfortable and start slacking off. Therefore, we decided to work on the project over spring break. The main focus right now is to improve the confidence level calculation and the face detection accuracy. Doing both should help us improve the overall quality and accuracy of the device.

Goal/Deliverable	Activities	Responsible Performer	PTD Results (Dates) Target	Actual	Comments/Concerns	Next Steps
Meeting with Industry Advisor	Fourth meeting with the Industry Advisor	Everyone	03/05/18	03/05/18	No meeting this week.	Meet with industry advisor next Monday
Meeting with Faculty Advisor	Fourth Meeting with Dr.Tribelhorn	Everyone	03/07/18	03/07/18	In this meeting, the team discussed the trip to Hyster-yale's facility and their findings. The team also explained how normalizing the y-coordinates using the face box was not being reliable. Dr. Tribelhorn offered some advice on how to actually normalize the y-coordinates. He also, suggested that the team keeps track of the location of face-box over a period of time. Then he suggested we average that to ensure that we get rid of the unwanted noise that might occur.	Meet with Dr.Tribelhorn
Building a circuit	Building the circuit	EE Team: Matt Erdhardt -Ibrahim Almubarak	02/28/18	03/01/18	Since the parts have arrived, and with current CAD Schematic done, the circuit is ready to be built. It is expected to be done next Wednesday. UPDATE (03/1/2018): The circuit will be built on Friday 03/02/2018. UPDATE (03/07/2018): The circuit was built and tested.	Test the Circuit
Optimization	Optimization Pt2	CS Team : Hashim Aljawad	03/21/18		The software still needs to be optimized since it runs extremely slow on a raspberry pi. It also needs to take into account that we are looking into 2D to 3D face modeling which might be tasking on the CPU. UPDATE(03/01/2018): With the suggestions from the faculty advisor, this was pushed another week in order to corporate the suggestion discussed in the meeting. UPDATE(03/08/2018) There was some progress made but will still work on improving it.	Improve the framerate even further
Creating a Graphical User Interface	Improving the user interface	CS Team:	03/06/18	03/06/018	This task was put on a hold this week because of the immediate need to improve the frame rate. It will, however, be addressed in the upcoming week. Note: This task is set for March so, we are way ahead of schedule. UPDATE(2/22/2018) Task was is still on hold for the time being. UPDATE(03/1/2018) This is becoming less and less of a priority unless someone volunteer to improve it. The task might be scraped completely. UPDATE(03/7/2018): This task will no longer be pursuited due to the current interface surving it's purpose.	Improve the UI.
2D - 3D Face modeling	Convert a 2D face into a 3D face	CS Team: Kurtis Davidson - Ibrahim Almubarak	03/21/18		The group realized that in order to have a proper head orientation detection some parts of the face needs to be modeled in 3D. The first step is converting from 2D to 3D. UPDATE(03/1/2018): The team will move away from this task in favor of a faster and more efficient method. UPDATE(03/07/2018): There seems to be a way to calculate the change in head orientation using an iterative solver provided by OpenCV. The group will look into this a bit more on spring break.	Calculate rotation of the head.
Head orientation detection	Normalization of the face box	CS Team: Kurtis Davidson-Ibrahim Almubarak- Michael Waitt - Hashim Aljawad	03/21/18		In order to get more accurate data the calculated data for the movement of the head in the y-axis needs to be normalized in order to account for the z-direction. UPDATE(3/07/2018): There doesn't seem to be a proper way to normalize the distance from base to the actualy. The face box, unfortunately shifts with the head movement which messes up the data.	Calculate a confidence level based on the normalized values
Calculating the confidence level	Print Time stamp analysis	CS Team : Michael Waitt - Ibrahim Almubarak - Hashim Aljawad - Kurtis Davidson	03/07/18	03/07/18	In order to be more accurate with the confidence level calculation and to account for more variables, the team is going to print out a text file that contains the time-stamped analysis of a video of someone falling asleep. In order to look into machine learning. UPDATE (03/07/2018): The task was completed by Hashim. We will move on to the next task	Run the test data through a machine learning algorithm
Mounting position	Visit Hyster-Yale's facility	Everyone	03/07/18	03/07/18	In order to pick the most optimal mounting position. The team will need to visit the Hyster-yale facility and test out the code in an actual forklift. UPDATE(03/07/2018): The group went to Hyster-Yale facility and took pictures of the different angles and did some alpha testing. The group also briefed the Industry Advisor on the current progress of the project and he offered them valuable advice on how to improve. The Industry Advisor: also, offered insight on case requirement and different mounting positions.	Modify the code to account for the new angle

