

# STUYENTIFIC AMERICAN

## THE ROBOT **DISSECTED**

The 2008 robot, DESbot,  
explained part by part  
page 5

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THE HEART OF THE COMPETITION

# **BUILDING THE ROBOT**

PART EIGHT



THE TEAM, NYC REGIONAL '08

2008 Team 694, "Stuypulse", Stuyvesant H.S. Robotics Team, New York



# STUYENTIFIC AMERICAN



ABOVE: DESbot completes another  
successful hurdle during competition

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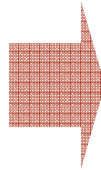
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# Building the Robot Part VIII

**T**hough one would not normally attribute nation-wide success to an eight year old, Stuypulse defied the odds time after time to produce their strongest 'bot to date, DESbot. This year marked the last season for Stuyvesant's second generation of engineers (2005-2008), and every member, parent, and mentor went into Overdrive to help the team shatter expectations in New Jersey, New York, and the Championships in Atlanta.

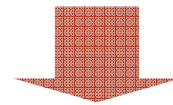
## Week 1 | Designing and Prototyping

From the moment the challenge was released, we analyzed the multiple methods of scoring points on the field. By the end of the first week, we chose the lucrative eight-point hurdle as our scoring target and tested prototypes. The top choice was inspired by Larry, our 2004 'bot. The plan was to build a larger grabber combined with a pneumatic "puncher" to launch the ball over the hurdle. Other engineers worked on DESbot's drivetrain, employing Ackerman geometry to steer the front wheels using power from a window motor, while the rear wheels provided power.



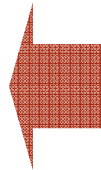
## Week 2 | The Beginnings of a 'Bot

By the second week, our chassis and electronics was nearly complete, using Ackerman drive which could be swapped for reliable four-wheel drive. It was also around this time that we successfully explored hybrid mode, where a robot could be directed using autonomous code or infrared signals.



## Week 4 | DESbot is Born

By the end of week four, we had transformed thirty-seven pounds of wheels, axles, plates, and electronics into an operational four-wheel drive robot. As our drivers took DESbot for a spin, the remaining engineers began to take on the challenge of transferring the grabber from Larry to DESbot. After a few adjustments, DESbot was finally assembled in all its glory.



## Week 3 | Redesigning the Grabber

The team redesigned the grabber to include a set of "tusks," aluminum conduit secured underneath the grabber's arms that would slide under the ball while acquiring it and support the ball as the puncher fired. When our lab was closed, we sketched the entire robot in Autodesk Inventor in order to expedite eventual construction.



## Weeks 5-6 | The Finishing Touches

During our final two weeks of build season, we hooked up all of the pneumatic tubing for our grabber, puncher, and tower, and calibrated DESbot's sensors. Just as our OI (operator interface) was completed, we began to test drive around our field and try "punching" the ball over the hurdle. After achieving moderate success with two days left until robot ship day, we significantly improved the puncher's power by using a larger cylinder with a more efficient firing mechanism. All that remained was to give DESbot a fond farewell with some bubble wrap and shipping tape.



