Go Baby Go

Background Report

Team 22

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ABSTRACT

This background report discusses the background, requirement and existing design components of the 'Go Baby Go' project. The research program suggests for certain modifications to further improve the performance of the ride-on car developed under this project. The project is to design a device that assists a child with a mobility handicap, in which an option is to retrofit a ride-on-car. The client has a list of requirements that weighted based on importance and need to be met for the project. This work analyzes are already available designs and considers the new customer requirements to provide a new design that is cost effective and more comfortable to the special kids. Various aspects related to the ride-on car of this program is discussed from a managerial point of view and modifications are suggested. Existing designs by the 'Go Baby Go' club assists in the design the team decides on.

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1 BACKGROUND

1.1 Introduction

'Go Baby Go' program is a research program started in 2012 by Dr. Cole Galloway to support the toddlers and children who have disability [2]. It is a partial charity program. The aim of the 'Go Baby Go' program is to provide mobility to these children at a tender age. Kids having disability finds it hard to manage with the wheelchairs and needs some mechanism to move with ease. 'Go Baby Go' program is meant to develop ride-on-cars that are specially designed for kids [3]. This project aims to provide assistance to the mentioned research program and to further simplify the ride-on-car design so as to make it more cost effective and to extend its reach to more and more kids in need.

1.2 Project Description

This project mainly aims on two different aspects to further simplify the ride-on-car design. The first aspect is to improve the control system. For example, sensors can play a role with the controller for the car to move from a specific distance and to allow it to stop. Advance control features can be added to provide the safest driving conditions to make it easier to operate. The cost can be reduced through proper selection of design methods. The second aspect is to further improve upon the seat comfortability. The seat can be designed to be adjustable and adapt as per the kids' physique. It must provide maximum comfort and at the same time must be liked by the kid that will be using the car.

1.3 Original System

1.3.1 Original System Structure

The original system is just a slight modification of a commercially available toy car. The existing design improves the ruggedness and control of the already available toy car. The prime objective of the program is to develop a cost effective vehicle and hence must of the improvements are not carried out in the presently available cars [4]. Few compulsorily required features are carefully added to the system.

1.3.2 Original System Operation

The 'Go Baby Go' program has a base model to its ride-on-car and does a small modification with respect to the child's needs (depending upon the extent of disability). In certain cases, a child with disability may have control over hand but not legs and vice-versa. In such situations the vehicle design is made with respect to the kid's capability to operate. Some of the designs are switchable to different modes depending upon the child's actual need.

1.3.3 Original System Performance

The performance of the original system is quite good. The original system of the design suits well with the kids need, however, the technology is not utilized to its fullest and further comforting the children without much cost implications [5]. The available system can operate in different modes

with slight design change. The available operating modes are sitting mode, standing mode, advanced standing mode, walking mode and many others. The design gives a lot of emphasis to the safety in operation and makes sure that the kid using the car may not get hurt in any case. The present system performance is very good and is in line with the child's needs.

1.3.4 Original System Deficiencies

The system at present is satisfactory, cost effective and simple to use. However, a lot of further modifications can be done to further improve the system performance. For example, the present system does not have power control and the kids have to do a lot of steering adjustment to drive the vehicle. The seat in the ride on car is un-adjustable and all the kids have to adjust themselves to it. The present vehicle has no monitoring for obstruction.

2 REQUIREMENTS

2.1 Customer Requirements

The customer requirements are mainly to design a car that is adaptive in nature and suit to kids having different physique. The toy car must be flexible to operate in different modes. It must be highly durable and take loads for a longer time [1]. The vehicle needs to have a low cost to make it affordable for the child's parents. Vehicle aesthetic is important for the kids to get attracted and start playing with it. Safety is an important aspect for the kid using the car; it must be safe to operate.

2.2 Engineering Requirements

There are several engineering requirements that need to be met for the design that is getting made. Some of them include; first, is that the weight should not exceed 130 lb. the weight is a safety aspect, for the particular device to stabilized with the child in it. Also another reason is for the family to be able to move it easily and comfortably. For a child's safety, there should be no sharp edges and no sharp corners.

The other thing is that the seats need to be comfortable for the children that are using the cars. Therefore, the team has a requirement for the speed to be adjustable and to start accelerate from 0 to 5 Mph.

