Extendo Bot - From Concept to Design

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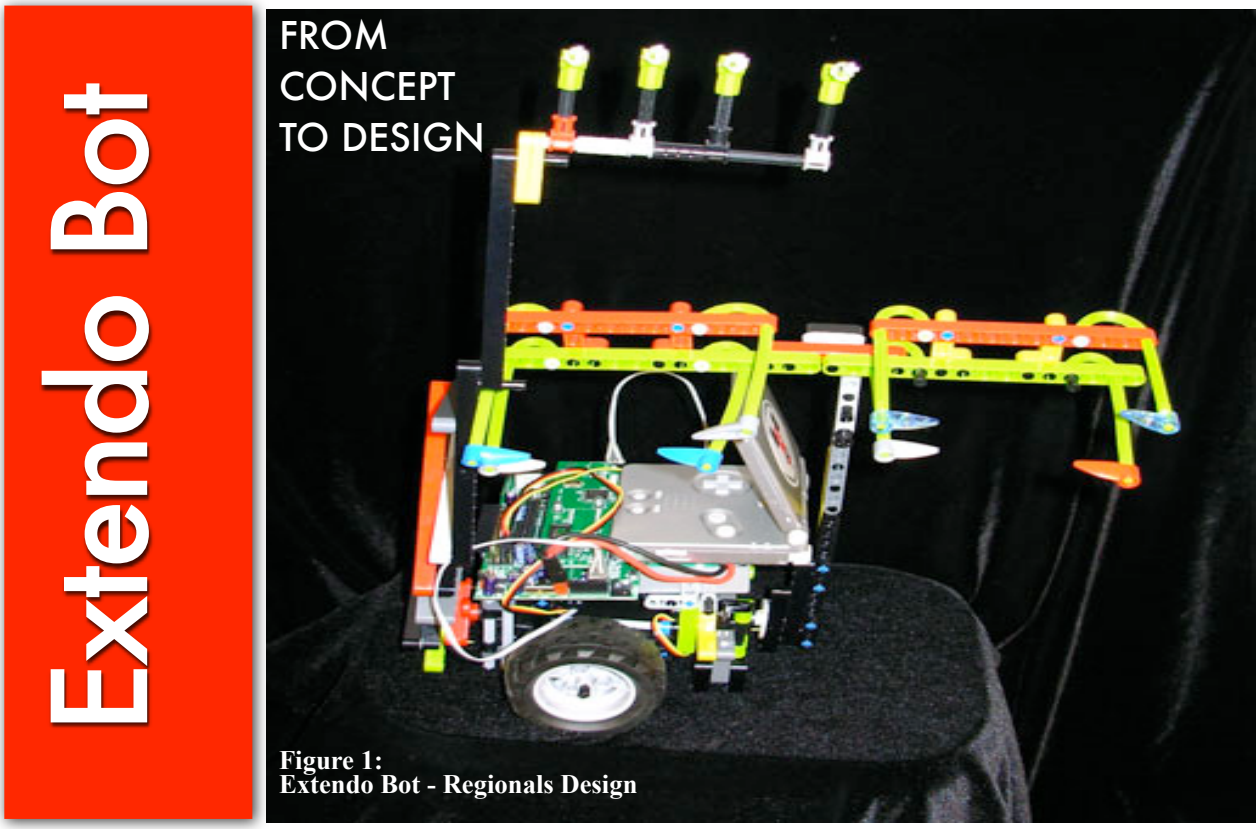

Figure 1:
Extendo Bot - Regionals Design

1. The Mission

ExtendoBot is designed for two tasks. The first is to pick up the blue ocean balls and place them in the bins. The second task is to cover the volcano before it explodes and expels the lava. See Figure 1.

