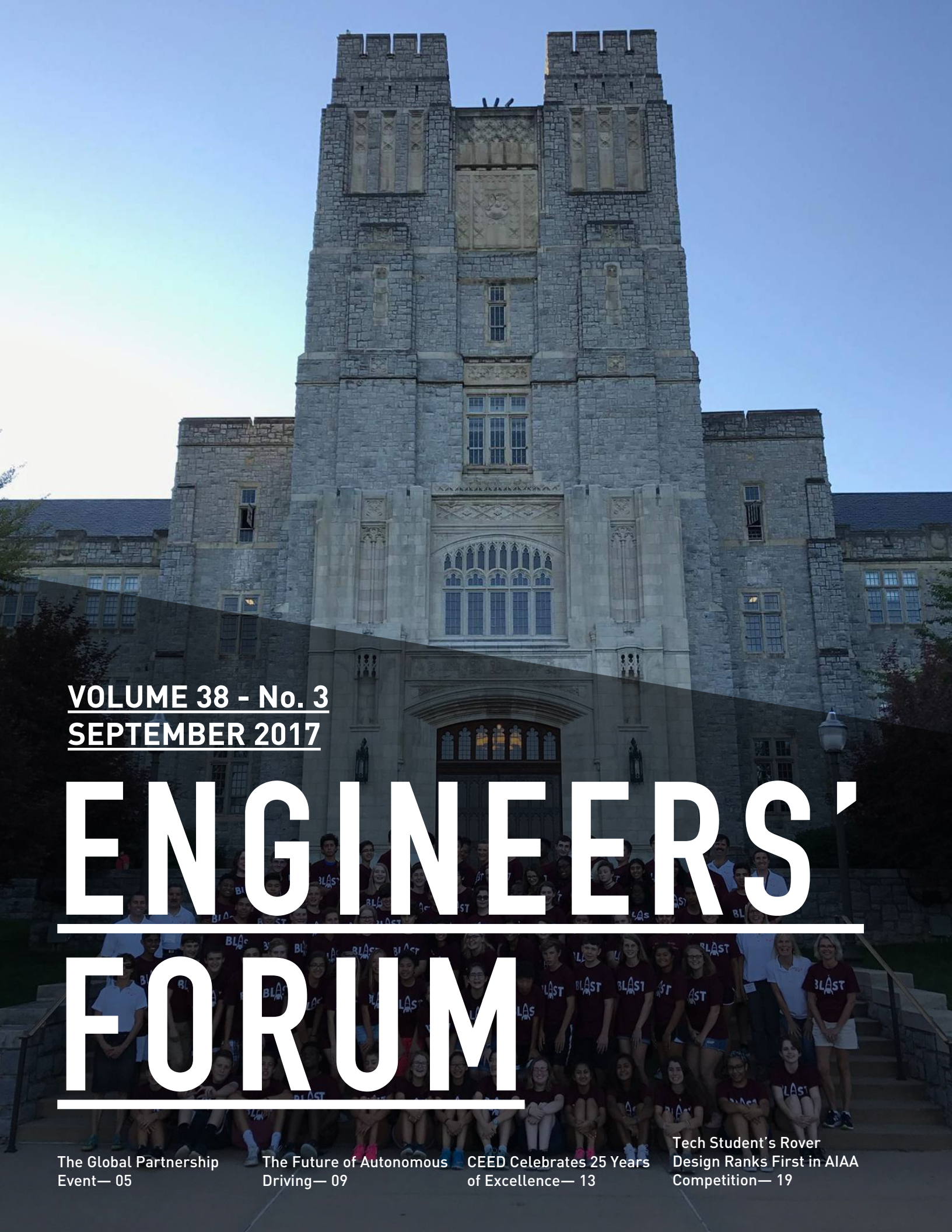

VOLUME 38 - No. 3
SEPTEMBER 2017

ENGINEERS' FORUM

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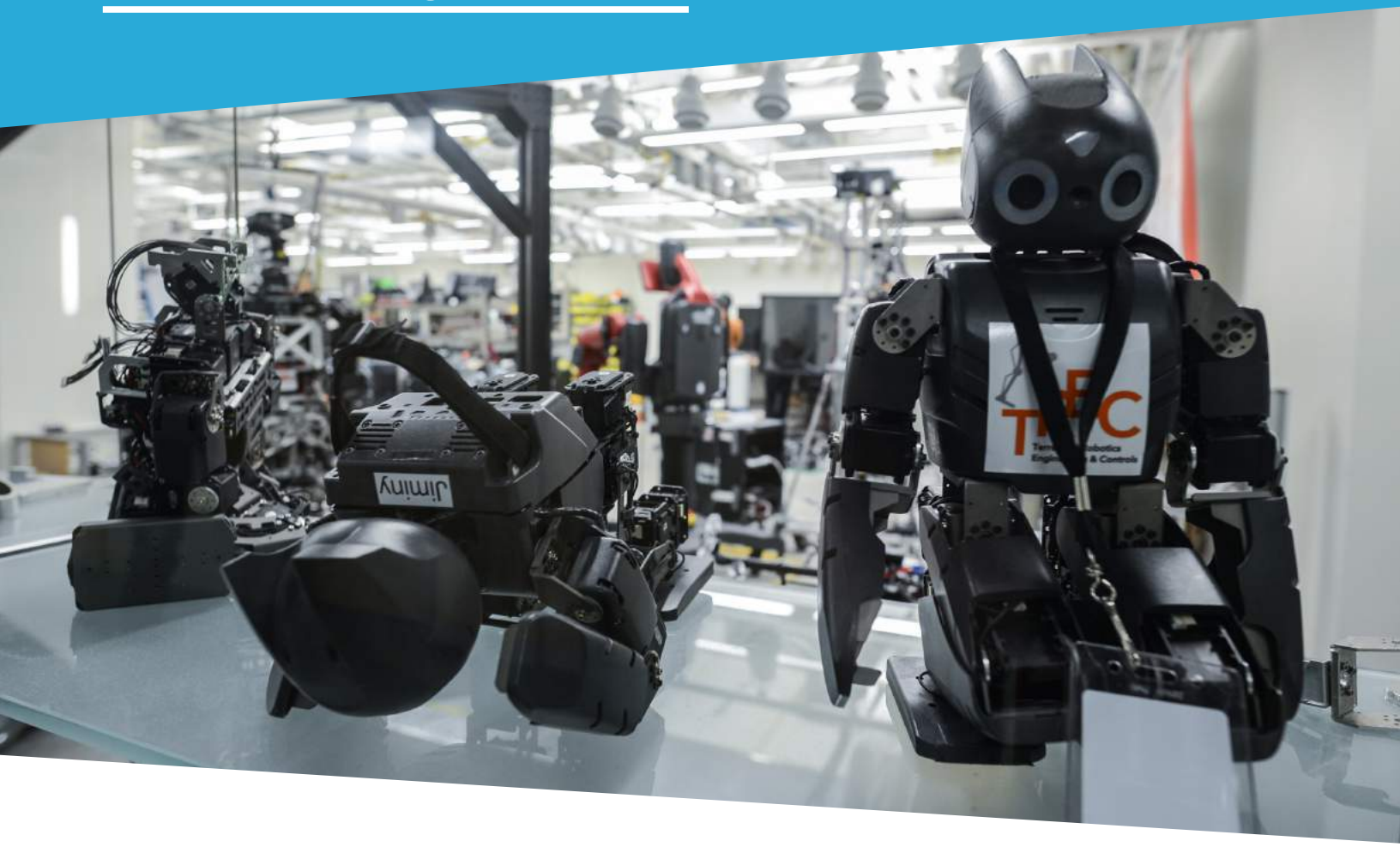

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On The Cover

Photo: Provided by CEED

The BLAST group poses in front of Burruss Hall. BLAST targets Virginia 8th and 9th graders with at least a C+ average.
Read More on Pg. 13

ENGINEERS' FORUM

FEATURES

VOLUME 38 NUMBER 3

LETTER FROM THE EDITOR

Welcome to the Fall semester, readers! The staff at Engineers' Forum Magazine is thrilled to update you with some exciting stories from the summer and past year. Our production team has once again delivered top quality work for all of you and we will continue to do so in further issues. This issue of our magazine focuses on some of the newest projects and important programs going on here at Virginia Tech.

Reporting on the lively VT community is always stimulating for us with countless stories emerging constantly across all departments. This issue of Engineers' Forum uncovers four stories on the innovative work and diversity efforts going on at the university. In fact, we hope to make it a central theme this year to focus on diversity in engineering and what Virginia Tech is doing to address this issue. I cover this topic in an article highlighting the excellent work going on at the Center for the Enhancement of Engineering Diversity (CEED) under the supervision of associate director Susan Arnold-Christian. CEED has several programs supporting both our students and external students looking to explore STEM and the opportunities VT provides. Arianna Krinos is back with another article in this issue covering the VT KnowledgeWorks Global Partnership Event which took place just before the start of the semester. This is a unique entrepreneurship challenge that focuses on giving students an advantage going into the professional world. Our Managing Editor Soshiant Raeesian has delivered an article about another remarkable lab in Goodwin Hall that is working on autonomous driving through an autonomous driving simulator. Finally, Alex John wrapped up last semester by visiting with a team at the Senior Design Expo back in April. This team designed a Mars rover capable of sheltering astronauts and travelling in a rocket to the distant planet.