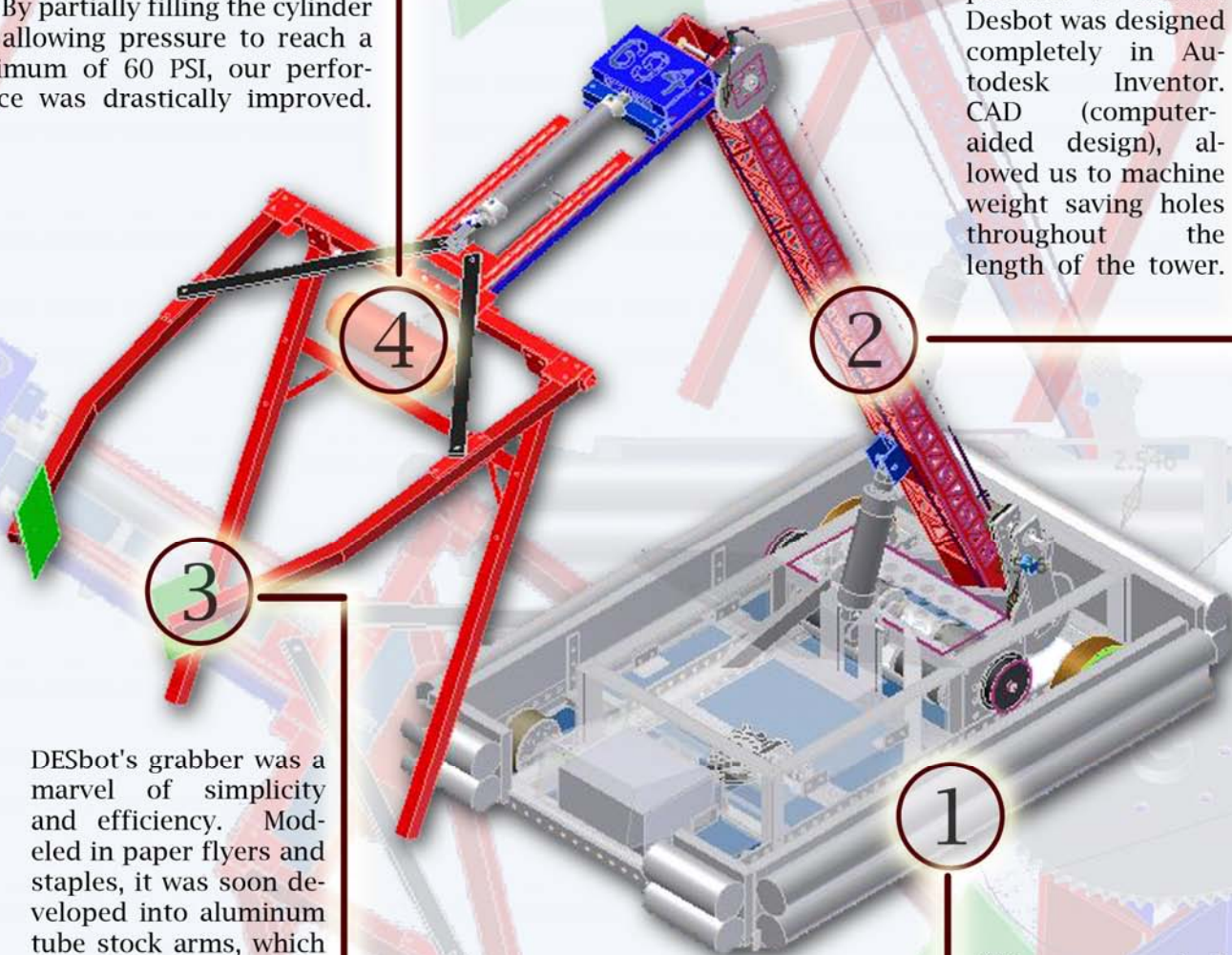


# DESbot DISSECTED

By Seth Berg

When DESbot drove up to the overpass, not only did it need to place the ball, but it also needed to launch it. Originally we had a pneumatic cylinder that simply extended and pushed the ball over; this proved far too weak. The solution for this problem was pre-pressurizing the cylinder by physically preventing it from extending, until our drivers were ready to fire the ball. By partially filling the cylinder and allowing pressure to reach a maximum of 60 PSI, our performance was drastically improved.

DESbot's tower had two positions; one position to acquire the ball and another position to hurdle. Desbot was designed completely in Autodesk Inventor. CAD (computer-aided design), allowed us to machine weight saving holes throughout the length of the tower.



DESbot's grabber was a marvel of simplicity and efficiency. Modeled in paper flyers and staples, it was soon developed into aluminum tube stock arms, which opened and closed using a 1.5" bore pneumatic cylinder. The grabber was also equipped with two tusks, designed to slip underneath the ball. The easily-shaped conduit arms also served as shock absorbers, protecting the more vulnerable parts of the robot.