2. The Concept

The arm that will pick up the blue ocean balls is on top of the robot with the yellow flexible axles and the pointed eye pieces. These pieces catch the balls and hold them with friction only. The arm moves up and down with a servo and pushes over the blue balls to catch them. The scissor arm is in the half folded position at the left side of the picture. This arm moves up with a scissor like motion, expanding to reach the top of the volcano. There are pointed axle pieces at the top that cover one side of the volcano keeping the lava pieces inside when the volcano erupts.

3. Extendo Bot Design

Robot 2 has a very simple design. See Figure 2. The wheels are directly attached to the black motors by way of a 24 tooth gear screwed on to the round servo horn. The black motors are held in place by two axles that are connected across the sides of the motors with 1 x 4 liftarms. Two beams hold the axles together. One arm is in the front of the robot and the other is in the back.

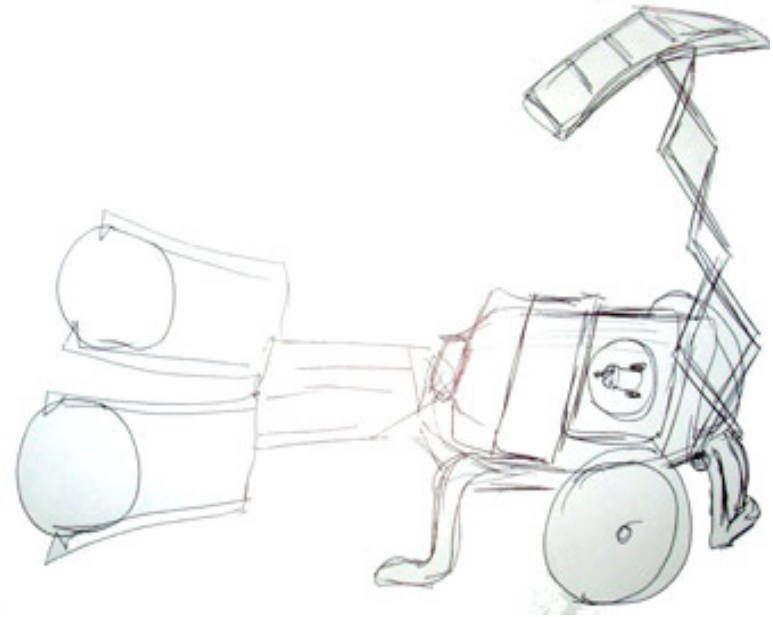

Figure 2 Concept Drawing

4. Chassis and XBC Holder

This is the chassis for ExtendoBot. You can see the two black motors. See Figure 3. They make up the drive train and are attached to the wheel directly with short axles. This has not changed much since we first built the robot. The black motors have worked well and this robot runs consistently straight.

The housing is between the wheels and sits at an angle causing the xbc to tilt and not fall out. See Figure 4. To make the whole thing stand up there is a leg in the front. The ball arm is attached on the opposite side.

