Florida Tech IGVC Milestone 3 Report

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Milestone Three Task Completion Matrix

#	Task	Percentage	Will	Adam	Chris	Brent	To Do
1	Finished GUI	30	15	15	0	70	none
2	Optimized Navigation Algorithm	70	0	30	0	70	Improve time
3	RabbitMQ Clients for each software component	80	100	0	0	0	Motor control
4	Finished Line Following	90	0	0	100	0	Shading
5	LIDAR Integration	**	25	0	75	0	none
6	IOP Test Client	20	0	100	0	0	Understand documents
7	IOP Nav Platform	20	0	100	0	0	Understand documents
8	Control Component	20	50	50	0	0	Fill in states
9	Integration Testing MQ Clients and IOP	50	50	50	0	0	In progress
10	Integration Testing Components	50	25	25	25	25	Finish components

** Given the performance of the edge detection algorithms on line following. Another ZED may be employed using the same edge detection algorithms to identify obstacles. We also have needed to complete safety templates and may need to do hardware testing if we want to use a LIDAR.

Milestone Three Discussion

Task 1 & 2

Code has been written to pull runtime metrics from test runs. Applying them has revealed that certain things we thought needed to be optimized (space usage) are actually perfectly manageable as they are, and that run time has to do mainly with what parameters are chosen (I.e map resolution). Further examination of Dr. Gupta's dissertation will give more insight into good heuristics for choosing parameters, but the results of current testing have provided a good idea of what resolution will be appropriate for the competition course. Further optimizations will explore worst-case scenarios, searching for edge cases where the algorithm may not be sufficient as currently implemented.

Limited progress has been made on the GUI because other components need to be completed, but a rough framework has been developed.

Task 3

RabbitMQ Java clients have been created for control, navigation, IOP, and the GUI. Additional work has been done on C++ components. There are still threading issues; however, the GPS

communication unit is done. RapidJSON was selected as the JSON library for C++; subsequently, demos were created for FSU to teach how RabbitMQ works in C++.

Task 4 & 5

Algorithms run on data now recognize lines reliably on the stereoscopic camera indoors. A depth map overlay of the lines is in progress so that lines may be mapped to locations. Furthermore, the edge detection algorithm is being modified to detect changes in inclines. Using an additional ZED instead of a LIDAR is the primary goal right now. Our edge detection can be extended to obstacles so using an additional ZED for which we have developed algorithms makes sense.

Task 6 & 7

Three documents concerning the SAE JAUS standards have been purchased. The protocols outlined in those standards are being investigated and a sample test client and IOP client has been written. Custom identification headers for UDP communication are being researched.

Task 8 & 9 & 10

The control component will be implemented as the IOP component is implemented. A benefit of such an implementation is that the structure of the software will reflect the JAUS standards. Integration testing requires complete components, while many components are close to complete; none truly are yet.

Contributions

1. William Nyffenegger: wrote individual Java clients for communication. Built C++ communication framework for multi-threaded applications that sends GPS locations to other components. Reviewed designs with team
2. Chris Kocsis: finishing line detection and extending it to obstacle detection. Achieved line recognition indoors and outdoors with a stereoscopic camera using only a GPU.
3. Brent Allard: optimizing navigation algorithm and generalizing GUI for overall robot.
4. Adam Hill: read through IOP documents after acquiring them. Wrote IOP test client and a basic Java basedIOP client.

Milestone Four Task Completion Matrix

#	Task	Will	Adam	Chris	Brent
1	Finish Navigation	15	15	0	70
2	Standardize Message Formats	25	25	25	25
3	Vision & Motor Control RabbitMQ Clients	100	0	0	0
4	Line recognition and Obstacle recognition	0	0	100	0
5	Help FSU develop software	40	10	40	10
6	IOP Test Client	0	100	0	0

7	IOP Nav Platform	0	100	0	0
8	Control Component	33	33	0	33
9	Integrating Components and Integration Testing Components	25	25	25	25

Milestone Four Summaries

Task 1

Integrate navigation algorithm with previously created simulations and with the messaging framework to receive messages from the vision component. Prototype a GUI to accompany the simulation. Finish optimizations and develop methods for adjusting randomly created points if robot cannot find a path. Learn more about LPA* algorithm to integrate with pathfinding algorithm.

Task 2

Across all units develop Java and C++ standard methods for sending and receiving each message type to fill in framework completely. This will also be part of integration.

Task 3

Write C++ code for sending and receiving motor control information necessary for traveling including navigation information and position information. Write multi-threaded pieces of software that FSU only needs to fill in.

Task 4

Overlay depth information and line information to determine presence of lines and extend that code to identifying obstacle size and location. Integrate resulting information into communication framework specifically for navigation.

Task 5

Task 3 also covers this. FSU needs help designing their software components for motor control and position. Specifically, they need help with multithreaded applications. We will design the components for them if necessary and allow them to focus on the wiring issues concerning the INS and motor controllers.

Task 6 & 7 & 8

Write full software for IOP and a test client as an integration testing module for both IOP and the robot's entire performance. Construct control unit with appropriate concurrency tools for handling IOP requests and monitoring the state of the robot.

Task 9

Integrate as many components as possible with priority assigned to vision and navigation into the communication framework by the end of January to prepare for FSU visit.

Faculty Sponsor Signature

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Evaluation:

William Nyffenegger	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Chris Kocsis	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Brent Allard	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
Adam Hill	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10