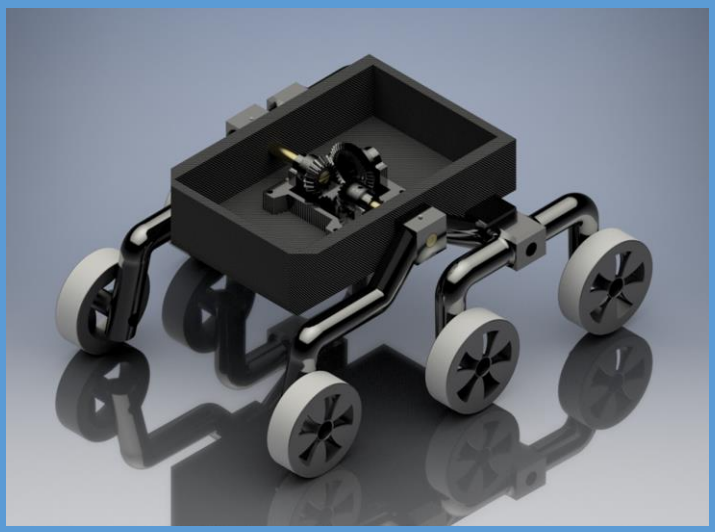
THE MARS ROVER TECHNICAL REPORT



Muhammad Saifuddin
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Mr. Rattray
TDJ4MR
Engineering Design

The Challenge:

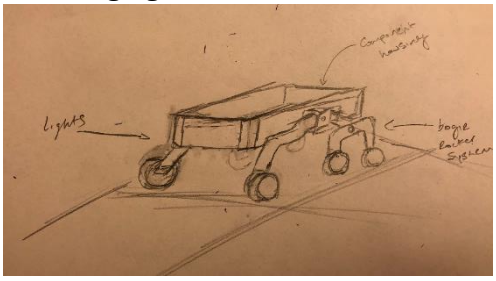
The objective of the Mars Rover assignment was to build a robotic vehicle that would have the capabilities of successfully maneuvering itself through rugged and rigorous surfaces; in addition to this the robot would also have to maintain a level body throughout the course of its movement. Moreover, the robotic vehicle was also given the challenge of recording the gasses in its environment while it was under exploration, this enhanced the simulation of a real mission.

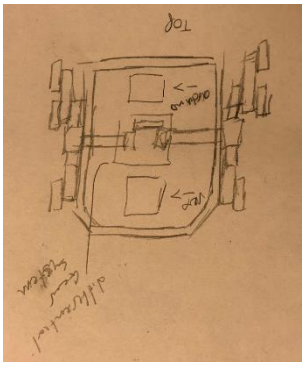
Rationale:

The proposed challenge has extensive and extremely useful applications. As, in various situations in the real-world, where because of certain circumstances only robotic vehicles can be used oppose to human for exploration; the robot would have to navigate its way through unexpected/harsh terrain while also maintaining a level body. The reason for maintaining a level body is significant to the capabilities of the robot, because at times where the robot is carrying several billion dollar components, if any damage is to be gained then this can compromise the mission in its entirety and defeating the purpose for exploration. Therefore, the robot designed in this specific manner, can be applied to future robots; this ensuring that a misfortunate event of broken components does not occur. Furthermore, the addition of the gas sensors of the robot enhances its capabilities and adds to its effectiveness in the real-world; the data acquired from the robot can be dramatically affect the human race, by detecting gasses that pass as habitable or not, this then allowing humans to create plans for the future, when larger planets are required for the growth of the human race.

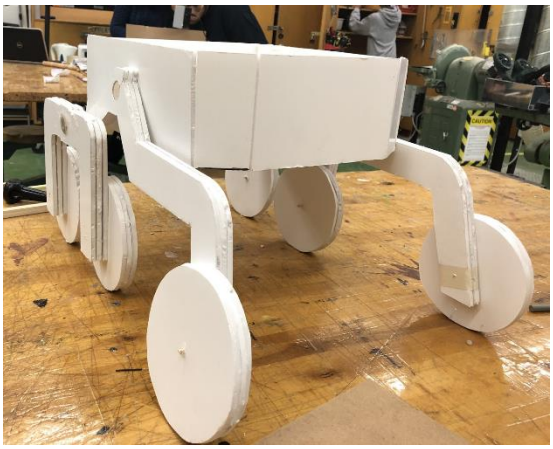
The Brainstorming Stage:

So to complete the challenge at hand, my partner and I first conducted research on past built robots that were specifically designed in a similar manner to the challenge given to us. While conducting research, we came across the Mars Rover; we then conducted researched on the rocker-bogie. The Mars Rover featured a rocker-bogie suspension system, the suspension system worked by focusing on weight balancing; my partner and I saw this as a major flaw because any sudden disorder in the weight would throw off the balance of the body and would then cause a damage of the components. The implementation of this suspension system was finalized; but the flaw was yet to be fixed. Then through extensive research, we then decided that the addition of a differential gear system would allow for a level body. This is because our design would have shafts that are connected to the gears of the differential system which would ensure a level body when motion occurred. This lead us to the implementation of the differential gear system into our design; it also eliminated the weight balancing factor of the old design and allowed for a level body at all times. After determining a safe a reliable mechanism, we moved on to deciding the technical parts of the robot (types of motors, wiring, etc). While we were in this stage, we decided on certain parts and materials that would ensure a final working robot. For example, in order for our robot's success we decided to go with 5in wheels and not the regular 4in;