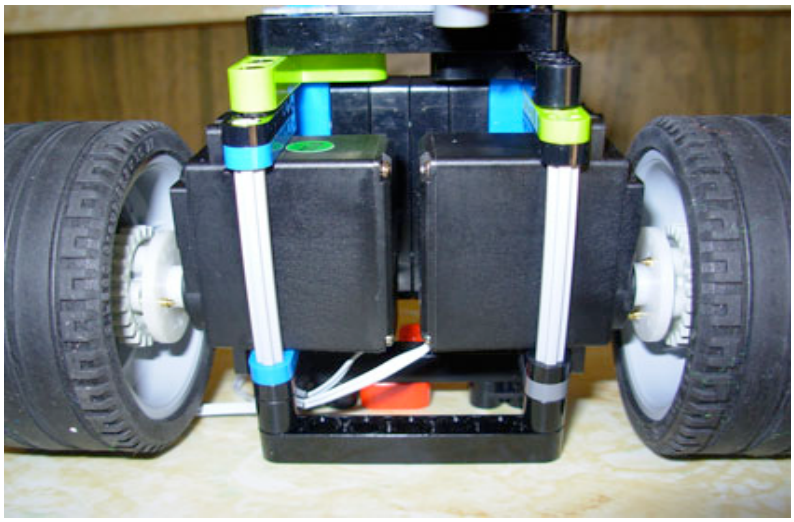

Figure 3 Prototype: Wheel Assembly and Gear Train

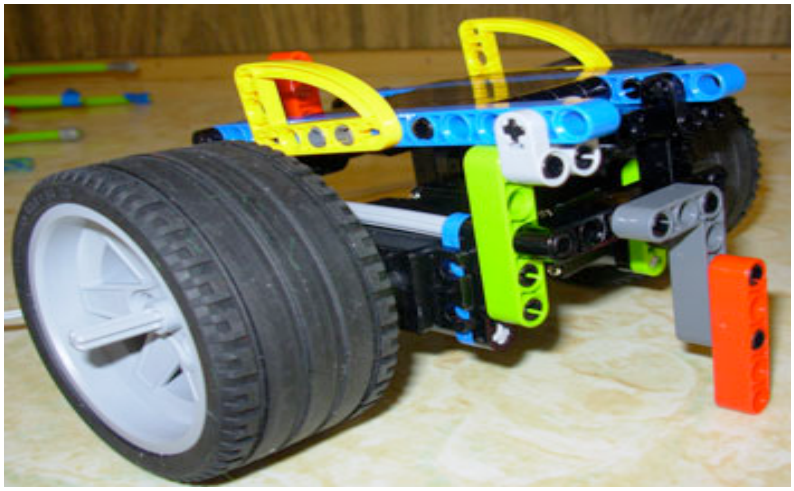

Figure 4 Prototype: XBC Housing

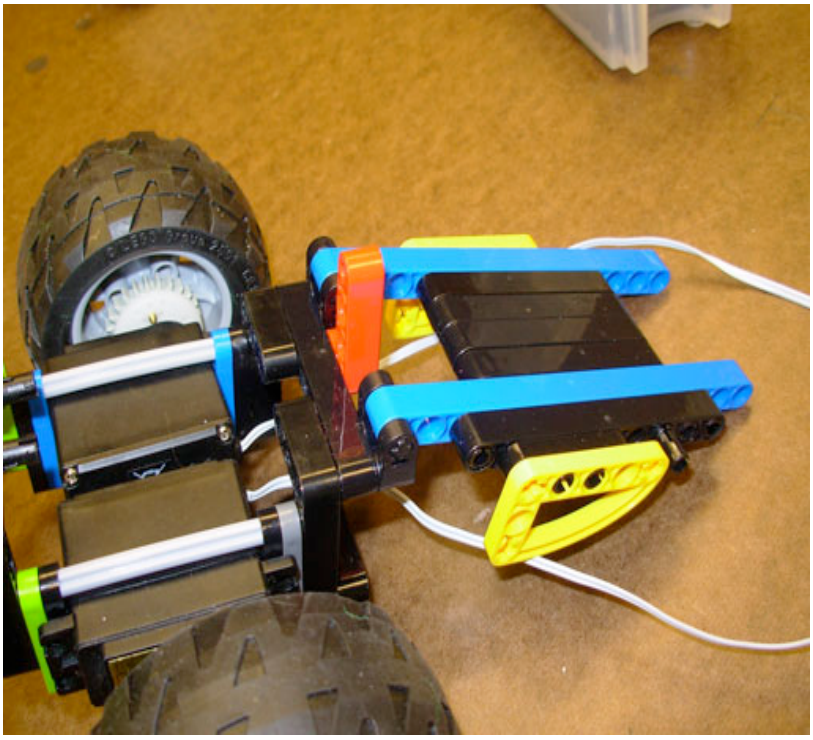

Figure 5 Flip Top

4.1 Flip Top

The chassis flips open to allow access to the motor drive train. See Figure 5. We changed several things about the flip chassis. One was the small # 2 axles that held them on. In this picture you see them right at the left end of the blue beams. We have changed them with longer axles that we can pull out with out hands. This made it easier to work with the chassis and move things around if needed.