We at Engineers' Forum are elated to announce the success of our own students awards program. Because of the success granted to us by our readers and providers, we have allocated funds to award students involved in projects made up of primarily undergraduate student with an engineering orientation. The start of the program saw five teams awarded funds and their stories can be found in the April issue of our magazine. We look forward to reviewing the next round of submissions and putting together riveting articles to complement their efforts. Look out for more information about our awards program and other inspiring stories coming out of Virginia Tech in the November issue of Engineers' Forum.

Editor-in-Chief,

Zeyad Zeitoun

Zeyad Zeitoun

ENGINEERS' FORUM

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Virginia Tech-Engineers' Forum

Volume 38 | Number 3 | September 2017

After each presentation, judges scrutinize the work of the students through a series of tough business questions. The pictured panel was evaluating the "Plann3r" team.

THE GLOBAL PARTNERSHIP EVENT: REACHING OUT TO WORLDWIDE BUSINESS TALENT

ARTICLE: ARIANNA KRINOS
PHOTOS: JAMES SHACKLEFORD

The room was crowded by a mosaic of well-dressed students and professionals, intently listening to two young people presenting at the front of the room. The presenters, Ruben Muel and Nicholas D'hondt, a team from Ghent University in Belgium, were pitching an idea for a new app called "Plann3r," a "cross-company…cross-solution" scheduling tool for integrating communications and organization software. Muel and D'hondnt, along with 13 other teams presenting at the 2017 VT KnowledgeWorks Global Partnership Event, had earned the right to compete for $25,000 at the Virginia Tech Holtzman Alumni Center by winning a schoolwide competition at their own university.