Project Title: UP Vision System			Team Members: Michael Waitt, Kurtis Davidson, Hashim Aljawad, Matt Erhardt, Ibrahim Almubarak			
Project Definition			**Project Goals**		**Progress Against Goals**	**Comments**
Forklift operators work long shifts that typically range between 8-12 hours. They also must navigate small, packed spaces. This means that any mistake that the operator does could result in injury or a major loss of merchandise. To avoid such problems, Hyster-Yale wants to take steps to aid the operators by making sure that they are fit to operate the forklift at all times. The goal of this project is to minimize the potential for forklift collisions with merchandise and people, which will, in result, ensure both the safety of forklift operators and the company's goods.			to provide various forms of cited research on similar modern systems, documentation of a framework for our solution, as well as a basic prototype of our solution by the end of the project. We also plan to explore some of the more ambitious solutions to the problem such as Artificial Intelligence or Computer Vision. Our main goal is not only to find a solution to the problem, but offer Hyster-Yale new areas in which they could further improve the product.		The most immediate concern right now is improving the face detection accuracy. Because that is the backbone of the project. The project is only as good as the face detection. The group has dedicated resource to combat that issue. Hopefully, it will be resolved as soon as possible.	The project is stable in terms of confidence level calculation. So the detection of both the head orientation and the duration eyes closed, work as intended. The only thing left is getting the face detection to work correctly. There is also the possibility to expand confidence level calculation into machine learning. Moving into machine learning will ensure that confidence level is dynamically determined as oppose to following a specific equation.
Goal/Deliverable	**Activities**	**Responsible Performer**	**PTD Results (Dates)**		**Comments/Concerns**	**Next Steps**
			Target	Actual		
Meeting with Industry Advisor	Fourth meeting with the Industry Advisor	Everyone	03/19/18	03/19/18	In this week's meeting, the group discussed the current state of the program and the direction going forward. The group also expressed their concerns in regard to the low framerate. The industry advisor offered some valuable advice on how to improve it.	Meet with industry advisor next Monday
Meeting with Faculty Advisor	Fourth Meeting with Dr.Tribelhorn	Everyone	03/21/18	03/21/18	The group should Dr.Tribelhorn a quick demo. The group also discussed how to proceed with potentially implementing machine learning as a way to calculate the confidence level. Dr.Tribelhorn expressed the need for testing. He requested that the group dedicate a week in order to do testing.	Meet with Dr.Tribelhorn
Face Detection Optimization	Train new data set for dlib/find a clever way to improve face detection.	Michael Waitt	03/26/18		In order to improve the accuracy of the face detection algorithm, a new dataset needs to be trained specifically for our project. This will require finding a data set of images around 1000 or so and then train the face detector on that dataset.	Further, improving the face detection.
Optimization	Optimization Pt3	CS Team : Hashim Aljawad	03/26/18		The third part of improving the framerate for the raspberry pi. Right now the focus will be to utilize the architecture of the pi in order to improve the quality. Hashim will be scheduling a meeting with Dr.Tribelhorn in the upcoming week to hopefully find a way to utilize the pi's architecture.	Improve the framerate even further
Case	3D print the case	Matt Erhardt	03/26/18		The case design has gone through multiple iterations. It is ready to be printed. Matt will examine the current options of 3D printing the case.	Place everything inside of the case and ensure proper proportions
2D - 3D Face modeling	Convert a 2D face into a 3D face	CS Team: Kurtis Davidson - Ibrahim Almubarak	03/21/18	03/21/18	The group realized that in order to have a proper head orientation detection some parts of the face needs to be modeled in 3D. The first step is converting from 2D to 3D. UPDATE(03/1/2018): The team will move away from this task in favor of a faster and more efficient method. UPDATE(03/07/2018): There seems to be a way to calculate the change in head orientation using an iterative solver provided by OpenCV. The group will look into this a bit more on spring break. UPDATE(03/22/2018): The group successfully modeled the face in a 3D plane and calculated the Euler rotation angles. The confidence levels have updated to look at this new data.	Calculate rotation of the head.
Head orientation detection	Normalization of the face box	CS Team: Kurtis Davidson-Ibrahim Almubarak- Michael Waitt - Hashim Aljawad	03/21/18	03/21/18	In order to get more accurate data the calculated data for the movement of the head in the y-axis needs to be normalized in order to account for the z-direction. UPDATE(3/07/2018): There doesn't seem to be a proper way to normalize the distance from base to the actual y. The face box, unfortunately shifts with the head movement which messes up the data. UPDATED(3/22/2018) Normalizing the orientation detection seems to be unreliable at best. With the way that the face detection works, it sometimes causes the landmark detection to jump around massively from one point to another which causes huge fluctuation of the resulting data.	Calculate a confidence level based on the normalized values
Calculating the confidence level	Look into machine learning as an alternative way to calculate the confidence level.	CS Team : Michael Waitt - Ibrahim Almubarak - Hashim Aljawad - Kurtis Davidson	03/07/18	03/07/18	In order to further improve the algorithm and in turn increase the accuracy of the drowsiness detection. The group is planning on looking at machine learning as an alternative to a mathematical model for calculating the confidence level. Specifically, the group plans on using a neural network that gets fed all the necessary information and trained on a set of data to detect drowsiness.	Compare the machine learning confidence level to non-machine learning confidence level