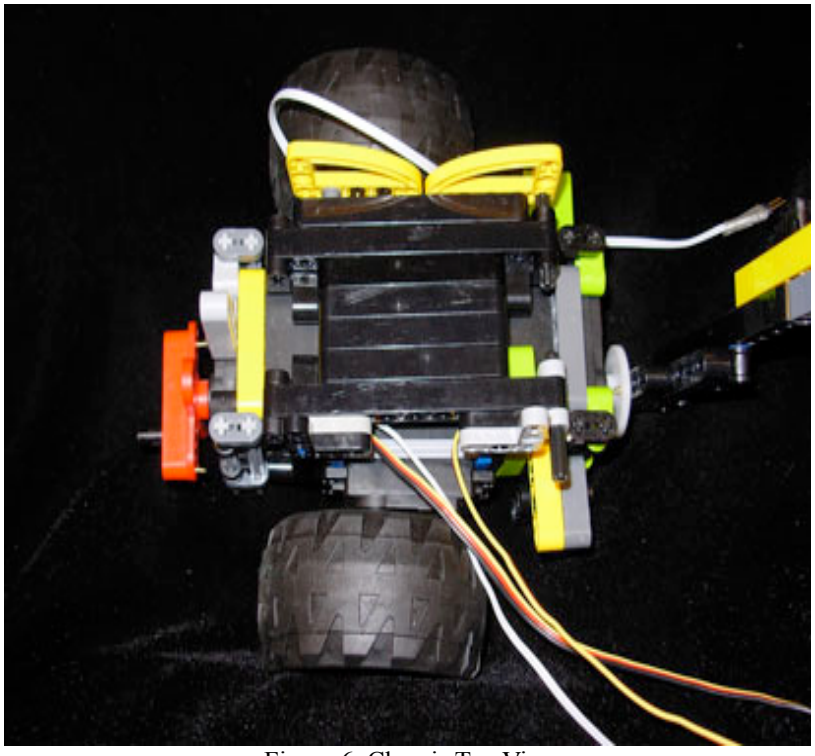

Figure 6 Chassis Top View

This is a top view of the robot 2 chassis. See Figure 6. You can see the two yellow triangle liftarms on one side of the chassis and the two right angle liftarms on the other side. These make the chassis the right size to keep the xbc from moving from side to side.

The thin liftarms were used because the xbc is not an even size of LEGO.

The xbc and game boy fit nicely on the top. The yellow liftarms hold the xbc in place and keeps it from sliding sideways. See Figure 7.

The gear assembly is very simple. We are using the large wheels. First we had to get the 24 tooth gears screwed on to the round horn of the two black motors. Then an axle fits in the gear to attach the wheels.