The Global Partnership Event was initiated eight years ago by the current event executive director Jim Flowers and the rest of the staff at VT KnowledgeWorks. VT KnowledgeWorks, a

At the entrance of the Holtzman Alumni Center, banners demonstrate the wide sponsorship the event enjoys. The 2017 Global Partnership Challenge shares its sponsors with VT Knowledgeworks, which is supported by both corporate and municipal entities.

subsidiary of the Corporate Research Center (CRC) at Virginia Tech, first developed the concept more than a decade ago in response to a need for an entrepreneurship competition on the Virginia Tech campus. Flowers commented that at the time, many of the business competitions required students to write a comprehensive plan to compete. It was time for a change, and an interactive pitch and presentation format were the key to energizing students with imaginative ideas. A few years later, Flowers saw the opportunity for the event to become a "hands across the sea" international collaboration. The first year only saw seven teams participate and this year the event brought in teams of students from almost every continent.

Flowers emphasized the challenge is not only a great opportunity for students to have their ideas heard in a fast-paced business setting, but is also positive exposure for Virginia Tech. International students are afforded a trip to the United States, a tour around D.C., and the chance to shadow companies and meet future colleagues. By the end of the experience, "they all know each other and us"—by which Mr. Flowers meant Virginia Tech. The event also provides opportunities to Virginia Tech student teams, 20-30 of which vie to represent the United States at a VT-only competition in the spring. These students have an incentive to make it to the Global Partnership Event. Flowers said, "everyone associated [has] been able to meet a whole lot of cool people." He reminisced that once he was stopping through Montpellier, France, and a former participant invited him to dinner and to stay in their family home in the city. "[It's] just a whole lot of fun."

Ruben Muel, left, and Nicholas D'hondt, creators of "Plann3r," pose in front of the stage on which they had recently presented. The pair are the the CEO and CTO, respectively, of the company, which aims to streamline and simplify scheduling across platforms.

In the eight-year run of the global event, a Virginia Tech team has won just once, in 2016. One member of the winning team, David Hall, was present at the 2017 event, cheering on his classmate competing this year. His company, Park & Diamond, which he runs with co-founder Jordan Klein, pitched a bike helmet that can be rolled up to be the size of a water bottle and is as thin as a baseball cap when worn, while offering the same level of protection. Hall says he was inspired to develop the product after his sister was in a car crash when riding a bike without a helmet. Hall says that winning last year was an "incredible feeling" and a stepping stone to their further achievements, including securing $100,000 in funding at a later competition in Minneapolis, Minnesota. According to Hall, the "financial funding and networking" that an organization like VT KnowledgeWorks provides "really sets you apart," something that could not be more important for their CRC-based business. A mechanical engineering major, Hall credits his education at Virginia Tech for the foundational skills he needed to effectively create a winning and impactful business concept. Hall envisions spending the next several years working on Park & Diamond with Klein, noting the concept "can expand, grow, [and is] not a one-off product," with possible applications in different sports, such as snowboarding, and other novel applications.

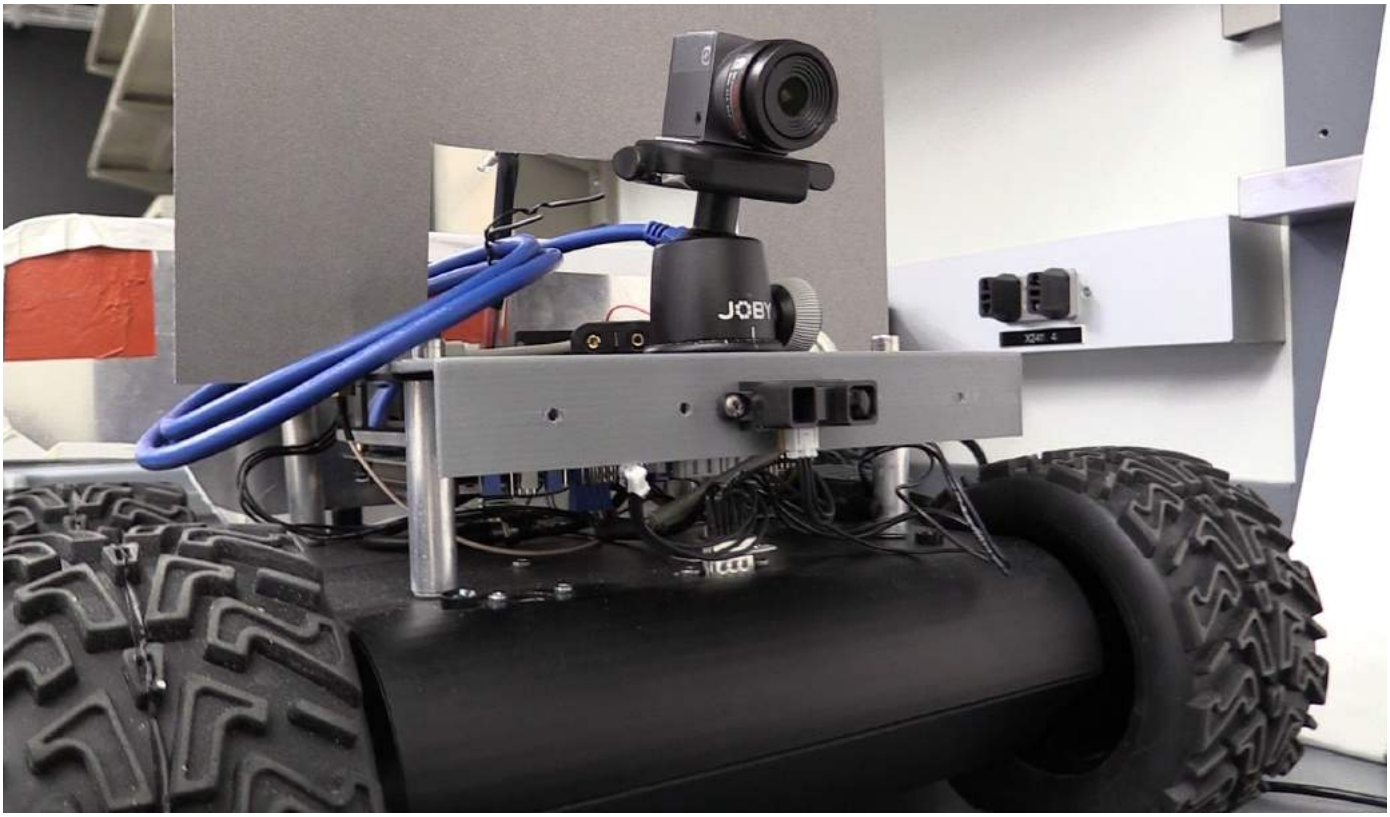
With last year's winner cheering her on from the audience, Danielle Jeffers, a journalism major at Virginia Tech, took the stage to explain her solution to the issue that "three billion dollars in scholarship money goes unclaimed each year." After earning $150,000 in scholarships for college for herself, Jeffers decided to share her skills by doing scholarship consulting for other families; this led to the development of CollegeDough, a scholarship opportunities management and mentorship program. Like all the teams at the challenge, Jeffers had an elaborate presentation,