Engineering Requirement
Weight <130
No sharp Corners
Battery Max 12V
No sharp edges
speed 0<2.5<5 Mph
Tolerance

Figure 1 Engineering Requirements

2.3 House of Quality (HoQ)

While designing for the work, a complete attention is required on quality and safety of the ride-on car. The design must be such a way that, it can go in line with the customer's need. After going through the customer needs, the design team must figure out certain crucial areas and focus on them to get the required quality. Emphasis must be put on and fine tuning must be made until the required quality is met. Any compromise with the quality will ultimately lead to unpredicted failures and will totally mess up the situation. Proper weight has to be given to each of the customer's need and design work has to be carried out accordingly.

Customer Requirement	Weight	
1. Low cost	3	
2.Ease of Assembly	3	
3. Safety	5	
4. Aesthetic	2	
5. Accelerетion/Decelerетion Control	4	
6. Comfortabilty	4	
7. Lightweight	2	
8. Durable	4	

Figure 2 HoQ

3 EXISTING DESIGN

3.1 Design Research

The existing designs under the 'Go Baby Go' program involve an in-depth analysis on the actual requirement and listing the possible solutions. Each of the listed solutions are further analyzed to select the option that best suits the requirements [5]. The selected option is then studied for the practical feasibility. A particular design is selected after a serious study and testing.

3.2 System Level

Research in the area of providing power cars to kids started from late 1980s [1]. Over the period of time with the advent of modern technology many modifications have been brought about. The table below shows the development in the design area

Table 1. Design Research Over Time [1]

Year	Car Design
1980	Adapting Power Chairs for young children
1990-95	The Cooper car
1995-1999	Go BOT
2000	The standard Paediatric Power Chair
2005-2010	Mobile Robots
2010-2015	Go Baby Go Modified Ride-on car

Technology has played its role over time and a lot of modifications have happened. However, in recent times with the beginning of 'Go Baby Go' program, much of the emphasis has been put on the cost control and simple design. The objective of the programs is to provide low cost and maximum comfort vehicles to the kids. Therefore, certain compromises have been made with the features to make it available to maximum kids with disabilities as possible.

3.2.1 Existing Design #1: Ride-On-Car

The ride-on-cars are modified due to the child's disabilities and parent's requirements. The modifications differ from one kid to another. Some ways that the cars were modified are; playing around with the wheels; change the steering wheels, cushions, safety system modification, and much more. Some kids might need entertainment, such as adding an iPod dock, or even just a radio system.

3.2.2 Existing Design #2: Playpen Harness

The Harness Play Pen is a mobility assisting system that utilizes a safety harness and pulley system. The child is secured into a harness and moves around within a 10'x10' play area. There is a pulley system that gives assistance to a child by applying additional leverage support for the child to walk. The system allows the child to move freely within the given area [10].

3.2.3 Existing Design #3: The Original Plasma Car

The Plasma Car is human energy powered self-propelled toy that is designed for children to move around. It uses the twisting motion of the steering wheel that utilizes the natural forces of inertia, centrifugal force and friction to move the car forward and backwards. The Plasma Car does not require any external power sources and has a durable structure for a child to use safely. The physic fundamental that the car incorporates allows any user to operate the car quickly [9].

Figure 3 Plasma Car

3.3 Subsystem Level

The main area of focus is on the improvement of the controllability, introduction of power wheels and improvement on the seat efficiency. The controllability can be improved by using microcontroller based systems. Powerful microcontrollers and sensors can be used to design the

circuit and improve controllability. Introduction of the power wheels will be helpful for the kids in assisting the steering to drive the vehicle. The power wheels can be used through proper mechanical design and powerful drive motors. The seat ergonomics can be enhanced by understanding the baby sitting posture and design accordingly. The special kids may have certain abnormal body posture and seat efficiency must be according to the physical examination of the individual kid. Some software can be developed that will take the inputs on the kid's physical size and will provide the seat design with parameters.

3.3.1 Subsystem #1: Safety

3.3.1.1 Existing Design #1: PVC Pipe around the car frame

The roll cage is built with PVC pipes mounted around the car frame [8] Figure 4 below is one way of how PVC pipes protect the child while playing around with the ride-on-car.

Figure 4 Roll cage on a ride-on-car with PVC pipes

3.3.1.2 Existing Design #2: Seat Belt

A seatbelt is the easiest and the most practical safety product a kid can have. It can be bought off the shelf from any hardware store.

3.3.1.3 Existing Design #3: Body Side Support

Body side support is constructed with foam sheet and can be adjusted. It is a support system for the child, while it straightens out the body, and also helps with the safety of the child, as shown in figure 5 below [8].

