State of the Robot

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Executive Summary

We're just past the mid-point of build season. This provides a good opportunity to summarize what the team has achieved, what we've yet to do, and where we are going.

Our game strategy for *BREAKAWAY* is centered on scoring competence with the game's soccer balls. Our Pivot drive-train will give us the agility we need to quickly approach and line up balls for scoring. Our Kicker will be able to loft balls over bumps and, with the vision system, should score reliably from at least Mid-Field. We will be able to cross bumps and drive through the tunnels to move between zones. DEWBOT VI will not elevate or suspend at the match's end.

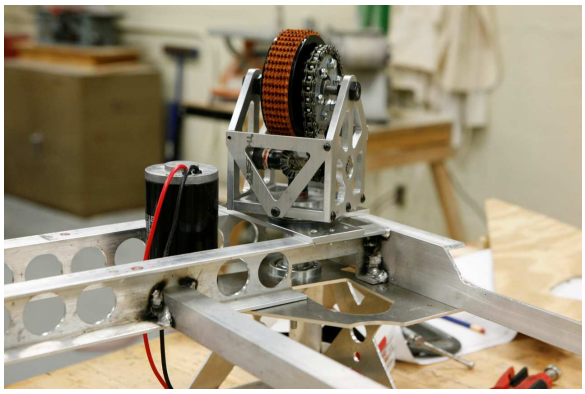
All of DEWBOT VI's drive-train components and the welded chassis frame are complete. The team will be assembling the drive-train onto the chassis tonight.

The robot control (cRIO) and motor controller (Jaguar) panels are wired and ready to install on the chassis as well. These will go on as soon as the drive-train assembly is complete. Two additional electrical panels are needed for the Power Distribution, controller side-cars, digital relays (Spikes) and solenoids.

We need to get the robot driving so that we can test control code, train drivers and develop tactics.

A kicker has been designed based on prototype testing. Kicker fabrication will start after we have a driving robot.

Drive-Train & Chassis



DEWBOT VI will utilize a multi-mode, 4-wheel pivot drive-train. Each wheel will be independently driven and steered. If we do this well (from both a mechanical and programming perspective), we should have an extraordinarily maneuverable robot and one well-suited to this year's *BREAKAWAY* competition. Pivot Drive was selected for:

- It's superior maneuverability. This should be especially valuable in aligning with soccer balls and with the goal.
- Safety while crossing the bump. A 6wd robot would tilt over further during the climb and would also experience two tipping points. The

second of these (coming off the flat top of the bump) will put the robot at a considerable tipping risk unless center of mass (CoM) is very low.

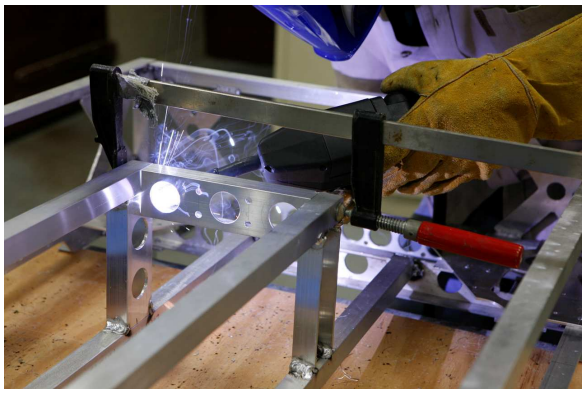
Maximum robot speed on flat grade should be about 9.8 ft/s. There is no gear shift. Drive reduction of 8.3:1 is achieved without a gearbox, using chains & sprockets instead. Wheels are AndyMark's new 4" Plaction wheels with roughtop treads. (4) CIM motors will propel the robot. (4) Nisso-Denso motors are used for steering. All (8) drive-train motors will be controlled using Jaguars.

Pivots are co-axially driven and can be rotated infinitely. Pivot angles will be measured using magnetic absolute encoders which actually measure the steering motor drive angle, but since drive and driven sprockets are both 15T, this should provide accurate angle values.

Wheelbase is 28" (x) x 21.5" (y). CoM is 9" above grade and centered between the four wheels.

DEWBOT VI should be able to safely cross the bump and also drive through the tunnel. For both of these actions, the robot will need to drive in its long (x) axis direction. Chassis orientation is important in *BREAKAWAY*. The robot will not be capable of driving along the top of the bump.

Chassis frame is welded aluminum. Pivot mount plates are riveted to the frame using steel rivets with steel back-up washers.



Pivot bodies are machined 6061 aluminum. Machining was graciously provided by Wamac, Inc., a Downingtown Area Robotics sponsor. (3) thrust bearings are used in each pivot to bear rotating axial loads (including one bearing the robot's weight). (2) roller bearings and (6) ball bearing races are used to bear each pivot's rotating radial loads.

Scoring

DEWBOT's scoring strategy is to focus on soccer balls. Towards this, we should be able to:

- Herd up to 3 soccer balls and push these into the goal if playing in the alliance zone
- Herd balls with the robot side as well and also push into the goal using the side.
- Kick the ball towards the goal. We expect to be able to reliably score from Mid-field and to at least be able to reliably move balls from the

opposing zone to the alliance zone with a single kick over both bumps. Bonus if we can reliably score from the opposing zone.