Danielle Jeffers, this year's Virginia Tech representative, pitches her idea, "CollegeDough." Earlier this year, she secured an investment from celebrity businessman Marcus Lemonis.

Architect of the Global Partnership Event, Jim Flowers, describes the impact of the program. Mr. Flowers conceptualized and saw out this challenge competition, which now serves as a bridge between Virginia Tech and the international community.

which detailed the fraction of her allocated investments which would be put towards research and development, sales and marketing, administration, and other categories. Unlike some of her competitors, however, Jeffers has already secured an investment from a prominent businessman. When Marcus Lemonis, host of NBC's The Profit, visited Virginia Tech's campus last spring, Jeffers seized the opportunity and convinced Lemonis to invest in her company. For Jeffers, however, the money and allure of starting a business as an undergraduate has never been what comes first. She describes that when she went to college, "it was an either/or: either find money, or don't go to school." Her underlying business vision is to communicate to students that, "you can go to college and graduate debt-free…instead of settling for loans."

Team Cohex from Adolfo Ibáñez University in Chile ultimately took home the top prize for the 2017 Challenge for their project, a method of regulating humidity in fruit shipments to reduce economic and environmental waste. However, each challenge participant left Virginia Tech having experienced first-hand what it is like to pitch ideas in a professional setting before a panel of accomplished judges. Going forward, competitors have the opportunity to secure funding for their ideas with enhanced confidence, and a growing network of business contacts to assist them in achieving their goals. VT KnowledgeWorks is bridging the gap between the exceptional promise of young entrepreneurs and the level playing field of money and resources that they need to achieve their goals, benefitting Virginia Tech—and the global economy—in the process.



NEW ASIM LAB SIMULATES THE FUTURE OF AUTONOMOUS DRIVING

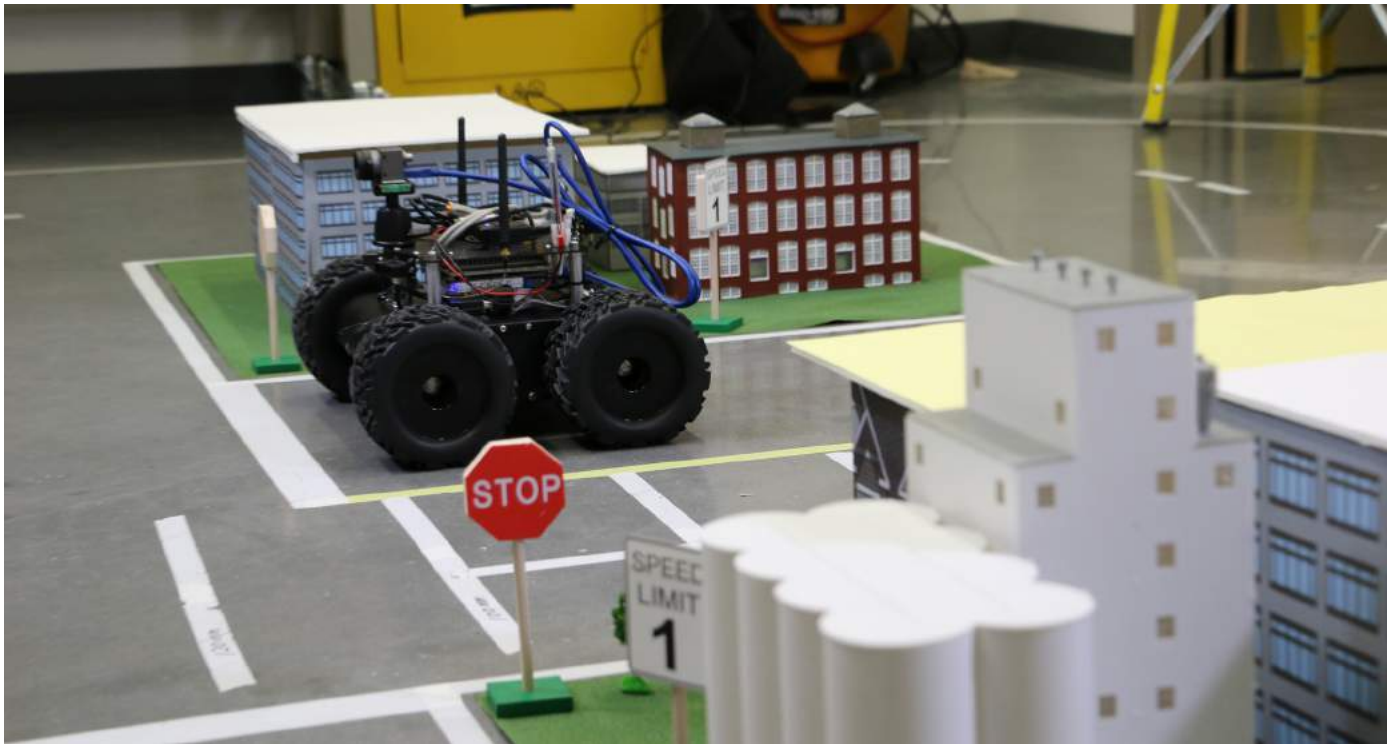
ARTICLE: SOSHIANT RAEESIAN
PHOTOS: ROSAIRE BUSHEY