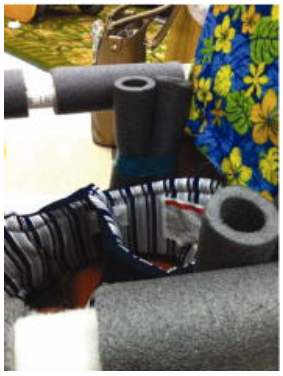


Figure 5 Body Side Support

3.3.2 Subsystem #2: Steering

3.3.2.1 Existing Design #1: Push-button switches of various sizes

With a change of wires, the ride-on-car can be controlled with buttons, shown in figure 6 below. The push button switches can be plugged into the connector directly allowing the use of various steering systems. These buttons are placed instead of the steering wheel [8].

Figure 6 Push Buttons

3.3.2.2 Existing Design #2: Bar handle style with different sizes of PVC pipe

Basic steering-drive system options include a round steering wheel with push-button switches of various sizes and a bar handle style with different sizes of PVC pipe shown in figure 7 below [8].

Figure 7 T-Bar Handle Control

3.3.2.3 Existing Design #3: Joystick

A child with muscular diseases have a hard time controlling a steering wheel. A joystick is the best option to steer a ride-on-car. There are two types of joysticks, one is controlled by the arm and the other is controlled by the hands and the fingers. This depends on the kids' ability and comfort when they move their hand. In figure 8 below, is a diagram which is one example of how a joystick could connect to a ride-on-car [6].

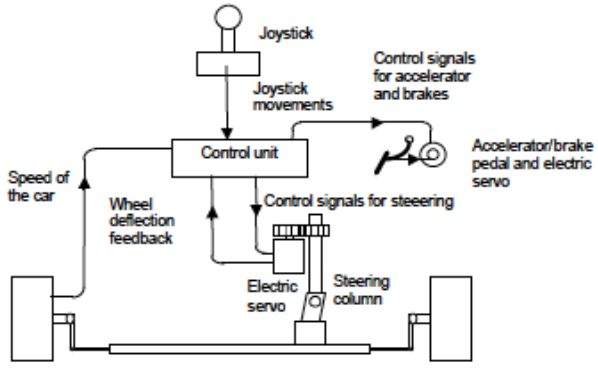


Figure 8 A diagram of how a joystick connect into the car

3.3.3 Subsystem #3: Acceleration

3.3.3.1 Existing Design #1: Lever on a ride-on-car

One idea was to play around with the acceleration lever on the car. Some ride-on-cars have that lever, where the side of the lever has a screw which can be removed, and with that it plays with speed variance shown in figure 9 [7].

Figure 9 Joystick in a ride-on-car

4 DESIGNS CONSIDERD

4.1 Design #1: The Solar Panel Car

The solar panel car, is design to help not only the child in-need, but also with the environment. This car is going to be designed in a way where the car will have a solar panel on top of the car, and it will then have a cross-belt, where the kid is also safe to move with the solar energy. This can have a bad side to it, this car is going to cost a lot, also it will be hard to assemble. The car will not have durability, and will be heavy to work with. But for the upside of the solar panel car is that the car could have a better and probably more stable acceleration/ deceleration. As shown below in figure 10, is a figure of the car.

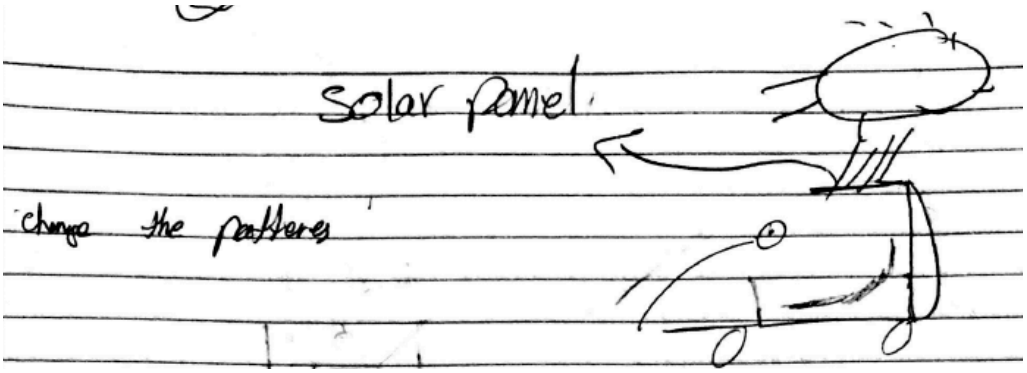


Figure 10 Solar Panel Car

4.2 Design #2: The Battery

The battery in the figure #11 below will be based on a way for the child to have control over the speed. The battery will have 3 switches and the first 2 switches will have speeds of 1 volt, while the third battery will have 2V. when the child turns the first switch on, the car will have a speed of 1 v. When the 2nd switch turns on, the first and second battery will work together increasing the acceleration to 2 volts. While the third switch is turned on, all of the 3 batteries work together and gives the car an acceleration of 4 volts.