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Project Title: UP Vision System

Team Members: Michael Waitt, Kurtis Davidson, Hashim Aljawad, Matt Erhardt, Ibrahim Almubarak

Project Definition	Project Goals	Progress Against Goals	Comments
Forklift operators work long shifts that typically range between 8-12 hours. They also must navigate small, packed spaces. This means that any mistake that the operator does could result in injury or a major loss of merchandise. To avoid such problems, Hyster-Yale wants to take steps to aid the operators by making sure that they are fit to operate the forklift at all times. The goal of this project is to minimize the potential for forklift collisions with merchandise and people, which will, in result, ensure both the safety of forklift operators and the company's goods.	to provide various forms of cited research on similar modern systems, documentation of a framework for our solution, as well as a basic prototype of our solution by the end of the project. We also plan to explore some of the more ambitious solutions to the problem such as Artificial Intelligence or Computer Vision. Our main goal is not only to find a solution to the problem, but offer Hyster-Yale new areas in which they could further improve the product.	Currently, the main concern is optimizing the algorithm. Currently, the project is running anywhere around 15-30 fps depending on the machine. We would like to get it to run at a steady 30 fps if possible. Therefore, most of the team's effort is going into making the code run faster.	The group is going to focus on testing, polishing and optimizing the code from now on. They will also pursue machine learning as an addition to the current algorithm. The current state of the algorithm is stable and can be used for testing.

Goal/Deliverable	Activities	Responsible Performer	PTD Results (Dates) Target	Actual	Comments/Concerns	Next Steps
Meeting with Industry Advisor	Fourth meeting with the Industry Advisor	Everyone	03/26/18	03/26/18	In this week's meeting, the group discussed the newly added features specifically the angle of rotation calculation. The industry advisor offered insight on possible hardware alternatives to speed up the processing time. The group also agreed to go to Hyster-Yale and present their project on May 5th. The industry advisor informed the group about the expectations for the presentation.	Meet with Industry advisor next Monday
Meeting with Faculty Advisor	Fourth Meeting with Dr.Tribelhorn	Everyone	03/28/18	03/28/18	Meeting canceled by the group's request.	Meet with Dr.Tribelhorn
Face Detection Optimization	Train new data set for dlib/find a clever way to improve face detection.	Michael Waitt	03/26/18	03/26/18	In order to improve the accuracy of the face detection algorithm, a new dataset needs to be trained specifically for our project. This will require finding a data set of images around 1000 or so and then train the face detector on that dataset. UPDATE: After extensive research, it was determined that this task would take a lot of time to complete therefore it was canceled but will be included in the future improvement section of the final report.	Further, improving the face detection.
Optimization	Optimization Pt3	CS Team : Hashim Aljawad	03/26/18	03/26/18	The third part of improving the framerate for the raspberry pi. Right now the focus will be to utilize the architecture of the pi in order to improve the quilty. Hashim will be scheduling a meeting with Dr.Tribelhorn in the upcoming week to hopefully find a way to utilize the pi's architecture. UPDATE: Hashim met with Dr.Tribelhorn and was able to improve the framerate to around 12 frames per second.	Improve the framerate even further
Case	3D print the case	Matt Erhardt	03/26/18	03/26/18	The case design has gone through multiple iterations. It is ready to be printed. Matt will examine the current options of 3D printing the case. UPDATE: Gained access to the 3D printer and will start printing.	Place everything inside of the case and ensure proper proportions
2D - 3D Face modeling	Convert a 2D face into a 3D face	CS Team: Kurtis Davidson - Ibrahim Almubarak	03/21/18	03/21/18	The group realized that in order to have a proper head orientation detection some parts of the face needs to be modeled in 3D. The first step is converting from 2D to 3D. UPDATE(03/1/2018): The team will move away from this task in favor of a faster and more efficient method. UPDATE(03/07/2018): There seems to be a way to calculate the change in head orientation using an iterative solver provided by OpenCV. The group will look into this a bit more on spring break. UPDATE(03/22/2018). The group successfully modeled the face in a 3D plane and calculated the Euler rotation angles. The confidence	Calculate rotation of the head.
Testing	Come up with a white box test cases	Everyone	04/14/18		In order to ensure the quality of the project, the group is going to implement some tests. These tests will focus on edge cases that the group considers "Algorithm breaking".	Continue testing and polishing the product
Machine Learning	Implement a basic neural network	Everyone	04/14/18		As an alternative to the basic confidence level calculation, the group decided on implementing a neural network. The goal of the neural network is to calculate the confidence level based on input from the landmark face detection. In addition, the angles of rotation will also be fed to the neural network. This with the optimization will be the only focus of the group from now on	Debug the neural network

