Report 1 (25 pts, Due10/22): The Problem must be initially formulated in the Formulator software. After reading the problem statement, please give your initial reaction as answers to the following questions (before using the Formulator):

1. What are the explicitly stated requirements?

The explicitly stated requirements are as follows:

* The vehicle should start and stop at reference point.
* The vehicle should fit in a box of 6 x 6 x 12 inches.
* The vehicle should use only 1 or 2 Radio Shack DC motors (part number 273-223, 258 or 047) and compatible batteries. No other energy source shall be included within the vehicle.
* The vehicle must travel around building 1, cross the reference point, and travel around building 2, then come to a stop at or near the reference point.
* There should be an index mark on the vehicle.
* The vehicle should be autonomous.
* Guide ways or chutes or tracks should not be made.
* Micro-controllers or any type of CPU is NOT allowed; however non-programmable electronic or electrical components can be used.
* The vehicle should be capable of stopping at a precise location.
* The vehicle should be capable of completing the circuit in minimum time possible.
* The design and construction should be done by us and it is not allowed to retrofit an RC car, but its parts can be used in the making of our vehicle.

1. Are there any implicit requirements, or ones that you might add/derive?

The implicit requirements are as follows:

* A vehicle should not contact either building (not larger than 12 X 12 X 12 inches and not smaller than 9 X 9 X 9 inches) (As it has been mentioned that if this happens you will be disqualified).
* Not a single vehicle part should depart from the plywood sheet (Dimensions 4’ X 8’ X ½”) (As it has been mentioned that if this happens you will be disqualified).
* The vehicle should be capable of maneuvering the turns on its own i.e. without the help of guide ways or chutes or tracks.
* The vehicle should be light in weight so as to have small inertia such that the stopping location can be precisely controlled.
* As the maximum power supply required for 1 Radio Shack DC motor motors (part number 273-223, 258 or 047) is 3 V hence maximum power supply of 9 V (3 V for each motors and additional 3V for overcoming potential drops and frictional losses) can be used.
* The length and diameter of 1 Radio Shack DC motor motors (part number 273-223, 258 or 047) is 1.5 inches and 0.94 inches respectively hence the chassis or body of the vehicle should be capable of housing the motors and the power supply required for it.
* The maximum rpm of the motors in no load condition is 8300 rpm so we need so some sort of speed reduction mechanism.
* The cost of the vehicle should be less than 100 $.
* The vehicle should be easy to start i.e. by just pressing a switch it should start.
* The vehicle should have steering mechanism or differential motion of the wheels in order to take a turn.
* Should consume power efficiently.

1. Is there any information missing? If so, what?

The missing information is as follows:

* What is the specifications of the batteries that are allowed and how many number of such batteries are allowed?

1. Is there any needless information? If so, what?

The needless information is as follows:

* As it is mentioned that“Once started, no communication of any kind shall be transmitted to the vehicle” so it is needless to mention that “………..in the starting position and motion initiated by a **"switch"** on the vehicle.” It is needless to mention that switch should be used to start the motion of the vehicle.
* The thickness of the plywood (1/2 inch) is not required.
* The boxes are corrugated is a needless information.

1. What is the most important thing that needs to be achieved?

The most important thing that needs to be achieved is:

* Turning of vehicle in order to keep the vehicle on the circuit and also avoid touching the buildings.
* Making the vehicle autonomous without the use of Micro-controllers or any type of CPU.
* Completing the circuit in minimum possible time and also stopping it precisely at the reference point.

1. What is the most difficult/challenging aspect of this design?

The most difficult/ challenging aspect of this design is:

* Making the vehicle autonomous without the use of Micro-controllers or any type of CPU.
* Completing the circuit in minimum possible time and also stopping it precisely at the reference point.