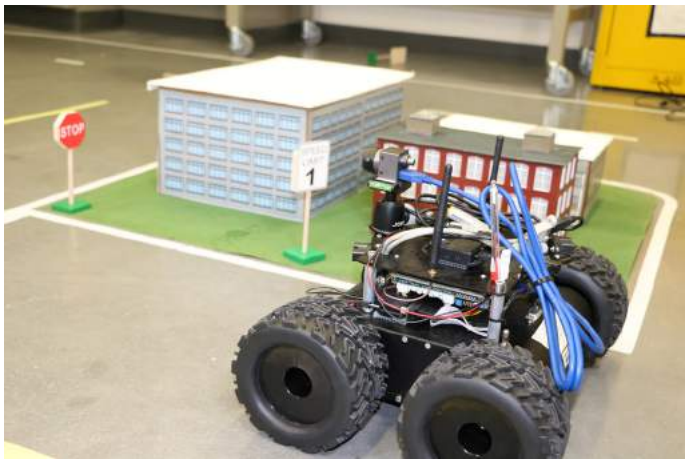
The modern world is on course to completely transform our perception of transportation as we know it today. We are constantly inching closer to the once fictional cinematic fantasy of self-driving cars as the most common form of transportation. Virginia Tech aids the quest for ubiquitous autonomous driving through various research projects centered around the development of autonomous systems. These projects are facilitated by organizations on campus such as the Autonomous Systems and Intelligent Machines (ASIM) lab and the Virginia Tech Transportation Institute.

The ASIM lab is one of the newest laboratories to be introduced at Virginia Tech. The lab was established in the Mechanical Engineering department to propagate understanding of autonomous systems through intelligent control systems. The lab aims to provide scientific insight into how people interact with automated vehicle systems. Understanding the nature of these interactions will lead to more conclusive answers for our future with autonomous transportation that could improve the essence of transportation systems around the world.

The new lab is located in Goodwin Hall on Virginia Tech's Blacksburg campus. Half of the lab is a small-scale model of a town, specifically focused on the realism of the street itself and its street signs to reflect a real-life driving scene. Several robotic vehicles can be seen moving around the track equipped with cameras and sensors to give them a real-time feed of data about the surroundings. These cars can see each other and the features of the road and can communicate with each other to avoid colliding. This part of the lab is equipped with a system of sensors that effectively shows a map of the roads and where the cars are located so that the vehicles themselves can navigate the

Half of the ASIM lab is a model town with robotic cars self-navigating their way around. The detailed features such as the road signs and buildings provide a real-life scenario for this simulation.





roads. The students and faculty working in the ASIM lab use this model traffic system to develop more effective algorithms for self-navigating vehicles.

Professor Azim Eskandarian is head of the Mechanical Engineering Department and director of the ASIM lab. He recognizes the gap in simply developing algorithms for self-driving cars and actually getting them onto the streets. “Anyone can make a slow-moving autonomous vehicle…there are control and safety challenges that need to be investigated here in the lab before we can test them using real vehicles.” Producing an autonomous commercial car necessitates the car itself can perform effectively in a normal environment and has to take into account several potential sources of danger in a daily drive. Dealing with other drivers is one of the hardest aspects of this, as people are much more unpredictable than machines and are prone to making mistakes on the road.

The simulator features a projection screen that shows the various scenarios the car can operate in. The side mirror sports a small screen to show what would be behind the virtual vehicle.

Mechanical engineering senior Aly El Beshbishi operates the desktop simulator in the ASIM lab. This provides data of how a normal driver operates in the virtual environment the team has developed.

These robotic vehicles take up only half of the space in the lab and are just a piece of the overall picture. The other portion of the lab sports a real car that serves as a simulator and generates more key information for the ASIM team. The simulator is a Smart Car with a 180-degree projection screen that can illustrate a variety of roadway scenarios similar to those a driver would commonly encounter while traveling. These projections provide one set of data while another desktop driving station enables the team to have two drivers individually interact with the same digital roadway. The two stations allow researchers to gather data on the interaction of manual and autonomous drivers in the same scenario. This data helps address the difficult task of building autonomous vehicles that can deal with normal drivers on the road. The lab's mission is to continue conducting research that contributes to the safety and efficiency of autonomous and non-autonomous driving. The lab focuses in both areas because Eskandarian believes manual driving will still be prevalent as the transition to autonomous vehicles goes forth.

Many automobile companies aim to expedite the transition to autonomous vehicles. In early 2017, the Society of Automotive Engineering and General Motors announced they were sponsoring a college competition called the AutoDrive Challenge. Virginia Tech was selected as one of eight universities to compete in the competition designed to test the researchers' ability to successfully design and create a completely autonomous

passenger vehicle. Each team will be provided with a 2017 Chevrolet Bolt electric vehicle that will serve as their platform to be modified into a fully autonomous vehicle. Once the algorithms have been developed and the cars are wired up properly, the teams will have the chance to compete. The cars will be set in autonomous mode and left to navigate a driving course.