This year we had two drive train designs: one was simple four-wheel drive, the other had Ackerman (car steering) in the front two wheels. Instead of definitively choosing a design, we built two easily-interchangeable systems. The result was a reliable drivetrain that powered the robot at a rapid 11 feet per second.





## Robots at the Ready!

Team 694's stunning performance at Trenton, New York, and the Atlanta Championship **BY JOSEPH BLAY**

**T**hough the Stuyvesant Robotics Team has seen many successes in its eight years, the 2008 season was one of our best. Despite the difficulty of the FIRST Overdrive challenge and healthy competition provided by other experienced teams, our robot, DESbot, proved itself at the New Jersey and New York Regionals, and even at the Championship in Atlanta.

DESbot was developed from a few sketches to a full-fledged, competitive robot in just the six short weeks of build season. With a towering arm equipped with large pincers and a pneumatic puncher, and a sturdy and fast drivetrain, DESbot was designed to take the game challenge head on. The 2008 challenge, FIRST Overdrive, was a team based game played by two alliances of three robots on an oval track with an overpass suspended above the middle. Large trackballs would be placed on the overpass, and robots would score points by either running laps with the ball or "hurdling" the balls over the overpass. DESbot was designed to grab the trackballs with its pincers, race around the track, and use its puncher to launch the balls over the overpass.

### Trenton Regional

The Stuyvesant Robotics Team's first challenge came at the New Jersey FIRST Regional held in February. Sixty-three teams gathered to pit their robots against each other for the first time at the Sovereign Bank Arena in Trenton. Despite pneumatic trouble, fuse blowouts and drivetrain malfunctions, the team managed to win six out of eight preliminary matches. Our impressive record put us in sixth place and made us an alliance captain for the first time in an away regional. We selected Team 1279, a great hurdler, and Team 2016, a lithe and speedy robot as our alliance partners. Our alliance passed through the elimination rounds and ascended into the semifinals. Though we walked away from the Trenton regional without the gold, but with the satisfaction of pushing farther than we ever had before.

### New York Regional

We reached new heights at the New York City Regional held at the Jacob Javits Center in April, one of the largest

FIRST Robotics Competition Regionals. DESbot's drivers, hardened at Trenton, won all but one match during qualifications and our top match score was ten points higher than at the New Jersey Regional. As the 4th Alliance Captain, our strategists selected teams 1403, Cougar Robotics from Montgomery High School, and 2344, Rookie All Star Award winner Saunders Droid Factory, to join our alliance. 1403's fast robot, 2344's strong hurdling, and DESbot's trusty puncher were enough for the alliance to advance to the semifinals.

Throughout the year, the team made a concerted effort to bring the technology we work with every day to our school community and neighborhood. Due to our efforts in advancing engineering awareness in our community, we were awarded the Engineering Inspiration Award, the second highest award a team can garner. Winning this award qualified us to proceed to the Championships in Atlanta.

### The Championship

The best teams from regionals in the US, Canada, Brazil, Israel, and now even New Zealand gather every year to compete against each other in Atlanta's Georgia Dome. The team was placed in the Galileo

division that year, and DESbot remained competitive against the robots arrayed there. In our first match, our alliance won with a score of 148 to 20, the highest qualification match score at the entire competition.

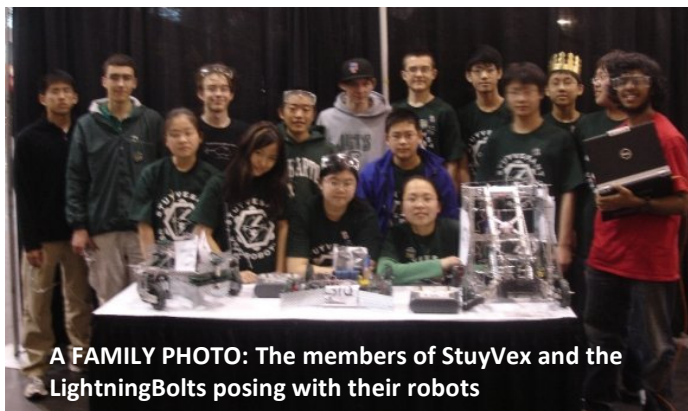
Even though the season has long been over, the Stuyvesant Robotics Teams still continues its work. At the end of the New York Regional, FIRST founder Dean Kamen gave all the teams a mission: To bring the unique and invaluable experience that is being on a FIRST Robotics team to as many high schools in the New York City area as possible. As an organization dedicated to spreading science and technology to not only our own students, but also to people in other schools and our local community, the Stuyvesant Robotics Team has taken that mission to heart. Next season, expect to see our faces among the crowd, but don't be surprised if you see a couple of new ones too.