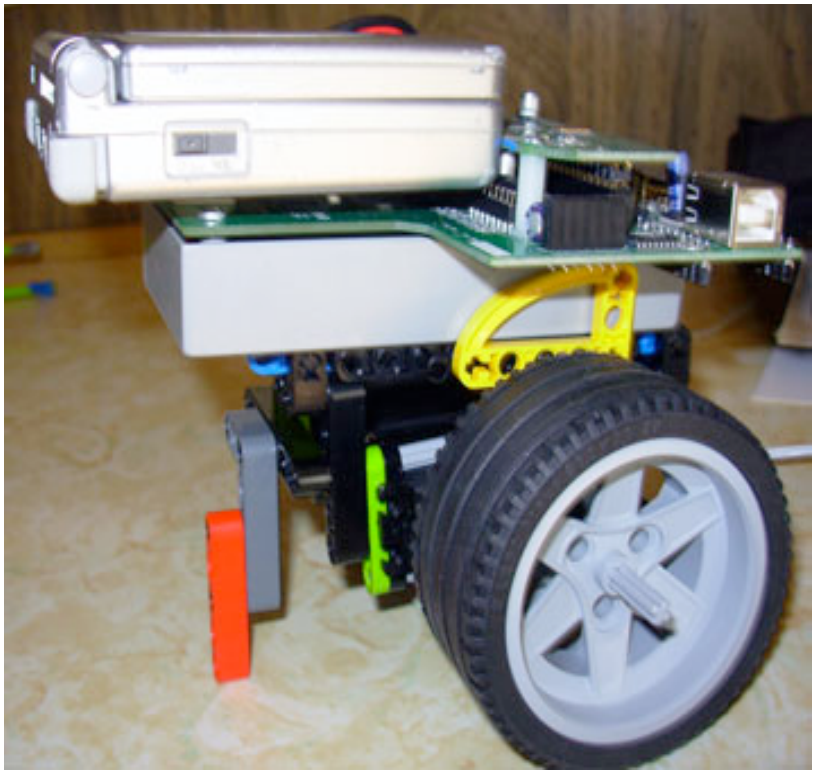

Figure 7 Side View

Our first method to create an arm used a pincher with two motors, one for raising/ lowering the arm and on for closing/opening the pincher. But we decided to apply the KISS principle and tried something with only one motor to raise and lower the arm.

The arm piece is made up of soft axles and just catches the blue balls inside of the end pieces with friction. See Figure 8. It catches both of the balls at the same time. The arm catches the blue balls with flexible axles and pointed eye pieces. It holds them with friction.