A team of faculty and students, led by mechanical engineering Associate Professor Al Wicks, who put together a team to take on this challenge. Being able to come up with a sufficient proposal for developing a self-driving car is no easy task and required a strong team of diverse talent. “As part of our proposal to be selected for the AutoDrive Challenge, we leveraged our technical diversity,” Wicks said, referring to multiple engineering departments making up the group. The team will also include support from TORC Robotics, Advanced Auto Parts, and the Virginia Tech Transportation Institute. Collaboration like this fuels the progressive efforts of researchers around the globe diligently working to perfect a safe and efficient autonomous transportation system to be implemented all around the world.

CEED CELEBRATES 25 YEARS OF EXCELLENCE IN PROMOTING A MORE DIVERSE VT

ARTICLE: ZEYAD ZEITOUN
PHOTOS: PROVIDED BY CEED

The girls attending the C-Tech2 summer camp receive the introduction to the program. The participants live on campus for two weeks and explore the exciting world STEM through hands-on experiences.

"A commitment to diverse and inclusive communities" is one of Virginia Tech's core values listed in the university's mission statement. Racial and gender diversity are a central topic of discussion and consideration at universities around the country and Virginia Tech is actively seeking to improve diversity on campus.

The university currently ranks on the better end of diversity studies with the website College Factual ranking Virginia Tech as the 654th most overall diverse university out of 2,397 universities considered nationwide. Despite this ranking, the same website ranks Virginia Tech as number 1,103 out of 1,722 universities for gender diversity and number 1,289 out of 2,655 for ethnic diversity.

The University's official statistics show that out of 31,000 students, 13,345 are women, or about 43%, and about 63% of all students are white. These statistics are particularly interesting considering the 2010 census results showing Virginia's population is about 69% white and 51% female. Virginia Tech currently has several initiatives to make a more inclusive and connected community. In the 2006-07 academic year, the Task Force on Race and the Institution was formed to "explore the issues of race and the university." This eventually led to the development of the Diversity Development program and InclusiveVT, which both reflect the university's dedication to engage the community in cultivating an environment of respect for all genders and races.

The longest running initiative to boost diversity at Virginia Tech is the Center for Enhancement of Engineering Diversity (CEED). Founded in 1992, CEED has prided itself in enabling

A middle schooler in the BLAST program conducts the classic penny in zinc hydroxide experiment. The BLAST students visited the Chemical Engineering Unit Operations Lab this summer for this and other famous experiments.

Some of the TechGirls participants take on a hands-on building activity here at Virginia Tech. The activities here in Blacksburg are only a small portion of the mentoring experience TechGirls provides these young Middle Eastern girls.

a more diverse School of Engineering by "focusing on the under-represented population." CEED runs on a focused set of objectives starting with a basic foundation of increasing the diversity of both those who attend and those who apply to Virginia Tech. They aim to "foster the collaboration between CEED, the university, industry, and the local community" by elevating people's awareness of STEM and the massive rewards in terms of excitement and career paths emerging from STEM. CEED also promotes diversity by providing continuous support to groups including the National Society of Black Engineers, the Society of Hispanic Professional Engineers, the Society of Women Engineers, and the Council for the Advancement of Minority Engineering Organizations. Perhaps most importantly, one of CEEDs objectives is "to provide academic, professional and personal support programs." Several of these programs have been formed since CEED's foundation to support Virginia Tech students and educate students outside of the university about the opportunities in engineering.

CEED has put programs in place to support undergraduates seeking a degree at Virginia Tech; the support is available for students before they even start classes. The Student Transition Engineering Program (STEP) is a summer program for incoming engineering freshmen to help the selected students transition from high school. The students are instructed by faculty and graduate students from several departments for five weeks, in

which they get the chance to "network with peers, instructors, and industry representatives…in an intensive academic environment." STEP is also designed to give students a preview into the style of coursework they will deal with in engineering. Chemistry, mathematics, and engineering education courses are available in STEP to put students through classroom and lab situations they will likely face in the future.

Galileo and Hypatia are perhaps CEED's most important work, bringing together freshman male and female engineering students in a residential environment. These engineering living-learning communities bring together freshman students and upperclass mentors to boost the students' chances for success. Galileo and Hypatia consist of over 420 freshmen engineering students with over 130 upperclass mentors, who provide advice about studying at Virginia Tech and about key social and networking events. These communities help students find out about career opportunities and the best way to approach the job hunt through seminars and meetings with their peers. The support gained through these communities is priceless, and not only the freshmen students benefit from the program. The upperclass mentors are gaining valuable experience by acting as leaders in their fields and widening their own career opportunities upon graduation. These communities operate under the name Virginia Tech inVenT, which houses Galileo, Hypatia, and two other communities called Curie and Da Vinci in Lee Hall, where students also have access to a state-of-the-art design lab and study spaces. CEED has established a separate mentoring program outside of the inVenT communities that also supports diversity in engineering. Four individual mentoring groups composed of small groups of 10 freshmen and one mentor are available, and three of these groups are focused on an underrepresented subset of Virginia Tech's student body. They are called the Academic Hispanic Outreach Alliance, the Black Engineering Support Teams, and Women in Engineering Support Teams. Like the living-learning communities, this mentorship provides the participating students with a chance to connect with their peers and faculty, while learning about campus resources and important social events.

Kim Lester, the coordinator of pre-college programs oversees several initiatives bringing in youth and international students outside of the Virginia Tech community. Many of these groups come to the University and can be seen roaming around campus during the summer semesters. One program bringing in middle schoolers from the region is Imagination, a one-week science camp which takes place in mid-July. Imagination is a fun, exciting experience for students who get to do hands-on activities related to what going on at Virginia Tech. Building Leaders for Advancing Science and Technology (BLAST) is another summer opportunity for Virginia eighth and ninth graders to delve into the world of STEM and the special work here at Tech. BLAST participants explored the Chemical Engineering Unit Operations

A chemical engineering graduate students presents a liquid nitrogen demonstration to a group of girls from the C-Tech2 summer camp. The Unit Operations Lab in Hancock Hall is an important stop for this program as well as the BLAST students.

