ECE445 Project Proposal

Quadpod transform vehicle

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Contents

1. Title:

Our main purpose in this project is transformation. The idea we had was to build a scaled model of a vehicle, which would transform into a quadpod when the vehicle encounters obstacle. The obstacle could be any place difficult to move by vehicle but we're mainly focusing on rough unpaved road or hill. Since we already have certain design schematic in our mind, we won't be using an already built car; we will build both car and the leg parts of the project from the scratch. There will be 2 legs on each side, which will be hidden inside the vehicle while in car mode. We will be using 9 motors; 2 motor for vehicle, 4 motors for the legs and 4 motors for transformation. The 4 legs will be fixed at certain position and will follow a circular motion similar to that of train. We are also installing a touch sensor inside the front bumper of the vehicle, so that it can detect the obstacle whenever the vehicle hits it for a few sec. The project will be fully controllable by the user with a controller. We believe this project is important because this scaled version of vehicle can access places (mountain and bumpy roads) that the vehicle cannot get through with typical wheels. This project merely shows the basic concept of the transformable vehicle but it may help the vehicle to be used in more various situations in the future.

2. Objectives:

Goal: To experiment a transformable car using a scaled model for future use.

Functions: The vehicle can pass through the ground that the typical vehicle couldn't get through.

Benefit:

a) Vehicle can overcome obstacles such as bumpy road, mountain, jungle and forest, which typical car can't get through

b) Vehicle automatically transforms when the conditions are met.

c) Car can convert to the Quadpod when the car encounters obstacles

d) Both car mode and Quadpod mode are fully controllable by controller

Feature benefit:

a) The vehicle can sense obstacles by using touch sensor in the bumper

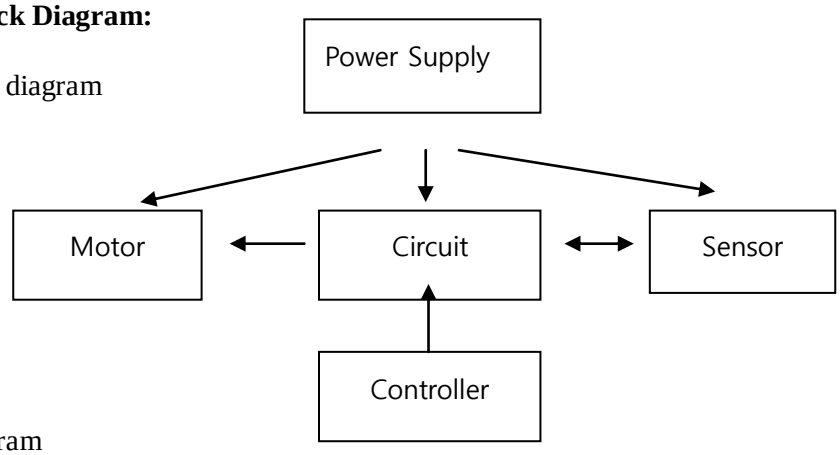
b) Multifunctional vehicle for using at multipurpose.

c) Easily controllable by using controller

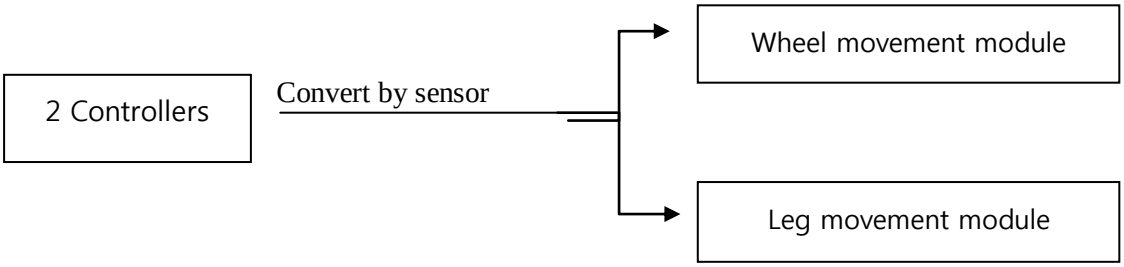
II. **Design** **2**

1. **Block Diagram:**

Modularity diagram



System diagram



2. **Block Descriptions:**

Power supply: 8 Rechargeable Battery. This power source gives electricity to the motor, sensor and circuit block.

Motor: Minimum 5 motors will be used. One for the car mode and 4 for the QuadPod's each leg; the four motors will work as a joint for the leg's movement. The power this motor use will be coming from the power supply and the signal for the motor's operation will be coming from the circuit block.

Sensor: It will be touch sensor and it will be installed inside the front bumper. Sensor will give the particular signal to the circuit depending on whether car hits the obstacle for few fixed seconds.