Project Title: UP Vision System

Team Members: Michael Waitt, Kurtis Davidson, Hashim Aljawad, Matt Erhardt, Ibrahim Almubarak

Project Definition	Project Goals	Progress Against Goals	Comments
Forklift operators work long shifts that typically range between 8-12 hours. They also must navigate small, packed spaces. This means that any mistake that the operator does could result in injury or a major loss of merchandise. To avoid such problems, Hyster-Yale wants to take steps to aid the operators by making sure that they are fit to operate the forklift at all times. The goal of this project is to minimize the potential for forklift collisions with merchandise and people, which will, in result, ensure both the safety of forklift operators and the company's goods.	to provide various forms of cited research on similar modern systems, documentation of a framework for our solution, as well as a basic prototype of our solution by the end of the project. We also plan to explore some of the more ambitious solutions to the problem such as Artificial Intelligence or Computer Vision. Our main goal is not only to find a solution to the problem, but offer Hyster-Yale new areas in which they could further improve the product.	Currently, the main concern is optimizing the algorithm. The project is running somewhere around 15-30 fps depending on the machine. We would like to get it to run at a steady 30 fps if possible. Therefore, most of the team's effort is going into making the code run faster.	This week the main focus was testing and the powerpoint presentation. The group also was able to track the activity level of the operator in order to enhance the overall accuracy of the confidence level detection.

Goal/Deliverable	Activities	Responsible Performer	PTD Results (Dates)		Comments/Concerns	Next Steps
			Target	Actual		
Meeting with Industry Advisor	Fourth meeting with the Industry Advisor	Everyone	04/02/18	04/02/18	Meeting canceled (easter break).	Meet with Industry advisor next Monday
Meeting with Faculty Advisor	Fourth Meeting with Dr.Tribelhorn	Everyone	04/04/18	04/04/18	The group met with Dr.Tribelhorn and gave an update on the status of the project. Discussed how to implement meaningful tests. Also, discussed the final report and how to organize it.	Meet with Dr.Tribelhorn
Final Presentation	Create the powerpoint slides	Everyone	04/06/18	04/06/18	In order to prepare for the final presentation, the group is going to do a dry run on Friday 4/6/2018. Therefore the group will work on creating the slides this week.	Further, improving the face detection.
Confidence level Calculation	Activity level	CS Team : Michael Waitt	04/14/18	04/05/18	As per Dr.Tribelhorn previous suggestion. The group decided to track how "Active" the operator is and take that into account when calculating fatigue. Because if an operator is moving a lot then he probably is not asleep nor drowsy.	Improve the framerate even further
Case	3D print the case	Matt Erhardt	04/14/18		The case design has gone through multiple iterations. It is ready to be printed. Matt will examine the current options of 3D printing the case. UPDATE: Gained access to the 3D printer and will start printing.	Place everything inside of the case and ensure proper proportions
Data collection	Generate a graph of how the operator fatigue is tracked	CS Team: Hashim Aljawad	04/14/18		For the sake of improving the quality of both the final report and the powerpoint presentation, the group decided to dedicate some time to generate a graph of drowsiness being tracked in real time. This will be included in both the final report and the powerpoint presentation.	Use generated data to enhance the final report and the slides.
Testing	Come up with a white box test cases	Everyone	04/14/18		In order to ensure the quality of the project, the group is going to implement some tests. These tests will focus on edge cases that the group considers "Algorithm breaking".	Continue testing and polishing the product
Machine Learning	Implement a basic neural network	Everyone	04/14/18		As an alternative to the basic confidence level calculation, the group decided on implementing a neural network. The goal of the neural network is to calculate the confidence level based on input from the landmark face detection. In addition, the angles of rotation will also be fed to the neural network. This with the optimization will be the only focus of the group from now on	Debug the neural network

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Project Title: UP Vision System

Team Members: Michael Waitt, Kurtis Davidson, Hashim Aljawad, Matt Erhardt, Ibrahim Almubarak