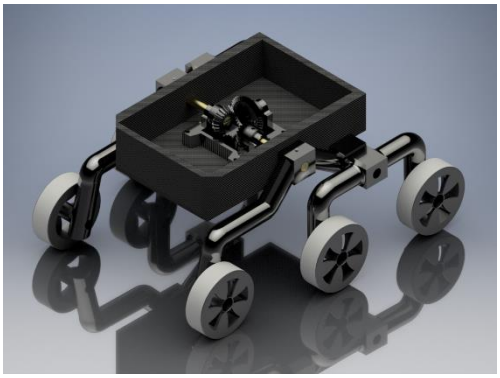


this is the case because we knew 4 in wheels would not be large enough to go over the hills and bumps presented to us. We then incorporated all the designs into an orthographic sketch as seen above. After we finalized on the design and its technicalities we moved on to creaking a mock up. As you can see on the right, this is the final design; we iterated the initial design as we moved along. From this design we changed certain things, we increased the length of the body to incorporate more space for the components and add to the overall spaciousness to the design. Additionally, we also decided on changing the way the wheels were placed on the exterior of the robot; we put it on the outside to remove from any complications from occurring during the wiring process. Once all the changes were made, we moved on to creating our robot using AutoDesk Inventor.



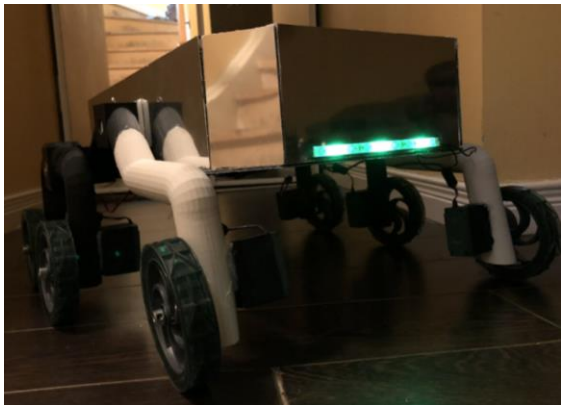
The Electronic Design:

Next, we moved on to creating the robot in its entirety using a computer aided designing software. Using AutoDesk Inventor we achieved this; we first used the software to make individual part, after this was done everything was put into an assembly; we then put the robot together. Then using the same three dimensional software, simulations were done to see whether the robot would work. After this all, the decided parts were 3D printed and the others were made using other decided upon ways. As you can see on right, the 3D design of the robot.



The Build Process:

Once the 3D design of the robot was done, certain parts of the robot were sent to the 3D printers provided to us; here the pieces were printed, certain pieces were reprinted because of printing errors, such as wrapping and sizing errors. The parts of the robot that were printed are, the bogie, the rocker, shafts, the differential gear system and the base plate for holding the differential gear system. Next we were introduced to a new software, which dealt with the CNC machine, this machine was used to create the frame of the body, the frame of the body was made out of wood; likewise, the plating for the frame was then created in a similar manner, where the software was used again and then cut; instead of wood, metal was used for this to help with the aesthetics of the design. Once all of this was done we gathered everything that was made. Assembling the body of the robot is what was done first, the frame was put together with a strong glue, this was let to dry and then the



metal plating was added to all sides of the body, including the interior. Next the base plate was aligned and screwed down to the frame, its components were then added to it (the shaft and the differential gear system). After most of the robot was built, we were came to a decision where we had to choose whether Vex or Arduino motors were going to be used for the robot. After experimenting with both types we finalized out robot to have Vex motors, this is because while experimenting we found that it was much harder to get all the Arduino motors to work in sync, no matter how many times the code was set for the wheels to move in sync, they moved out of sync; we then experimented with Vex motors and found that they always move in sync, allowing for tricky turns. This then lead to the coding part of the assignment, the Vex motors were codded in the controls of a tank. At this stage of building we also codded the gas sensor for the robot, at this moment we realized that we were given the wrong gas sensor because zero parts per million (ppm) was consistently given in all areas where we tested, we the researched the model of the gas sensor, our findings showed us that this specific sensor only gave readings for petrol and natural gases.

What We Learned:

Throughout the course of designing and building our robot we learned several things. Firstly, the use of the CNC machine and its software; the machine and its software was completely new to both my part and I this meant for a large learning curb, both my partner and I quickly adapted to the new software and were efficient in making what was needed. Secondly, we learned the difference between Vex and Arduino motors; using Vex motors for a more cohesive and more in sync motor, oppose to an uncoordinated and uninform motors. Lastly, the importance of assembling in a mechanical manner; this was discovered after assembling the robot, by the assistance of a mechanical assembly, parts would be able to be replaced and removed at any time.

Conclusion:

In my opinion I feel like my partner and I accomplished the task at hand, we were able to build a robot that was able to maintain a level body throughout unexpected terrain. However, for future iterations I would improve certain parts drastically to improve its longevity and its efficiency. First I would reprint all 3D parts at hundred percent in fill, this would ensure that when putting the motors through no breaking would occur; next I would add metal shaft and gears to the robot, the shaft would limit or lower the chances of breaking of them occur, also creating metal gears would also for a better mesh and also lower chances of any teeth breaking. In addition to these iterations, I would also make all the joints and fits of the robot to fit in a mechanical manner this would allow for easy access and changing of parts. Lastly, I would switch out the gas sensor, as mentioned before after coding we realized that we were given the wrong gas sensor, replacing this would improve the data collection of the robot. In conclusion, I felt like this assignment was an overall success and hope that this project remains at Chinguacosuy Secondary School for a long time.