Circuit: Circuit will get signal from the sensor and decide which motors will be used. If the circuit receives the certain signal from the sensor, it will send the signal to the motor so that vehicles will transform. After some times, the circuit send signal to the motor so that the Quadpod can transform back to the vehicle mode. The circuit also gets signal from the controller to control each leg's and wheels' movement.

Controller: Controller will have an independent power source. Controller send signal to the circuit so that we can control the movement of vehicle and Quadpod.

III. Block Level Requirements and Verification 3

1. Requirement And Verification

Since the project has two different modes, we need to test each mode separately. While the Project is in vehicle mode, we will mainly test operation of wheel movement and the direction control. While the project is in Quadpod mode, we will test the balance of the vehicle while it's moving. Also, during transformation, we will test whether vehicle transform to the Quadpod well when the conditions are met.

a) Power Supply:

Each power supply/battery will be attached to motor. Since there will be 2 different types of motor requiring different voltage, 2 different types of power supply will be used. While in car mode, the power supplies attached to the Quadpod motors will be disabled. Reversely, while in the Quadpod mode, the motors used as the engine for the vehicle mode should be disabled. We will test this by simply controlling motor in each case.

b) Touch Sensor

The touch sensor will be installed inside the front bumper and will be responsible for detecting obstacle. The sensor we had in mind is a circuit system that allows electricity only when the front bumper is pushed. We will test this by adding LED to the sensor's circuit and test whether the LED light up when the bumper is pushed.

c) Motor

There will be 10 different motors used for the project. 2 motors will be used for the operation of the vehicle mode, 4 motors will be used for the Quadpod mode, and 4 motors will be used for the transformation. Since the way motors operate will be controlled by the Power supply, only thing we need to test is whether the motors run with the specific power supplies.

d) Controller

Two controllers will be used for the car mode and the Quadpod mode separately for this project. As this vehicle does not have a steering control, the remote controller will control the movement of the left/right wheels or legs to make a turn. The two controllers will be responsible for the each mode because the motors for the wheels and the legs operate independently. We will check the controller by installing LED at the receiver so that we can know that the signal that we want is received.

e) Circuit

We will use the logic board that we used in ECE110 lab. Since all of us are majoring in Electrical engineering, we are lack of intelligence on coding. So, this logic board will help us out to make the robot work just as we want. We will test this logic board by using LED on each output so that we know the right output is made for our project.

2. Tolerance Analysis 4

One of the main concerns we have is the leg movement of the Quadpod. Firstly, we need to check that the legs have enough strength to lift up the whole vehicle when the transformation happens. Since the legs need to hold up the whole weight of the vehicle during the transformation, checking if the legs have sufficient energy and power will be a challenge. Also, every leg has to move simultaneously so that the Quadpod will maintain balance and move forward. In order to do that we need some major coding that will allow well-balanced leg movements. Also, our touch sensor is so sensitive that it may malfunction and transform when it is not necessary. Therefore, we are going to put two springs to hold the bumper to prevent from unnecessary bounce.

IV. Cost and Schedule

1. Cost Analysis:

Name	Hourly Rate	Total Hours Invested	Total =Hourly Rate X 2.5 X total hours Invested
Kee Woong Haan	$30.00	125	$9,375
Jiwon Park	$30.00	125	$9,375
Zenon Son	$30.00	125	$9,375
Total	$90.00	375	$28,125