**A BREAK IN THE ACTION: DESbot and driver Andrew Mandelbaum at the Championship**

# The FIRST Tech Challenge

StuyVEX and the LightningBolts advance the semifinals at the New York City FTC Regional **BY SUSAN ZHENG**



**A FAMILY PHOTO:** The members of StuyVEX and the LightningBolts posing with their robots

## The Manhattan FLL Qualifier



In previous years, Team 694 has hosted a FIRST Lego League practice event in our school cafeteria. This year, however, our team was asked by NY/NJ FIRST to host the Official Manhattan Regional Qualifier.

Due to an extraordinary growth in the New York FLL program, NY/NJ FIRST was forced to expand the competition from one tournament to five "Regional Qualifier" tournaments in each borough. Half of the teams participating in each of the qualifier events continued onwards to the regional championship, where they competed for the chance to go on to the FLL World Festival in Atlanta.

Thanks to a very generous invitation by nearby Pace University, we were able to hold the qualifier event in their gymnasium. In response to a call for volunteers, team members and even students from Stuyvesant's Key Club all came to help out at the event in December. The tournament was a success, and the team went on to send volunteers and referees to the Queens Regional Qualifier and the Regional Championship at Riverbank State Park.

-Hans Zhou

**A**s well as competing in the FIRST Robotics Competition, the Stuyvesant Robotics Team also participates in the FIRST Tech Challenge, a competition geared toward exposing high school students to robotics at a lower cost and smaller scale.

The FTC season started off with an interest meeting in the school library which drew almost a hundred students. Of those students, over half signed up to join the team. With such a huge number of enthusiastic team members, Co-presidents Jordan Perr and Susan Zheng decided to establish two teams, "StuyVEX" and the "LightningBolts".

Meetings were held to familiarize the new recruits with the VEX hobby set and the EasyC software throughout the fall. Newbies participated directly in the prototyping, designing, and programming of their creations, leading both teams to develop very different robots. StuyVEX opted for a durable and simple robot enhanced with various attachments. The *LightningBolts* developed a lifting arm which could raise the pucks and score easily.

The equally intense FTC Regional took place at the same time as the New York City FRC Regional. StuyVEX preformed well at competition, eventually advancing as an alliance captain. Choosing the capable *LightningBolts* and a team equipped with a versatile vector drive as their alliance partners, the StuyVEX alliance proceeded to the semifinals.

However difficult the 2008 FTC season was, the next season is sure to present many more challenges. With a new competition and a new platform, the veterans of Stuyvesant's FTC team will certainly have their work cut out for them.

## "A Robot is Born"

WSJ Reporter Andy Jordan shoots a documentary of our 2008 Season **BY JONATHAN MEED**

**L**ate in December, the lab was called by Ana Martinez, co-chairman of the NYC/NJ FIRST committee. She asked us if we wanted to be part of a Wall Street Journal documentary about FIRST Robotics. We happily accepted.

A few weeks later, as our build season was getting into high gear, a journalist named Andy Jordan stepped off a plane from Asia and into our lab. Over the next three weeks, he continually dropped in on the lab to interview team members and film our next great engineering accomplishment.

