Crew Position Indicating and Recording System

Western Carolina University
School of Engineering + Technology

Original Objectives

- Complete final design of solution
  - Program/code
  - Testing Rig
  - BOM of all components
- Implementation of solution
  - Functional working prototype
  - Test plan with data collected and analysis
  - Report/presentation of findings
- Testing Report
- Design documentation checklist
- Symposium poster
- Project closeout checklist
- Presentation at Senior Capstone Symposium

Requirements

- Area of detection to be cockpit and cabin which combined measures 15 ‘ L x 8’ W x 8’ H
- Display positional data in Realtime
- Record positional data every 10 seconds for 8hours
- Record up to 6 crew members at once
- Accurate within 12 inches
- Function in environments to include smoke, dust, and rain
- Obtain positional data from passive devices which can be attached to flight suit

Concepts

Initial Concepts
- Ultra Sonic Concept
- RFID Concept
- IR Barcode Concept
- Laser Grid Tracking
- Optical Tracking
- UV Light

Final Concepts
- IR Barcode
- Laser Grid
- IR Time of Flight

Down Selection

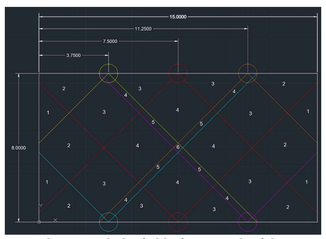
We took our many concepts and examined each one for cost, feasibility, and risk. By doing so we arrived at 3 complete concepts to move forward with.

Problem Statement

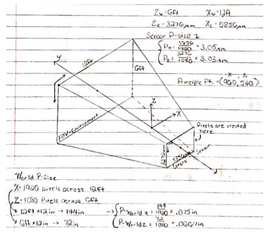
Many of the Navy and Marine Corps’ operational commitments are within extremely harsh environments. These harsh environments make it very difficult for pilots to maintain situational awareness within the aircraft. Situational awareness (location) of the flight crew is paramount for pilots, ensuring that the aircraft and crew are positioned correctly for safe and efficient operation. While intercommunication systems assist with this, they are not always an ideal solution. FRC East would like to enhance pilot awareness by providing a means to actively track and record positional data of crew members in an aircraft and display it to the pilots.

Final Design/Results *

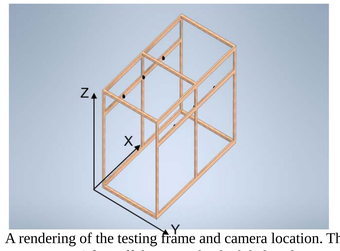
Final Design:
- 6 cameras, each acting independently
- Identifying patches on the helmets of the crew members



Camera layout with the field of view each of the cameras has. The number in each field is the number of cameras that can see that space

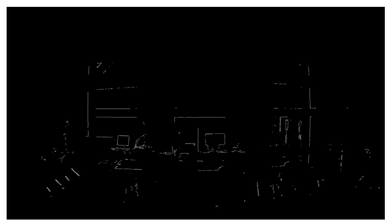


Central projection model used to determine location of the crew members. Along with calculated values needed for determining the location.



A rendering of the testing frame and camera location. The cameras are 6 feet off the ground, which helps eliminate noise from the ground and other lower objects.

Picture taken with a camera using the code. This camera had the identify of camera 0.



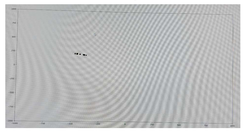
This is the above photo of the room filter. Each of the white lines are contours, which is what was used to identify the crew members. There is a lot of contours that can be seen, which makes for a lot of data that is going to throw the readings off.