- **PARTS:**

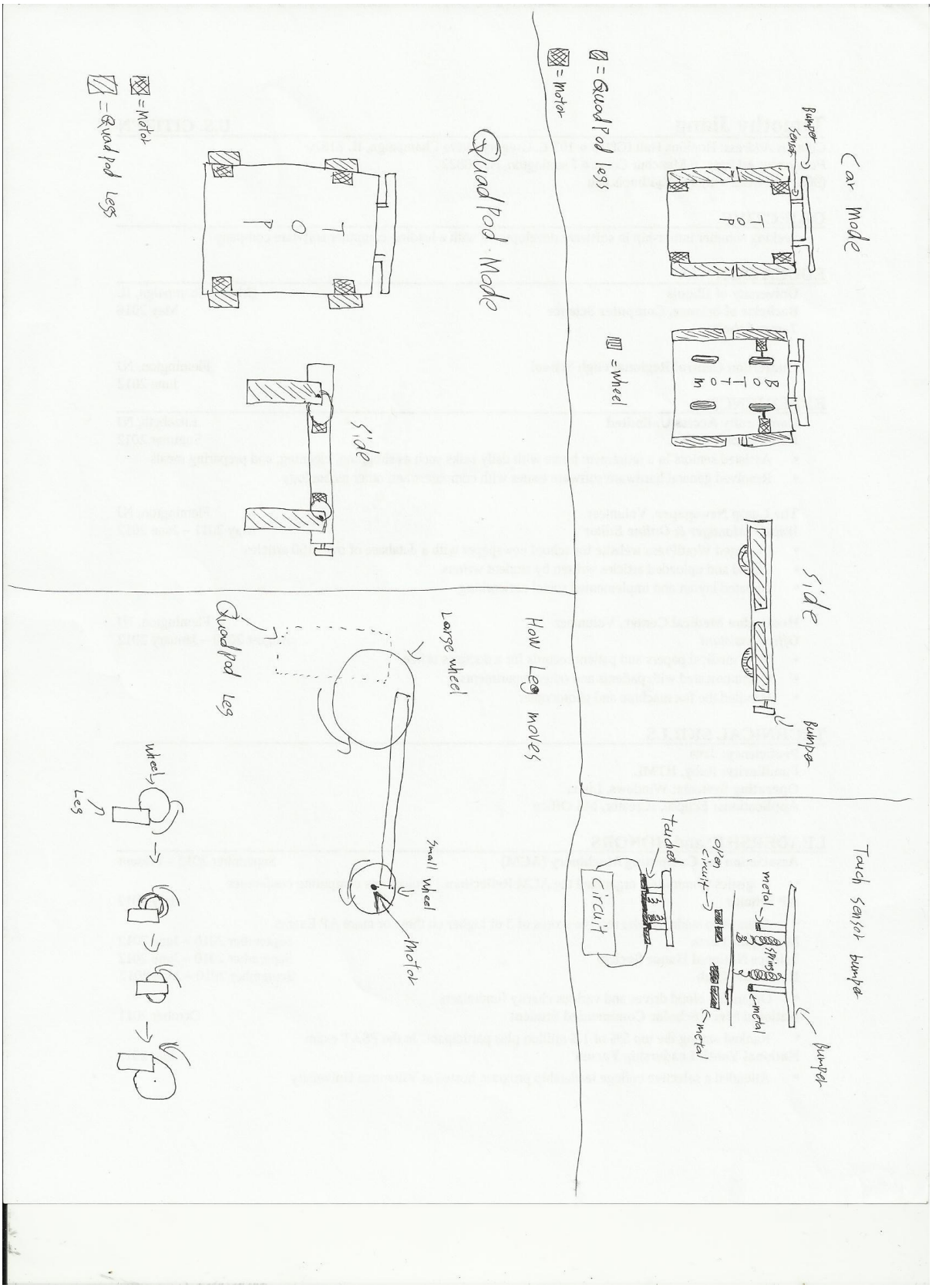
Part	Part Number	Unit Cost(Estimate)	Quantity	Total
Frame set with motor And controller	625412 555004	$40.67 $62.99 X 2	3	$166.65
Parallax Standard Servo	900-00005	12.99	4	$51.96
Sensor LED Spring Al rod	 350-00001 #######	 $0.5 0 0	 2 4 1	 $1 0 0
Power 9V battery Rechargeable 1.5V battery	 ######## ########	 $2 9/pack	 1 1	 $2 $9
Circuit Logic board	 #######	 $30	 1	 $30
Total	$260.61			

GRAND TOTAL = $28,125 + $260.61 = $28,385.61

2. Schedule **5**

Week	Kee Woong Haan	Zenon Son	Jiwon Park
9/16	Project Proposal		
9/23	Vehicle Frame Work (Vehicle Structure, Sensor Bumper) Installing Electrical Component for Vehicle (Motor, controller) Testing Start Design Review		
9/30	Quadpod Frame work (Legs) Installing Electrical Conponent for Quadpod (Motor, controller) Testing Finish up Design Review		
10/7	Adding Additional Electrical Modules (Integrating Circuit, Sensor) Wired Electrical module with the vehicle.		
10/14	Creating Program For The Circuit (Coding)		
10/21	Individual Process Report		
10/28	Overall Debugging		
11/4	Mock-up Demos		
11/11	Work on Presentation and Paper		
11/18	Thanksgiving Break (Recover Late Work)		
11/25	Preparation for Demo and Presentation		
12/2	Demo and Presentation		
12/9	Final Paper Due and Check out		

Note: We all going to work together in each part, therefore, there is no individual works.


Car Mode
Bumper
sonar
TOP
BOTTOM
side
bumper
= Quad Pod legs
= Wheel
= Motor
Quad Pod Mode
= Motor
= Quad Pod Legs
TOP
side
How Leg moves
Large wheel
Small wheel
Motor
Quad Pod Leg
Wheel
Leg
Touch sensor bumper
bumper
metal
spring
metal
open circuit
metal
touched
circuit