Part one of the documentary was an instant hit. Friends and family of team members expressed praise at how Andy Jordan's feature revealed so much of our amazing robotics experience. Even sponsors enjoyed watching our achievements. Ms. Pollen from DE Shaw wrote, "We saw

the video feature of the team in the Wall Street Journal and just wanted to congratulate everyone for getting such a great feature! It was so much fun to watch!" She was so impressed, she sent the video to all of her coworkers.

When we got to the New York Regional, four parts of the documentary were already posted and Andy Jordan was busy filming the fifth. We made sure to mention to judges that our five part documentary would have six parts if we managed to advance to the Championship in Atlanta. In awarding us the Engineering Inspiration Award for our efforts in advancing engineering awareness, the judges ultimately announced that we would, indeed, have a 6th part to our documentary.

To see the documentary, you can view it at our website, [www.stuypulse.com](http://www.stuypulse.com). Andy Jordan's Tech Diary can be seen at <http://link.brightcove.com/services/player/bcpid119166902>



## Ron and Catherine Kunicki - the Dynamic Duo

By Mao Hu



Ron and Catherine Kunicki are among the most valued members of the Stuyvesant Robotics Family. Ron is a uncommon amalgam of traits: a man who is consistently humble and attentive to every team member but a veritable authority on machining. Since his daughter joined the team four years ago, he and his wife, Catherine, have earned their place at the beating heart of the team.

As a man with years of experience working with machines under his belt, Ron

Kunicki brings more than the skills and tips needed to run these machines, but also the ability to breath life into the most complex designs our engineers can muster. In 2006, when his daughter, Theo, designed a spiral tower for our robot, Joshua, Ron used his skill to help bring the spiral tower to fruition and earned Joshua a place in the book Aim High: Behind the Design. When he's not converting highly conceptual designs into real life metal and plastic, Ron spends his time helping others with tips and tricks for every machine in the lab, as well as other bits of wisdom.

Despite working full time as an architect, Ron somehow finds the time to help us during our frenzied build season, coming as often as the veteran team members do. And when we need him outside of the lab, he can

always be trusted to be on hand, even when it doesn't involve his area of expertise. Ron and Catherine appear at almost all demos and competitions, using their station wagon as a shuttle for parts and robots. They even host brainstorming meetings at their home after kickoff each year. For our marketers, Catherine Kunicki has become an expert mentor whose image and design skills fashioned an instant classic: the Dean Kamen face affixed to this year's robot, Desbot.

Together, Ron and Catherine Kunicki have been major help for the team the past four years. Due in large part to their knowledge and unyielding commitment, we have been able to reach goals that would have been unthinkable without them.

## Tom Ferguson - The Master Engineer

By Mao Hu



Tom Ferguson is an engineer with years of experience. He serves as Vice President of Engineering at Cox and Co., the industry leader in aerospace design. He exhibits a polite personality and is a responsible leader. He has a will not of iron, but of aluminum honeycomb.

And he is one of the most beloved and respected mentors of the Stuyvesant Robotics Team.

Since his twin sons, Ian and David, joined the team in 2002, Tom Ferguson has inspired generations of engineers on the team. Tom's

deft understanding of many mathematical and physical concepts in engineering is invaluable to us when we design and build our robot. He encourages us to use abstract formulas and laws to determine concrete requirements and limitations in our designs. For Tom, the old mantra of "measure twice, cut once" is vital.

Even though his sons have long since departed Stuyvesant, he has continued to provide the team with invaluable support. In 2007, when our faculty advisor, Mr Colón, was incapacitated and could not open the lab, Tom offered our team workspace at Cox and Co and the expert guidance of company professionals. When we

encountered a crippling weight problem with our robot, Tom donated expensive aluminum honeycomb as building material. Throughout his eight years as a mentor, he has repeatedly hosted planning meetings at his home and has even set up an internship program at Cox that many of the team's own engineers have participated in.

The Stuyvesant Robotics Team is greatly indebted to Tom, not just because he is one of our most astute engineering mentors, but because he is willing to sacrifice so much to help the team in any way he can. Thanks to his unyielding dedication, the robotics experience has been valuable for many countless members.

## Stuyentific American

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