Project Definition	Project Goals	Progress Against Goals	Comments
Forklift operators work long shifts that typically range between 8-12 hours. They also must navigate small, packed spaces. This means that any mistake that the operator does could result in injury or a major loss of merchandise. To avoid such problems, Hyster-Yale wants to take steps to aid the operators by making sure that they are fit to operate the forklift at all times. The goal of this project is to minimize the potential for forklift collisions with merchandise and people, which will, in result, ensure both the safety of forklift operators and the company's goods.	to provide various forms of cited research on similar modern systems, documentation of a framework for our solution, as well as a basic prototype of our solution by the end of the project. We also plan to explore some of the more ambitious solutions to the problem such as Artificial Intelligence or Computer Vision. Our main goal is not only to find a solution to the problem, but offer Hyster-Yale new areas in which they could further improve the product.	The main focus in the next couple of weeks is getting the hardware to communicate with the software.Also, getting a prototype of a nerual network up and running	Currently, The project is complete, we are adding final touches in order to ensure we have a complete package. The final report and the presentation are more of an immediate concern at this point.

Goal/Deliverable	Activities	Responsible Performer	PTD Results (Dates) Target	Actual	Comments/Concerns	Next Steps
Meeting with Industry Advisor	Fourth meeting with the Industry Advisor	Everyone	04/09/18	04/09/18	The group met with the Industry Advisor and discussed current progress. The group explained that a new metric was added to the confidence level calculation. The Industry advisor suggested that the group take into account the movement of the vehicle as a metric for the calculations. The presentation for hyster-yale will be conducted at May 4th at around 1:00-3: 30 PM	Meet with Industry advisor next Monday
Meeting with Faculty Advisor	Fourth Meeting with Dr.Tribelhorn	Everyone	04/11/18	04/11/18	The group gave an update on the last week's tasks and their status. They also discussed the presentation slides and the physical case. Dr.Tribelhorn would like to see the hardware communicating with the software by next week. Also, an update on the current status of the neural network.	Meet with Dr.Tribelhorn
Final Presentation	Create the powerpoint slides pt2	Everyone	04/16/18		The group received feedback from the faculty advisor and will incorporate those suggestions int he powerpoint slides.	Present at April 27th
Machine Learning	Implement a basic neural network	Ibrahim Almubarak	04/14/18		As an alternative to the basic confidence level calculation, the group decided on implementing a neural network. The goal of the neural network is to calculate the confidence level based on input from the landmark face detection. In addition, the angles of rotation will also be fed to the neural network. This with the optimization will be the only focus of the group from now on UPDATE(4/13/2018): Will probably implement our own neural network in order to avoid unnecessary API installation.	Debug the neural network
Case	3D print the case	Matt Erhardt	04/14/18	04/09/18	The case is finally built and only needs minor improvements. The only focus right now is to get everything setup and possibly spray paint the case.	Place everything inside of the case and ensure proper proportions
Data collection	Generate a graph of how the operator fatigue is tracked	CS Team: Michael Waitt	04/14/18		For the sake of improving the quality of both the final report and the powerpoint presentation, the group decided to dedicate some time to generate a graph of drowsiness being tracked in real time. This will be included in both the final report and the powerpoint presentation. UPDATE(4/13/2018): There was a switch in tasks Michael will now work on this task while Hashim has been assigned to another task.For the sake of improving the quality of both the final report and the powerpoint presentation, the group decided to dedicate some time to generate a graph of drowsiness being tracked in real time. This will	Use generated data to enhance the final report and the slides.
Testing	Come up with a white box test cases	Kurtis Davidson	04/14/18		In order to ensure the quality of the project, the group is going to implement some tests. These tests will focus on edge cases that the group considers "Algorithm breaking". UPDATE(4/13/2018) Kurtis was tasked with the testing portion for the next week	Continue testing and polishing the product

Spring Weekly Report 11

Project Title: UP Vision System

Team Members: Michael Waitt, Kurtis Davidson, Hashim Aljawad, Matt Erhardt, Ibrahim Almubarak

Project Definition	Project Goals	Progress Against Goals	Comments
Forklift operators work long shifts that typically range between 8-12 hours. They also must navigate small, packed spaces. This means that any mistake that the operator does could result in injury or a major loss of merchandise. To avoid such problems, Hyster-Yale wants to take steps to aid the operators by making sure that they are fit to operate the forklift at all times. The goal of this project is to minimize the potential for forklift collisions with merchandise and people, which will, in result, ensure both the safety of forklift operators and the company's goods.	to provide various forms of cited research on similar modern systems, documentation of a framework for our solution, as well as a basic prototype of our solution by the end of the project. We also plan to explore some of the more ambitious solutions to the problem such as Artificial Intelligence or Computer Vision. Our main goal is not only to find a solution to the problem, but offer Hyster-Yale new areas in which they could further improve the product.	Currently, the only thing left is preparing everything for the presentation and submission.	The project has reached its final sprint. The main focus is polishing and packaging. Anything that has not been implemented will be documented as a future improvement.

