Divide and Conquer V2

Go Baby Go
Group 13

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Project Narrative:

One of the most fundamental events of a toddler's development is the ability of movement. Learning how to walk, fall down, and move from one destination to another is essential for their growth and give them an underlying sense of freedom. However, children with limited mobility are not able to experience that and can make them feel socially excluded. UCF's Go Baby Go! project aims to provide these children with opportunities for mobility, participation, and play so that they can have a higher quality of life. It is our objective to help our client design and create a system that can further improve the lives of individuals with mobility impairments. The goal behind this project is to develop a prototype of an autonomous car that is affordable, durable, safe, and easy for children to use and explore the freedom of movement.

Our client requires that the Go baby Go! Car will have built-in safety features to prevent the child from crashing and hurting themselves or others around them. There will be sensors placed on the car that will be able to detect if the driver is about to collide and the car will come to a stop on it's own. This ensures that the caregiver does not need to be moving along with the car at all times. Sometimes a caregiver might have many children to watch after, so these collision-detection sensors can help them keep everyone safe. To further improve safety, there must also be a way for the caregiver to track the system and be able to intervene at a moment's notice. Through our companion web application, the caregiver will be notified if the child is about to collide with an object and give them the option to turn off the car remotely through a Bluetooth connection. This application will be easy and intuitive for anyone to uses

The Go Baby Go! cars are used by children with a wide-range of mobility impairments, so to improve the functionality of the system our customer has requested that we implement an alternative steering mechanism. The car will be outfitted with a joystick, so that more children will be able to drive the car. It is expected that the device will be used throughout various environments and some of these environments could be narrow or cluttered with others. To improve maneuverability, a zero-radius turn feature will be implemented so that the vehicle's turning circle radius is greatly reduced and will increase the precision of turns. Furthermore, since the drivers will be young children, their spatial awareness is still developing so they might not be accustomed to the turning radius of a normal vehicle. With a zero radius turn, they will be able to turn the car in any direction much faster than with a normal steering car. This feature would also help improve the battery life and efficiency of the motorized car, because less time is now needed to make a turn.

Since the Go Baby Go! is a national, community-based research program, it is important for them to continually investigate different ways to help children with limited mobility. Because of this, another key feature to our project is to incorporate data tracking. A Global Positioning System (GPS) Module will be placed on the car and will transmit data through a connection that our client can observe and analyze.

This goal of this collaboration with Go Baby Go! is to build a prototype device that will have the ability to modify readily available cars for use in the community and for research. Our team will focus on customizing and implementing affordable technology for our intended use, creating a user-friendly interface platform, and advancing common sense solutions for kids with limited mobility. We hope that this project will help restore physical independence for children with disabilities.