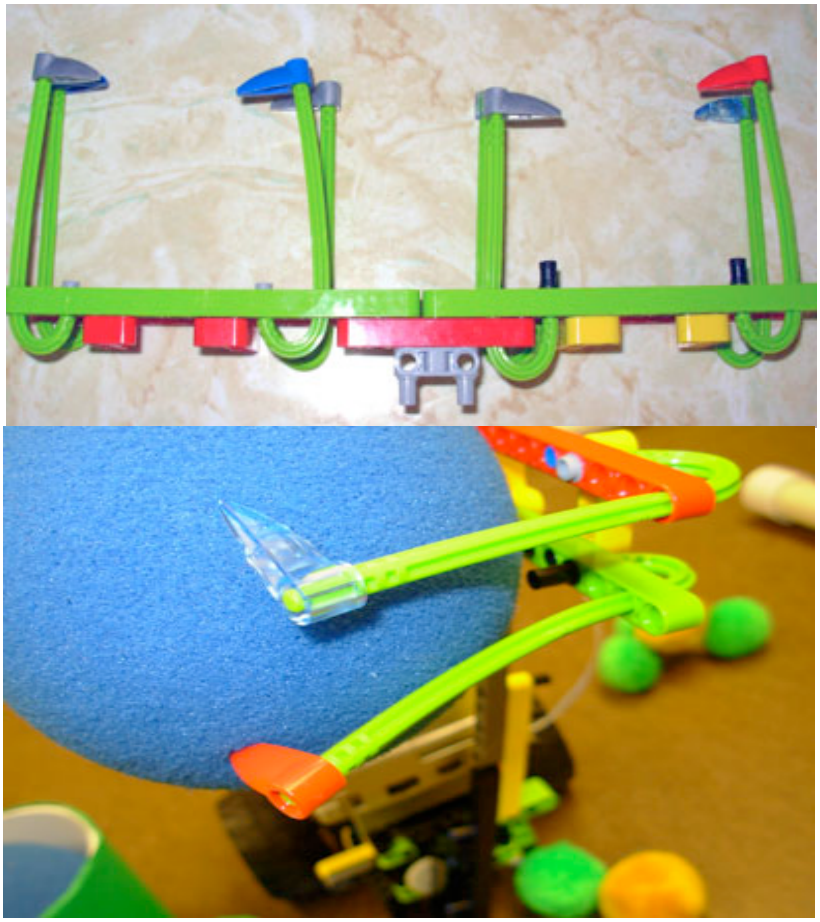

Figure 8 Blue Ball Arm

5. The Extendo Arm System

We made a scissor arm to shield the lava from coming out when the volcano erupts. It folds up to start. See Figure 9. Then it extends. See Figure 10 and 11. The first arm we made was too heavy to stay up straight and would always fall over. So the changes we decided to make were to take off the tip of the scissor arm and redesign it so that there would be less pieces and it would be lighter. See Figure 12. The original design had flat pieces of lego at the top of the scissor arm and that would hold the pieces of lava in, so to make it lighter we took off the long lego pieces and added on axles with three attached axles with bent pieces at the ends with a shallow axle on each bent piece. See Figure 12. This made a type of claw that was lighter but more effective to cover the lava.