Lab in Hancock Hall and were shown complex experiments and had fun shattering liquid nitrogen balloons. Programs like BLAST and Imagination trigger the excitement in students for STEM academics and keep Virginia Tech in their mind when they apply to universities in the future.

Pre-college programs are also directed toward diversity in the form of initiatives supporting women and international students in engineering. C-Tech2 is a two-week camp held in the summer for junior and senior high school girls. The program enables these girls to explore the possibilities in engineering and encourages them to pursue engineering through several hands-on activities and seminars. Participants are tasked with an engineering design project, which gives them a preview of the type of work they would have to deal with as an engineering student at Virginia Tech.

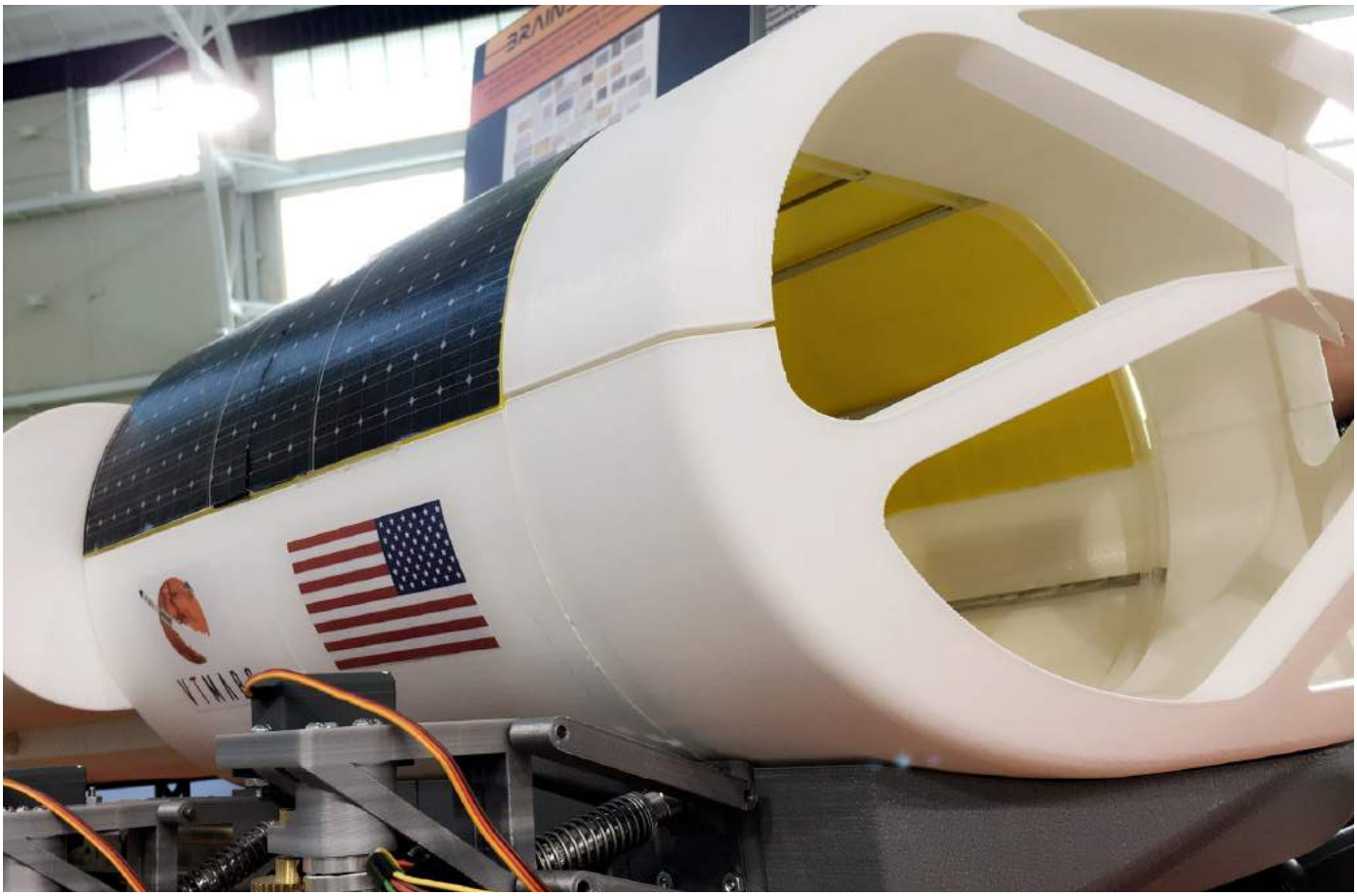
TechGirls is another program that CEED is involved with that promotes women in engineering. TechGirls mentors over 100 Middle Eastern girls and brings them to the states for a touristic trip in DC and an enlightening experience in STEM. The girls are given the chance to shadow employees at a tech company and are also put through a technology and computer camp. TechGirls is a government-sponsored program that CEED supports by providing a part of the programming for the girls who take part in the initiative.

The awards presented to the first place team at the C-Tech2 showcase. The high school upperclassmen girls taking part in the C-Tech2 camp complete the experience by completing an engineering design project.

Kim Lester also oversees Women's Preview Weekend (WPW), a yearly event in which female students interested in Virginia Tech are given the chance to visit the university and meet with faculty and students. WPW helps these students make an informed decision about what university they would like to attend. These programs are crucial in improving Virginia Tech's efforts to establish a more diverse community and more effectively represent the under-represented.