- Clear soccer balls from the tunnels

The Kicker is latex-tubing powered. Kicker is 15" wide and had a kicking face tangent to the ball at the contact point.

The Kicker will be cocked and fired pneumatically. A 2" bore, 4" stroke cylinder will drive a cocking arm to drive the Kicker into the Armed position, where it will be held by a Catch. Once the Kicker is Armed, the cocking arm will return to its rest position (it does not participate in the firing). To fire the Kicker, the Catch is released using a ¾" bore, ½" stroke trigger cylinder.

The Kicker power will not be adjustable during a match. It will be possible to adjust the latex tubing between matches to attenuate the Kicker's power.

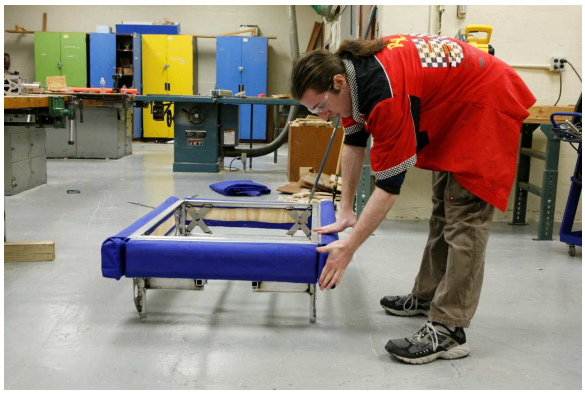
The Kicker will be a robust, welded aluminum assembly supported by a substantive welded structure within the chassis. Firing the Kicker will release a great deal of stored energy.

There is an important outstanding item: ball centering and possessing in preparation to kicking. This is the next design to-do.

DEWBOT will have no provisions to Elevate or Suspend for bonus points. We plan to score soccer balls until the match ends.

Bumpers

We will build two sets of bumpers for *BREAKAWAY*; blue and red. The blues are complete. Bumpers should take less than a minute to change.



The bumper zone is high this year (10-16") and the entire perimeter must be covered. Bumpers can weigh up to 20 lb. In the past, bumpers helped stability by moving the robot CoM down. This year, they shift the CoM up. Our bumpers weight 12.7 lb per set.

The renowned *Rizzo* bumper attachment technology pioneered in DEWBOT V is used again in DEWBOT VI, with improvements. Improvements include:

- Planned, consistent attachment points which have been accurately positioned on both bumper and chassis frame.
- All bumpers are symmetric; top-to-bottom. Front & rear bumpers are also symmetric left-to-right. Until we paint team numbers on, left and right bumpers are interchangeable. Front & back bumpers will be interchangeable with the team numbers.
- Countersunk, flat-head wood screws are used to secure the aluminum angles. These aluminum angles now fit flush against the frame. Very clean. Very sharp looking.

Electronics

The (8) drive Jaguars are mounted on (2) 3/16" polycarbonate panels, upright on the robot's interior side walls and close to the motors they control. The cRIO will be mounted on a ¼" polycarbonate panel at the robot rear.

A formed polycarbonate battery box will be centrally located (and may be shifted slightly fore or aft to adjust robot CoM). The battery box holds the battery securely without the need for Velcro straps.

The main disconnect and the light will mount on the side of the structure securing the cocking cylinder.

Other electrical components may be mounted on wing epanels left and right of the battery box. Power Distribution can be on one of these or immediately aft of the battery.

Pneumatics

The compressor hangs off the frame right between the rear pivots. Helps keep CoM low.

Clippard compressed air storage cylinders will be mounted low in the frame with a mind on their effect on CoM. It seems that carrying (4) Clippards will not be a problem from a weight standpoint.

We still need to specify and purchase the solenoids & tube fittings.

Vision System

Plan to also mount this on the back of the cocking cylinder tower. Needs to be protected and spring-hinged for "safe" tunnel transit. Very important!

Field Equipment

Field equipment is complete and waiting to play. A great job!

Autonomous Mode

We are looking into sensors to detect the balls during autonomous period.

Programming

We have drive code ready.

Robot Mass

The robot will be light. The Bill-of-Material (BoM) comes to just shy of 90 lb. This doesn't have everything in it yet, but most items are accounted for.

Cover

We need a cover on the robot to: 1) keep soccer balls out; and 2) prominently display team and sponsor information. This could be a printed, clear or white vinyl tarp or a cut piece of polycarbonate.

Righting Mechanism

We've got some ideas here, but not yet well defined. Given space and time limitations, it is uncertain that we will have a righting mechanism.

Priorities

1. A legal robot with a working, high-performance, reliable drive-train (and the software to control it)
2. A fast, accurate Kicker
    a. guided by the Vision System
    b. able to score reliably from Mid-Field
    c. able to kick from the opposing zone into the alliance zone
    d. need to accurately position the ball
    e. bonus if able to score from the opposing zone
3. A solid Autonomous routine
4. An efficient herder
5. Go over the bumps
6. Go through the tunnel
7. Right ourselves when we tip
8. Work the bugs out
9. Practice, practice, practice
10. Tactics development