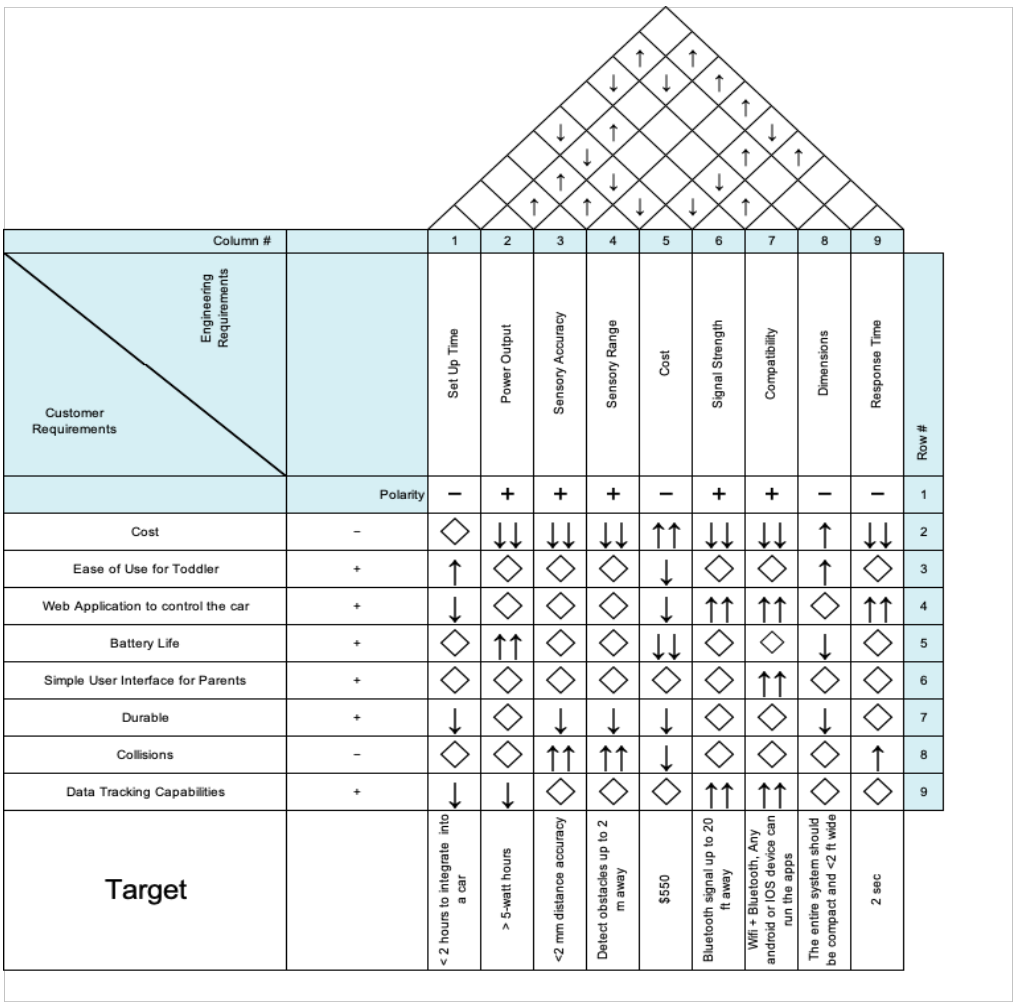
List of Requirements:

Note: Client has not come to a consensus on their requirements yet.

1. The Go Baby Go car will have a Bluetooth module that shall connect to a web application.
2. The web application will allow the parent to turn the car off and on.
3. The web application will allow the parent to steer, accelerate, and brake the car before a collision
4. The web application will allow parents to add flashcards with pictures and sort them into different categories to help their child communicate.
5. The Go Baby Go car will have a joystick to allow the child to steer, accelerate, and brake the car.
6. The Go Baby Go car will incorporate ultrasonic sensors that prevent the car from colliding into objects that are 25 cm away.
7. The web application will have a simple user interface.
8. The Go Baby Go car will have the capability of making a zero radius turns.
9. The Go Baby Go car will have a speed dial that allows the parents to set the speed of the car from 0 -6 mph.

House of Quality Diagram:

The diagram shown in Figure 1 shows the tradeoff matrix for the Go Baby Go! project. This matrix shows the tradeoff between various aspects of the design specifications and requirements.



Column #		1	2	3	4	5	6	7	8	9	
Customer Requirements / Engineering Requirements		Set Up Time	Power Output	Sensory Accuracy	Sensory Range	Cost	Signal Strength	Compatibility	Dimensions	Response Time	Row #
	Polarity	−	+	+	+	−	+	+	−	−	1
Cost	−	◇	↓↓	↓↓	↓↓	↑↑	↓↓	↓↓	↑	↓↓	2
Ease of Use for Toddler	+	↑	◇	◇	◇	↓	◇	◇	↑	◇	3
Web Application to control the car	+	↓	◇	◇	◇	↓	↑↑	↑↑	◇	↑↑	4
Battery Life	+	◇	↑↑	◇	◇	↓↓	◇	◇	↓	◇	5
Simple User Interface for Parents	+	◇	◇	◇	◇	◇	◇	↑↑	◇	◇	6
Durable	+	↓	◇	↓	↓	↓	◇	◇	↓	◇	7
Collisions	−	◇	◇	↑↑	↑↑	↓	◇	◇	◇	↑	8
Data Tracking Capabilities	+	↓	↓	◇	◇	◇	↑↑	↑↑	◇	◇	9
Target		< 2 hours to integrate into a car	> 5-watt hours	<2 mm distance accuracy	Detect obstacles up to 2 m away	$550	Bluetooth signal up to 20 ft away	Wifi + Bluetooth, Any android or IOS device can run the apps	The entire system should be compact and <2 ft wide	2 sec	