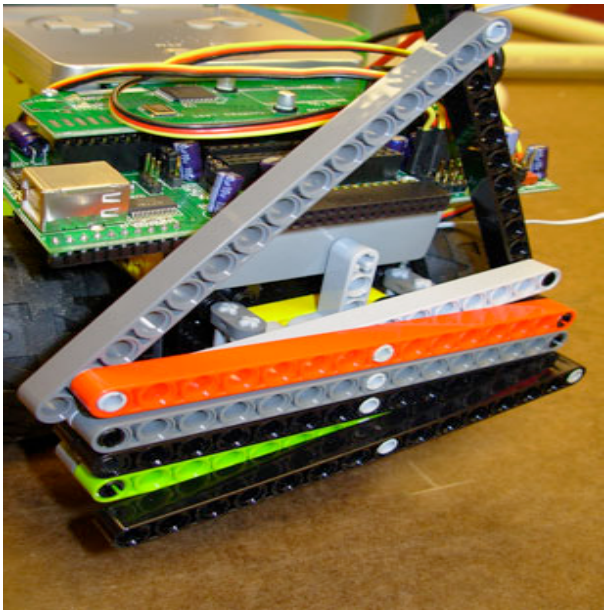

Figure 9 Arm in Starting Position

Figure 10 Arm Extending

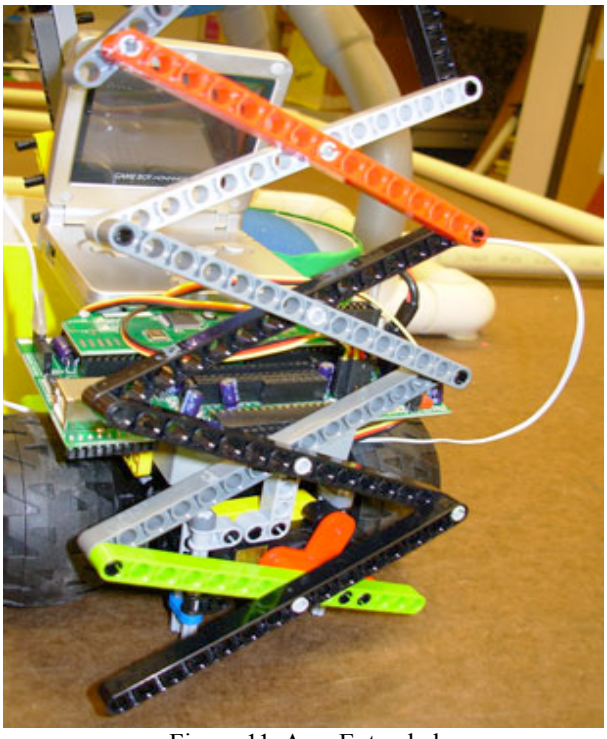

Figure 11 Arm Extended

Figure 12 Covering Lava

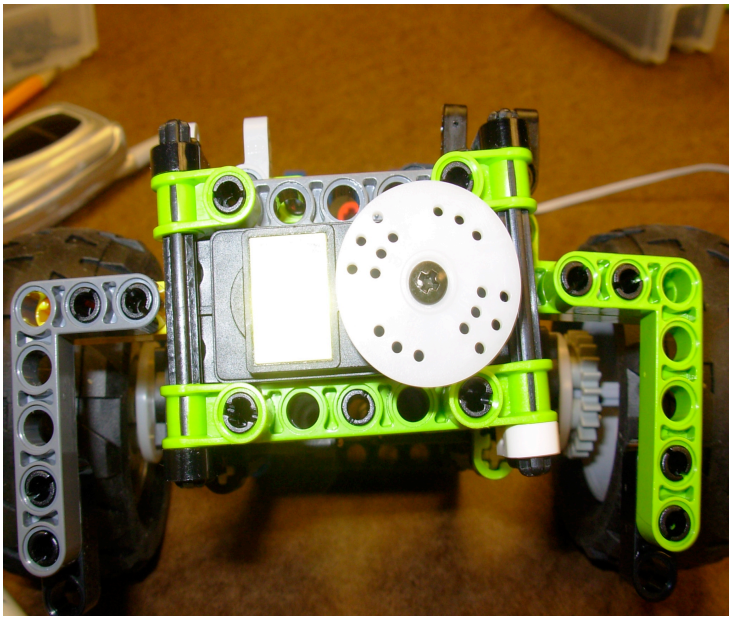

Figure 13 Servo Assembly

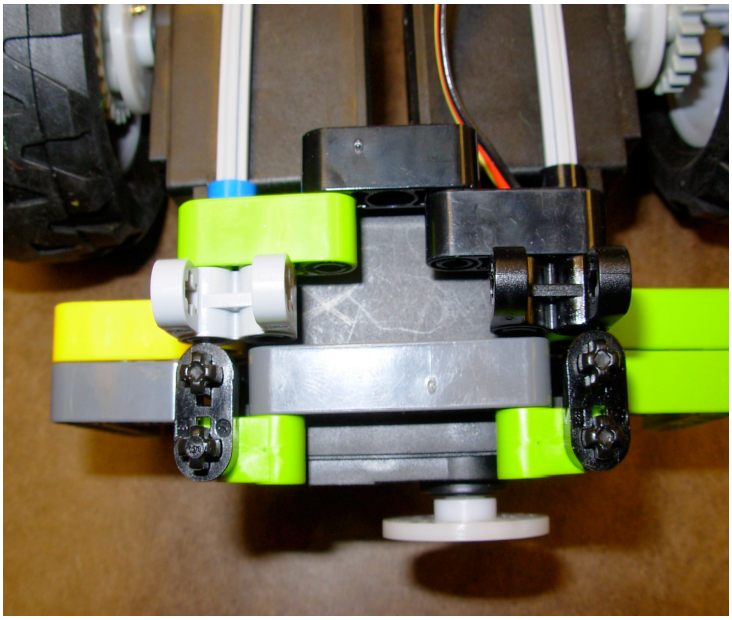

Figure 14 Top View

6. Servo Assembly

We caught the sides of the servo between two axles and then put lego beams around that with the axle pin connectors. See Figure 13. The whole thing is closed tightly around the servo. Then you catch the two short beams with a third 3 hole beam. You have to push the two longer beams together in order to attach the 3 hole beam. That holds the servo nice and tight. See Figure 14.

We tried lots of different pieces before we discovered the right ones that would hold the servo tight and give a place to mount the motor to the chassis. There is a servo in the front and in the back of the robot. They each work an arm. One picks up the blue balls and one extends up to the volcano. They fit right under the flip chassis (see next page). This makes the robot very stable. The arm catches the blue balls with flexible axles and pointed eye pieces. It holds them with friction.

In the beginning we made our own scissor arms to see which one would be the best. We used a model to base our arms on, but each member created their own version. One of the students didn't remember how the arm pieces were attached so he made up his own and made a mistake attaching the cross beams. What resulted was that instead of going up straight the top part of the arm bent over at an angle. This solved one of the problems that we were having. The arm needed to cover the top of the volcano. This mistake was perfect.

Extendo Bot has a good basic design. More testing is needed to make the program work better. We are working on our Nationals design for this robot.