The good thing about this prototype is that the child will have control of the speed, and not be stuck with a constant speed.

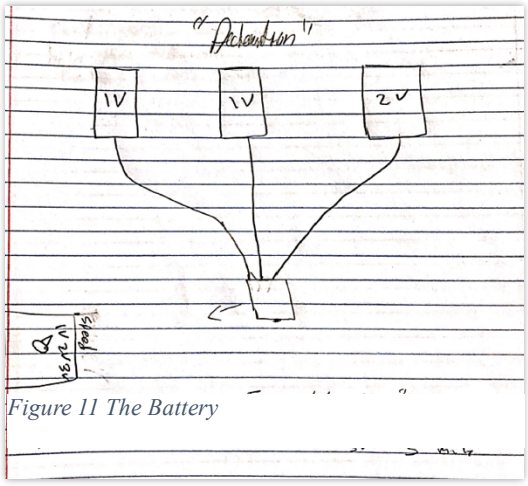


Figure 11 The Battery

4.3 Design #3: The Ride-On Baby Jeep Car

The ride-on car is one of the most comfortable design for a child with disability. This prototype is main source on the go-baby-go program. The only difference with this car is that the seatbelt will be a cross harness to support the child's back. The steering wheel is going to be change and be a circular wheel which is a touch pad.

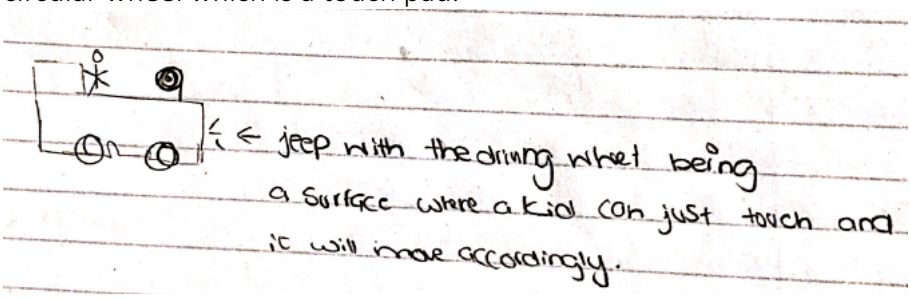


Figure 12 Ride-On Baby Jeep Car

4.4 Design #4: The Jet Pack

The Jetpack as shown in figure 13 below, is particularly a jetpack that can be sold in stores or online. This jetpack is a fun, and wild ride. With it having a higher and much faster acceleration/ deceleration but it can also be pricier, hard to assemble, it is also less safe for a child with a challenge to work around with. The good thing about the jetpack though, it has a good aesthetic.

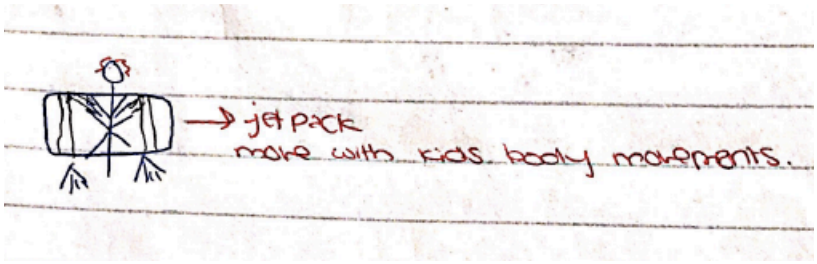


Figure 13 The Jet Pack

4.5 Design #5: Dino Car

Something similar to ride-on jeep car is the dino. The dino has the same features of the ride-on car such as the pricing, ease of assembly, safety, aesthetic, a reasonable acceleration/ deceleration, and also will be durable and light-weighted. The dino car will be the same as any electronic toy car, but with a harness that will be placed as a cross belt to protect the child from falling off and to protect the child's back from bending, also to pull the child from any sudden motion. Below is a figure of the dino car.