Polarity	
Positive	+
Negative	−

Relationships	
Strong Positive Correlation	↑ ↑
Positive Correlation	↑
Strong Negative Correlation	↓ ↓
Negative Correlation	↓
No Correlation	◇

Figure 1: House of Quality Diagram for Go Baby Go! Project

Block Diagrams:

The block diagram in Figure 2, provides information about the different components of the Go Baby Go! Project and how they interact with each other. This diagram also identifies who is responsible for each block by color and where the block is in the design process. Explanation of each block can be found below.

1. Steering system
    1.1. Hardware

- 1.2. Software
  - 1.2.1. Left and Right turns
  - 1.2.2. Zero degree turns
2. Control System
   - 2.1. Design
     - 2.1.1. Joystick option
     - 2.1.2. Wheel and paddle/pedal option
   - 2.2. Software
   - 2.3. Coding
     - 2.3.1. Interaction with steering system
3. Geolocation
   - 3.1. Hardware
   - 3.2. Configuring
   - 3.3. Software
     - 3.3.1. Location polling
     - 3.3.2. Storage
4. Sensor system
   - 4.1. Design
     - 4.1.1. Location of sensors
     - 4.1.2. Number of sensors
     - 4.1.3. Detection limits
   - 4.2. Hardware
   - 4.3. Software
     - 4.3.1. Collision detection
5. Motor system
   - 5.1. Hardware
     - 5.1.1. Power
   - 5.2. Software
     - 5.2.1. Control speed
6. Bluetooth connection
   - 6.1. Hardware
   - 6.2. Configuring
     - 6.2.1. Baud rate
     - 6.2.2. Sampling
   - 6.3. Software
     - 6.3.1. Data handling
7. Web Application
   - 7.1. Software
     - 7.1.1. Geolocation
     - 7.1.2. Bluetooth communication
     - 7.1.3. Remote on and off
     - 7.1.4. Steering Capabilities
8. Main board design
   - 8.1. Hardware
     - 8.1.1. Module layout
     - 8.1.2. Pin and pin out