ID	Heights in Pixels	Widths in Pixels	Distance Using Height	Distance using Width	FOVxL	FOVyL	PworldX	PworldY	Xp	Zp	Xl	Zl	ImagCtr_X	ImagCtr_Y	ImagCtr_Z	IndA_X	IndA_Y	IndA_Z	Cam_Id
3	4		593.4	590.1	1534.	738.3	0.799	0.683			-279.6	82.04	590.1	235.6	590.1	154.0			
			406593639342677793216097806974						-350		1208423036906		4463934			72842306393443690			0
3	4		593.4	472.1	1227.	590.7	0.639	0.546			-223.7	65.63	472.1	179.7	472.1	137.6			
			506593311474142214572278249579						-350		1204738449525		4431147			72473843114734952			0
5	7		339.0	786.8	2045.	984.5	1.065	0.911			-372.9	109.3	786.8	328.9	786.8	181.3			
			389481852456903724288463735965						-350		1201230791587		4485245			72123078524591587			0
6	4		593.4	472.1	1227.	590.7	0.639	0.546			-223.7	65.63	472.1	179.7	472.1	137.6			
			506534311474142214572278249579						-350		1204738449525		4431145			72473843114734952			0
6	7		339.0	472.1	1227.	590.7	0.639	0.546			-223.7	65.63	472.1	179.7	472.1	137.6			
			589481311474142214572278249579						-350		1204738449525		4431147			72473843114734952			0
6	4		593.4	393.4	1022.	492.2	0.532	0.455			-186.4	54.69	393.4	142.4	393.4	126.6			
			606593426238451862144731867982						-350		1205615357937		4442623			72561534262395793			0
3	4		593.4	1180.	3068.	1476.	1.598	1.367			-559.3	164.0	1180.	515.3	1180.	236.0			
			206593327865355557864319560394						-350		1206846087381		4432786			72684603278687381			0
5	6		395.6	393.4	1022.	492.2	0.532	0.455			-186.4	54.69	393.4	142.4	393.4	126.6			
			604395426238451862144731867982						-350		1205615357937		4442623			72561534262395793			0
2	2		1186.	1180.	3068.	1476.	1.598	1.367			-559.3	164.0	1180.	515.3	1180.	236.0			
			281318327865355557864319560394						-350		1206846087381		4432786			72684603278687381			0
1	28		84.77	78.68	204.5	98.45	0.106	0.091			-37.29	10.93	78.68	6.708	78.68	82.93			
			30237048524569037242885463715965						-350		1201230791587		4485245			72769308524591587			0

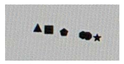
Different parameters for each contour, which are needed to determine the location of the contour. The values of this are from the noisy photo to the left, so the results are not realistic, just used to show the different parts of the code are working together

ID	X	Y	Z
1	-438.2370383	1017.572237	213.4613415
2	-383.9740951	903.0715661	197.5436327
3	-355.6234118	843.2485621	189.2271299
4	-341.4440716	813.3286228	185.0677055
5	-326.6982064	782.2132546	180.7420945
6	-320.4868282	769.1065757	178.9200239

Final set of data that would be saved and used to display information to the pilot. This data set is an averaged value of all the different contours with the same ID value. These values are also from the noisy data



Showing a plot/ display that would be shown to the pilot. The data is from the above table so, the values are unrealistic.



This photo is used to show the different shapes that would represent the 6 different crew members.

* On March 16, 2020 classes and labs were closed to students due to the COVID-19 Pandemic. Without access to fabrication and testing equipment, Objectives and Deliverables were modified accordingly.

Modified Objectives*

Below are a list of things that were unable to be completed for this capstone project:
- Program/Code: the program could not be finalized due to the inability to test the prototype. Current version of code/program was sent to the sponsor.
- Implementation of Solution: With the inability to test the prototype, the team was unable to gather any results or show the prototype working correctly.
- Testing Report: This is modified to show tests that would have been done, instead of results from testing.
- Presentation at Senior Capstone Symposium: With students being unable to return to campus for the reminder of the spring 2020 semester, the symposium has been cancelled.

Summary

- Developed a prototype program that can find the location of crew members within a desired field
- Determined and calculated specific equations that allow for the translation of pixel locations to real world coordinates.

Team & Acknowledgements

Team Members:
- Jonathan Mashburn – EE
- Brandon Olsen – EE
- Matthew Glascoe – ME
- Shawn Swayne – ECET

Mentor:
- Dr. Martin Tanaka

Sponsor:
- Alex Carter
- Kaila Peterson