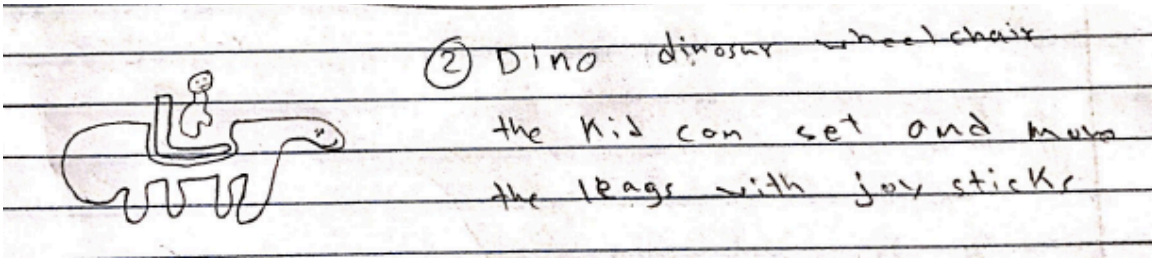


Figure 14 Dino Car

4.6 Design #6: The Walker

The walker is a circular stand which has four wheels shown in figure 15 below. The wheelchair is a standup/ sit-down chair, that is very safe for a child. The child can be placed into the circular space, which has a pamper like seat. It is very comfortable and a parent wouldn't worry about the child's safety.

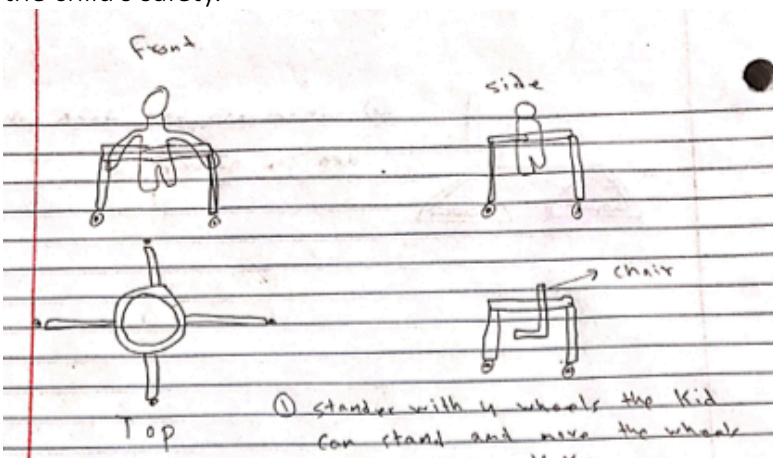


Figure 15 The Walker

4.7 Design #7: Spider Chair

A spider chair has 8 legs. It's probably like a walker, but instead, the chair looks like a spider. It is also controlled with a joystick. The price will be similar to the ride-on-car with a higher aesthetic, and is safer. While it has a lower acceleration/deceleration, due to the weight of the chair, also it is harder to assemble.

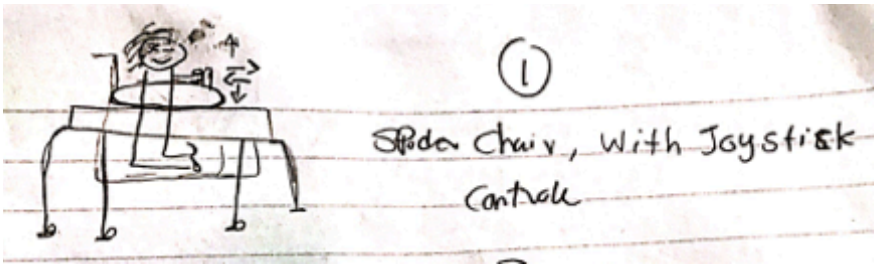
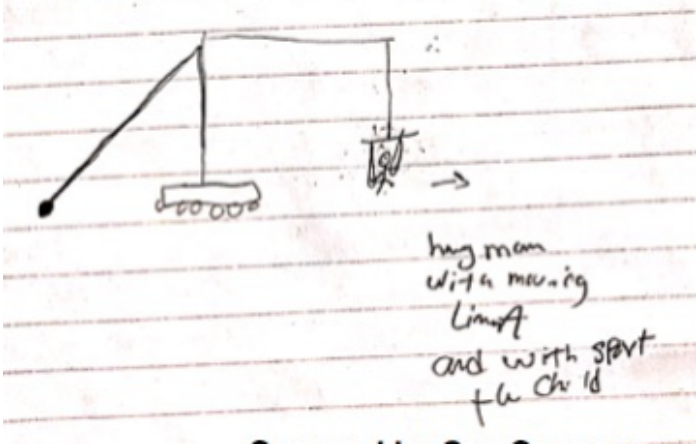