Goal/Deliverable	Activities	Responsible Performer	PTD Results (Dates) Target	Actual	Comments/Concerns	Next Steps
Meeting with Industry Advisor	Fourth meeting with the Industry Advisor	Everyone	04/16/18	04/16/18	Met with the Industry advisor. In the meeting, the group gave an update on the current status of their work. The group also discussed the final report and what to include in it. Also, the group discussed the final presentation and promised to update the industry advisor on the exact time as soon as that's available	Meet with Industry advisor next Monday
Meeting with Faculty Advisor	Fourth Meeting with Dr.Tribelhorn	Everyone	04/18/18	04/18/18	The group gave a quick update on the current status of the project. Dr.Tribelhorn asked that the group start looking into deliverables to Hyster-yale. He also gave some tips on how to get the neural network to work correctly.	Meet with Dr.Tribelhorn
Final Presentation	Create the powerpoint slides pt2	Everyone	04/16/18	04/16/18	The group received feedback from the faculty advisor and the industry advisor and will incorporate those suggestions int he powerpoint slides.	Present at April 27th
Machine Learning	Implement a basic neural network	Ibrahim Almubarak	04/14/18	04/17/18	As an alternative to the basic confidence level calculation, the group decided on implementing a neural network. The goal of the neural network is to calculate the confidence level based on input from the landmark face detection. In addition, the angles of rotation will also be fed to the neural network. This with the optimization will be the only focus of the group from now on UPDATE(4/13/2018): Will probably implement our own neural network in order to avoid unnecessary API installation. The neural network has been implemented but unfortunately can't be stored due to lack of support from the Dlib library.	Debug the neural network
Case	Get the hardware to interface with the softwarte	Hashim Aljawad	04/20/18	04/18/18	The Hardware is currently communicating with the software. Whenever the confidence level is less than 50% then the green LED lights up. When the confidence level is between 50% and 70% the Yellow LED lights up. Finally, when the confidence level is above 70% the RED LED lights up.	Place everything inside of the case and ensure proper proportions
Data collection	Generate a graph of how the operator fatigue is tracked	CS Team: Michael Waitt	04/14/18	04/14/18	For the sake of improving the quality of both the final report and the powerpoint presentation, the group decided to dedicate some time to generate a graph of drowsiness being tracked in real time. This will be included in both the final report and the powerpoint presentation. UPDATE(4/13/2018): There was a switch in tasks Michael will now work on this task while Hashim has been assigned to another task.For the sake of improving the quality of both the final report and the powerpoint presentation, the group decided to dedicate some time to generate a graph of drowsiness being tracked in real time. This will be	Use generated data to enhance the final report and the slides.
Testing	Come up with a white box test cases	Kurtis Davidson	04/25/18		In order to ensure the quality of the project, the group is going to implement some tests. These tests will focus on edge cases that the group considers "Algorithm breaking". UPDATE(4/13/2018) Kurtis was tasked with the testing portion for the next week UPDATE(4/18/2018): Some progress was made in this area but further testing is still needed.	Continue testing and polishing the product

Appendix IV – Team Resumes

Ibrahim Almubarak

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Portland,OR 97222 (xxx)xxx-xxxx

PROFILE

Diligent Student with a passion for knowledge. Adapt to ever-changing situations. Effective team player with excellent interpersonal skills. Eager for self-improvement.

EDUCATION

Bachelor of Sciences, Majors: Electrical Engineering, Computer Science. May 2018
University of Portland | Portland, OR

TECHNICAL SKILLS

Programming Languages: JAVA ,Python , Lisp ,C ,C++ ,Prolog, Android Studios.
Development Tools: MATLAB, Pspice , MPLAB , LEDIT , B^2spice

RELATED COURSEWORK

CE Amplifier Design and Build Fall 2016

- Individually designed and built a CE Amplifier using Pspice.

PIC18F46K22 Key Matrix and Audio Interfacing Fall 2016

- Worked as a team leader with two other people to make a PIC18F play music and display input form a key matrix using MPLAB

Deterministic Finite Automata equivalence checker. Fall 2016

- With one other person created a program, that given two automata will check if their equivalent. Implemented a fully working GUI.

Artificial Intelligence Summer 2016

- In a team of two created a fully functioning AI for a game using the following techniques: Genetic Algorithms, Min-Max, Neural Network, Temporal learning. This was accomplished using Python.

Object Oriented Program Spring 2016

- In a team of three created a Mastermind Game using Android studios. The game had fully function AI and a multiplayer mode.