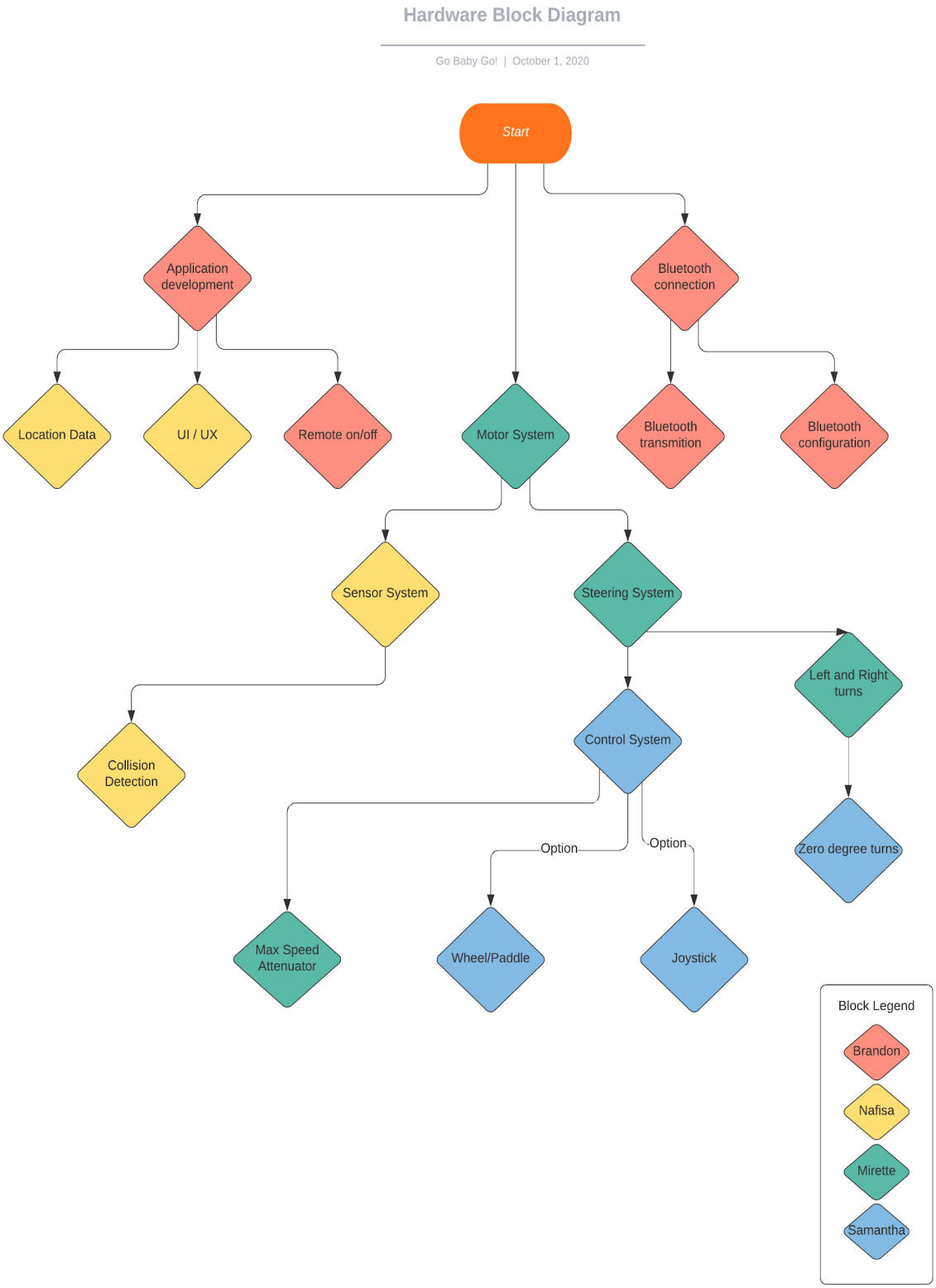


Figure 2: Hardware Block Diagram

Estimated Budget:

The Go Baby Go Car! Project is sponsored by UCF's Go Baby Go! Program. The parts listed in Table 1 give a basic idea of the components that will be needed for this project. The total price is only a rough estimate, as it is likely that other parts were overlooked and the design specifications will change as the semester progresses.

Table 1: Estimated Budget for Go Baby Go! Car Project

ITEM	PRICE ESTIMATE
Collision sensors	$10 – $40
Motors	$45 - $100
Joystick	$20 - $120
Power source	$30 - $100
Bluetooth Module	$3-$50
Web Application Module	$40-50
Motor Module	$100 - $250
Custom PCB	$30 - $150
Miscellaneous (Tools, Wires, etc)	$50 - $150
TOTAL (Estimated Range)	~$328 - $1010

Project Milestones:

The project milestones for the Go Baby Go! Car project is shown in Table 2. These milestones are divided between the two semesters of senior design and name the person/group responsible for each task.

Table 2: Project Milestones for Go Baby Go! Senior Design Project

Senior Design 1		Planned Completion
Familiarize ourselves with the project	Group 13	09/15
Role Assignments	Group 13	09/15
Identify parts	Group 13	09/25
Project Report		
Initial Document	Group 13	10/08
Updated initial document	Group 13	10/16
First draft	Group 13	11/22
Final draft	Group 13	11/27
Final document	Group 13	12/04
Research, Documentation, and Design		
Sensors Module	Nafisa	12/04
Bluetooth Module	Brandon	12/04
Joystick Module	Samantha	12/04
Motors Module	Mirette	12/04
Application	Brandon	12/04
Schematics	Group 13	12/04

PCB	Group 13	12/04
Order and Test Parts		
Senior Design II		
Build Prototype	TBD	TBD
Testing and Redesign	TBD	TBD
Finalize Prototype	TBD	TBD
Peer Presentation	TBD	TBD
Final Report	TBD	TBD
Final Presentation	TBD	TBD