Figure 16 Spider Chair

4.8 Design #8: Hangman

This design literally looks like a hangman game. This design is support by a beam that is connected to a wheeler which both are connected to a bounce string. The child will be placed into the bungee rope chair were the child could bounce off and move at the same time. The cost is the same as the ride-on-car, with the same safety and aesthetic. The disadvantage is that it's less safe, less comfortable, and has a lower acceleration/ deceleration.



4.9 Design #9: The Pod

The pod is a device that kind-off looks like an egg. It is electronically powered by a motor vehicle, shown in figure 18 below. Due to its motor, the pod is more expensive than the ride-on-car, but is safer due to the child's seat being covered with foam. The acceleration/ deceleration is better to control due to its electronic features. With a child being placed into the pod, it may be less comfortable for the child. It might be a bit tight for the child to have the space to freely express him/herself.

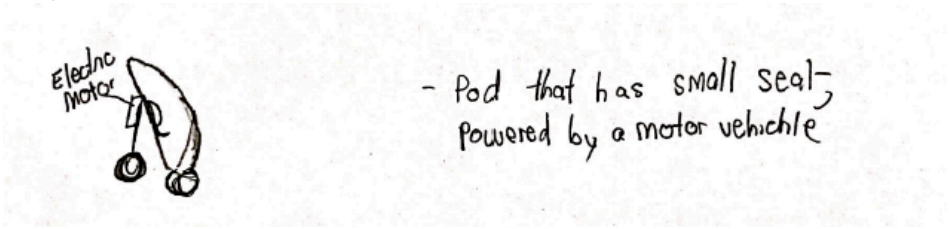


Figure 17 The Pod

4.10 Design #10: Bending Bearing

This concept has the same as the ride-on-car cost. The child can bounce up and down, which creates a propulsion of the system. This concept has a harder assembly and is less safe. This concept helps the child to move around a bit freely, but at the same time makes the child a bit tired from all of the movement. The bearing is a light weight device.

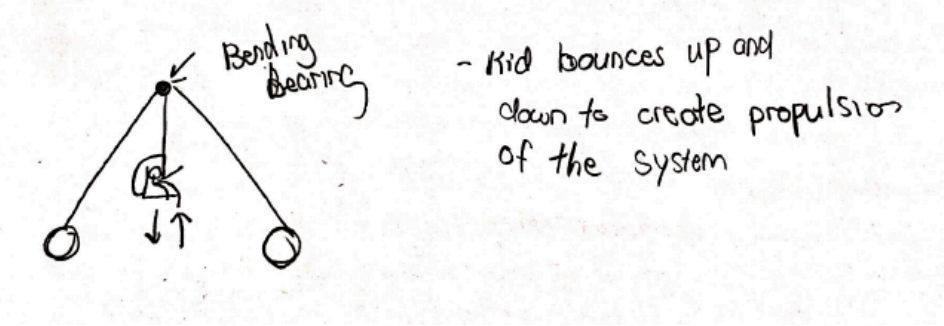


Figure 18 Bending Bearing

5 DESIGNS SELECTED

5.1 Rationale for Design Selection

From all of the 20 designs the team came up with, which includes the 10 above; the team made a Pugh chart with all of the customer requirements. The Pugh chart is assembled with plus, minus, and s signs. These indicate if the device due to the requirement is better, lower, or the same as the datum. The team choose the ride-on baby jeep car due to it being similar and probably one of the best choices for a go-baby-go project. As shown in the figure 20 below, is a sum of the four best concepts that fulfilled the datum's priority.

Concept/ Criteria	Jeep	Battery Acceleration	Walker	Dino
#'s	7	3	17	18
Low cost	D	+	+	S
Ease of Assembly		-	+	S
Safety	A	+	+	S
Aesthetic		S	-	+
Acceleration/ Decceleration Control	T	+	-	S
Comfortability		+	S	S
Lightweight	U	S	S	S
Durable		S	S	S
Total +	M	4	3	1
Total -		1	2	0
Total S		3	3	7

Figure 19 Design Selection

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