OTHER EXPERIENCES

Engineering Student Advisory Council Fall 2016-2018

- Served as a member of the advisory council. The council serves as a connection between the dean and the engineering students. I relayed the students concerns to the Dean.

Matthew Erhardt

18881 Hein St
Oregon City, OR 97045

matterhardt@outlook.com
(503) 780-0420

I have a constantly growing passion for technology and how it can be used to benefit society. I am a very goal oriented and driven individual who strives to make a difference. My greatest strengths include time-management, organization, devotion, and self-motivation. Hobbies of mine include learning new programming languages and financial planning. I am searching for a full time job after I graduate this upcoming May where I can best utilize my strengths and learn new skills.

EDUCATION

University of Portland | Portland, OR — May 2018

B.S., Electrical Engineering

Howard Vollum Scholarship

- Verilog Digital System Modeling
- Intro Digital VLSI Design
- Managerial Accounting

TECHNICAL SKILLS

Platforms: Windows OS, Apple OS, Linux OS
Programs: PSpice, B^{2}Spice, MATLAB, Microsoft Suite, LEDIT, ModelSim, Solidworks, LibreOffice Suite
Physical: Soldering
Programming Languages: Java, VBA, C

ACADEMIC PROJECTS

Key Matrix and Audio Interfacing Project

- Collaborated in group of 4 and took part in the building, programming, and debugging of the PIC18F46K22 embedded system.
- The microcontroller PIC18F46K22 was used to implement a key matrix input. In assembly language, a key matrix scanning algorithm and display subroutine for an LCD display was developed. The microcontroller enabled the input to communicate with the algorithm and resulted in an audio output.
- Successfully completed project and final report

WORK EXPERIENCE

Senior Capstone Project — Sep 2017 - Present

University of Portland

- Hyster Yale sponsored project with goal to eliminate injury, death, and product damage due to driver fatigue.
- Acted as lead electrical engineer to design the circuitry that provides the interface between the hardware and software
- Acted as lead finance leader and am responsible for the budget, hours tracking, and creating a project pro forma.

Media Services Technician — Jan 2017 - Present

University of Portland

- Provides technical support and assistance in operating media equipment to students, faculty and staff on campus
- Delivers, sets up, and disassembles technical equipment in classrooms and facilities
- Employs troubleshooting skills, gaining vital teamwork experience and gaining knowledge in customer service techniques

Video Production Assistant — Dec 2014 - Present

University of Portland

- Work cameras and manage the camera equipment at the University of Portland home sports games.
- Updates and manages graphics for home games.

Engineering Office Intern — June 2015 – Aug 2016

Marks Design and Metal Works

- Observed and learned the engineering process of building brewing tanks for brewing companies
- Organized and digitized customer files, ran errands, used Microsoft Suite to create or update inventory lists.

Michael Mario Waitt

5000 N. Willamette Blvd | Portland, OR 97203 | 509.828.3948 | waitt18@up.edu | linkedin.com/in/mwaitt

PROFILE

A goal-oriented, aspirational Computer Science and Mathematics undergraduate student at University of Portland with two prior internship positions in development roles. Strengths include software development, critical thinking, leadership, communication, teamwork, and passion of learning new concepts and technologies.

EDUCATION

University of Portland | Portland, OR — Graduation Date: May 2018

B.S. Computer Science candidate, Mathematics minor — 3.3 GPA

- Howard Vollum Academic Scholarship Recipient

Relevant skills attained through coursework:

- Java, Android, and C/C++ development in Object-Oriented Programming, Programming Languages, Software Engineering, Operating Systems, UNIX Laboratory, Data Structures, and Compiler Design
- Agile development practices learned in Software Engineering course and used in various software projects
- Learned time/complexity theory in Data Structures, Theory of Computation, and Analysis of Algorithms
- Developed understanding of encryption and cybersecurity concepts in Topics in Cybersecurity and Cryptography
- Broadened my mathematical horizons with courses like Applied Statistics, Discrete Structures, and Game Theory

RELEVANT EXPERIENCE

Team Lead | Multidisciplinary Capstone Project (UP Vision) — April 2017 – Present

- Leading a capstone team of five multidisciplinary students working on preventing forklift operator fatigue-related injuries and merchandise loss via computer vision
- Building facial detection software with OpenCV, Dlib, and C++ on a Raspberry Pi 3
- Coordinating with the clients, industry advisors, and faculty advisors for the project to assure success
- Team is sponsored by Hyster-Yale Materials Handling, one of the largest manufacturers of material-handling equipment worldwide, to create this product as an option for their lineup of over 130 trucks

Technical Communication Assistant | University of Portland Information Services — April 2016 – Present