Work in the Formulator tool to expand your problem definition; name your project as D2 Challenge. In addition to the data collected by the Formulator, submit the following in your report:

1. Make a list of requirements (mark them as explicit or derived)

The explicitly stated requirements are as follows:

* The vehicle should start and stop at reference point.
* The vehicle should fit in a box of 6 x 6 x 12 inches.
* The vehicle should use only 1 or 2 Radio Shack DC motors (part number 273-223, 258 or 047) and compatible batteries. No other energy source shall be included within the vehicle.
* The vehicle must travel around building 1, cross the reference point, and travel around building 2, then come to a stop at or near the reference point.
* There should be an index mark on the vehicle.
* The vehicle should be autonomous.
* Guide ways or chutes or tracks should not be made.
* Micro-controllers or any type of CPU is NOT allowed; however non-programmable electronic or electrical components can be used.
* The vehicle should be capable of stopping at a precise location.
* The vehicle should be capable of completing the circuit in minimum time possible.
* The design and construction should be done by us and it is not allowed to retrofit an RC car, but its parts can be used in the making of our vehicle.

The implicit requirements are as follows:

* A vehicle should not contact either building (not larger than 12 X 12 X 12 inches and not smaller than 9 X 9 X 9 inches) (As it has been mentioned that if this happens you will be disqualified).
* Not a single vehicle part should depart from the plywood sheet (Dimensions 4’ X 8’ X ½”) (As it has been mentioned that if this happens you will be disqualified).
* The vehicle should be capable of maneuvering the turns on its own i.e. without the help of guide ways or chutes or tracks.
* The vehicle should be light in weight so as to have small inertia such that the stopping location can be precisely controlled.
* As the maximum power supply required for 1 Radio Shack DC motor motors (part number 273-223, 258 or 047) is 3 V hence maximum power supply of 9 V (3 V for each motors and additional 3V for overcoming potential drops and frictional losses) can be used.
* The length and diameter of 1 Radio Shack DC motor motors (part number 273-223, 258 or 047) is 1.5 inches and 0.94 inches respectively hence the chassis or body of the vehicle should be capable of housing the motors and the power supply required for it.
* The maximum rpm of the motors in no load condition is 8300 rpm so we need so some sort of speed reduction mechanism.
* The cost of the vehicle should be less than 100 $.
* The vehicle should have steering mechanism or differential motion of the wheels in order to take a turn.
* Should consume power efficiently.
* The vehicle should be easy to start i.e. by just pressing a switch it should start.

1. Create an objective tree with weights

Objective tree:

1. Make a list of constraints (mark them as explicit or derived)

Constraints:

Explicit constraints are as follows:

* The vehicle should fit in a box of 6 x 6 x 12 inches.
* Use of 1 or 2 Radio Shack DC motors (part number 273-223, 258 or 047) and compatible batteries. No other energy source shall be included within the vehicle.
* The vehicle must travel around building 1, cross the reference point, and travel around building 2, then come to a stop at or near the reference point.
* The vehicle should be autonomous.
* Guide ways or chutes or tracks should not be made.
* Micro-controllers or any type of CPU is NOT allowed.
* The vehicle should be capable of stopping at a precise location.
* The vehicle should be capable of completing the circuit in minimum time possible.

Implicit constraints are as follows:

* A vehicle should not contact either building (not larger than 12 X 12 X 12 inches and not smaller than 9 X 9 X 9 inches) (As it has been mentioned that if this happens you will be disqualified).
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* The maximum rpm of the motors in no load condition is 8300 rpm so we need so some sort of speed reduction mechanism.
* The cost of the vehicle should be less than 100 $.
* The vehicle should have steering mechanism or differential motion of the wheels in order to take a turn.
* The vehicle should be easy to start i.e. by just pressing a switch it should start.

1. Create a function tree, including disjunctions

Function tree:

1. Identify key issues and your strategy

Some of the key issues and strategies are as follows:

* Moving in pattern of 8 without the use of programmable electronic circuit.

Strategy: I am planning to use timer mechanism (special gears or cams or Electronic timer circuit (IC 555)). The timer mechanism will actuate the steering mechanism and speed control mechanism depending on the predetermined timing calculated depending upon the speed and path to be followed by the vehicle. The path would be decided in such a way as to minimize the time required to complete the circuit and at the same time have precise stopping and turning control and avoid touching the buildings.

* To have high speed as well as have precise stopping location.

Strategy: I am planning to keep the weight of the vehicle as low as possible in order to have low inertia so as to have better control on the stopping location. Also it is possible to move at slightly higher speed due to light weight.

For stopping at the precise location I will make use of timer mechanism.