- Promoting personal cybersecurity awareness around campus with the use of various physical/digital media and on-campus events for University of Portland students, staff, and faculty
- These events and communications reach a total population of ~4,200 students, staff, and faculty at the university

Software Developer Intern | U.S. Bank — June 2017 – August 2017

- Full-stack Java web application development in a traditional Waterfall development cycle
- Took part in the final stages of the development of an internal Java web application with a large codebase
- Further expanded my technical communication skills with technical/non-technical audiences via multiple software demos and presentations
- Advanced my technical skillset by learning Spring MVC, JSF, IBM WebSphere Application Server, SoapUI, and many other frameworks and technologies

Operational Technology Intern | Cowlitz County Public Utility District — May 2016 – August 2016

- Provided end user support with assigned software applications including IBM Cognos BI, Microsoft BizTalk Server, among others
- Developed several web pages for the district's external/internal sites, primarily in the languages of PHP or JSP
- Gained proficiency in database management, primarily with Oracle or SQL Server databases
- Created and maintained an internal RESTful API service for use in displaying various data in either XML or JSON format for the Utility District, which is still widely used today
- This API service allows the PUD's ~23,000 customers to better visualize their electrical usage on a monthly basis

TECHNICAL SUMMARY

Current experience includes Java, Unix, Android Studio, C, PHP, JavaScript, JSP, JSF, Spring MVC, JQuery, Python, CSS, HTML, SQL, SOAP, REST, XML, JSON, Agile Development, and Waterfall Development

Kurtis Davidson

Kurtis Davidson
1415 Ala Hoku Pl
Honolulu, HI 96819

808.255.8991
kurtisdavidson9617@gmail.com

Skills

- Collaborative team member
- Reliable and on time
- Energetic and organized
- Computer literate with Excel, Powerpoint, and Word
- Intermediate knowledge of programming languages: Java, C, C++, LISP, and Python
- Intermediate knowledge of operating UNIX systems
- Intermediate knowledge of assembly language: MIPS and Verilog
- Ability to repair, monitor and build computer systems
- Experience with Android Studio

Community Service

Community Service Volunteer Aide / Home Care Assistance
December 2014 - PRESENT, Honolulu, HI

- Visiting and helping homesit patients
- Physically and verbally interacting with patient and caregiver throughout the day
- Ensuring that the primary caregiver is able to fulfill their duties without interruptions
- Using cooperation with the primary caregiver and quick thinking to ensure that the patient gets quick help when it is needed
- Visiting the patient on average of three times a week

Education

University of Portland
August 2014 - PRESENT, Portland, OR

Currently on track to obtain a Bachelor's degree in Computer Science in 2018.

Activities

Hawaii Club
August 2014 - PRESENT - University of Portland

Collaborate with other members on planning club events such as the annual Luau to share Hawaiian culture.

FASA Club
August 2017 - PRESENT - University of Portland

Collaborate with other members on planning club events such as the annual PCN to share Filipino culture.

Hashim Al Jawad

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OBJECTIVE

To obtain a full-time entry level position in software engineering that utilizes my relevant experience, technical expertise, and problem solving skills.

EDUCATION

University of Portland, Portland, OR
Bachelor of Science in Computer Science; Minor in Mathematics, May 2018

- Relevant Coursework: Introduction to Computer Science (Java), Object-Oriented Programming (Java), Data Structures (C/C++), Computer Architecture, Operating Systems, Programming Languages, Software Engineering, Artificial Intelligence (Python), Theory of Computation, Analysis of Algorithms, and Compiler Design (Java).

PROJECTS

Senior Capstone Project, *Hyster-Yale Group, Aug 2017 – May 2018*

- Implemented a vision system with four team members for identifying and responding to the condition of a forklift operator using OpenCV and dlib libraries in C++.

Application of AI Search Algorithms, *Artificial Intelligence, May 2016 – June 2016*

- Implemented several AI algorithms with a partner such as MinMax, A* search, and genetic algorithm for a computer game in Python that improved the game-playing performance of an AI agent.

Mock Restaurant Website, *Software Engineering, Aug 2015 – Dec 2015*

- Created a mock restaurant website with a team of three students for a course project as a part of an integrated restaurant software. Using Bootstrap's library, the team was able to make the website compatible for all devices.

Battleship Game, *Object-oriented Design, Jan 2015 – May 2015*

- Implemented and designed the Graphical User Interface for an Android game with two student using Android Studio in Java.

TECHNICAL SKILLS

Languages: Python (Intermediate), Java (Intermediate), Swift (Beginner), C++ (Beginner).
Tools: Xcode, Android Studio, Eclipse, PyCharm.