We at Engineers' Forum are inspired by the work at CEED and aim to make diversity a central focus of our work this academic year.

The side of the rover with the team's branding and the country they represent. Solar panels can be seen on top of the rover, which would be used to power the vehicle.



VIRGINIA TECH STUDENTS' ROVER DESIGN RANKS FIRST IN AIAA COMPETITION

ARTICLE: ALEX JOHN

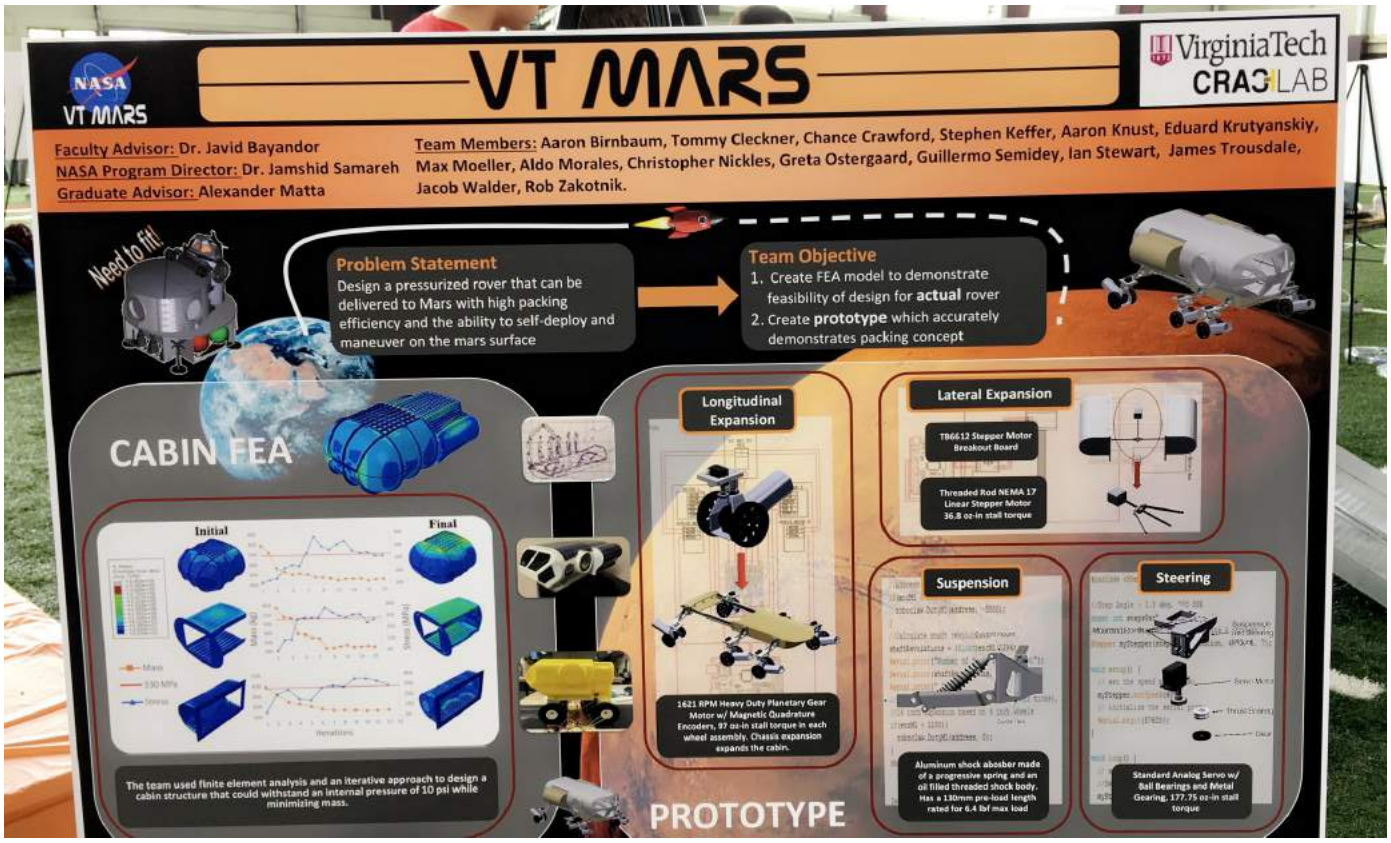
PHOTOS: CHANCE CRAWFORD

As space exploration approaches the height of relevancy, many governmental and private organizations are proposing sustainable methods for potentially travelling to various planets and moons. Organizations like NASA work to develop rovers for planetary exploration, like the rovers they have sent to Mars. The focus here is to make these rovers that can effectively be stored in a rocket without interrupting the rocket's aerodynamics. NASA and other organizations are also looking for innovations in the design of rovers to potentially build shelters for manned planetary exploration.

On a smaller scale compared to NASA, the American Institute of Aeronautics and Astronautics (AIAA) recently attempted to tackle similar endeavors through their annual Student Papers Conference competition. The conference tasked students with developing an 11-page research-based technical paper that exhibits cohesiveness and analysis on a relevant topic. Students then performed an oral presentation on the subject andthe paper and presentation were reviewed and scored by practicing professionals.Teams that ranked highly would receive financial merit and be invited to attend the AIAA Foundation's International Student Conference. The competition was divided into five regions, with participants in each region competing against one another to achieve first place.

Virginia Tech's team, participating in the AIAA Region I Student Paper Conference, consisted of 13 mechanical engineering seniors and two aerospace engineering sophomores, who used their senior design project as the basis for their technical paper. Led by Associate Professor Javid Bayanador, founder and director of the Mechanical Engineering Department's Crashworthiness for Aerospace Structures and Hybrids (CRASH)

The team's poster for last semester's senior design competition. Engineers' Forum first established contact with this special project at the event in April.

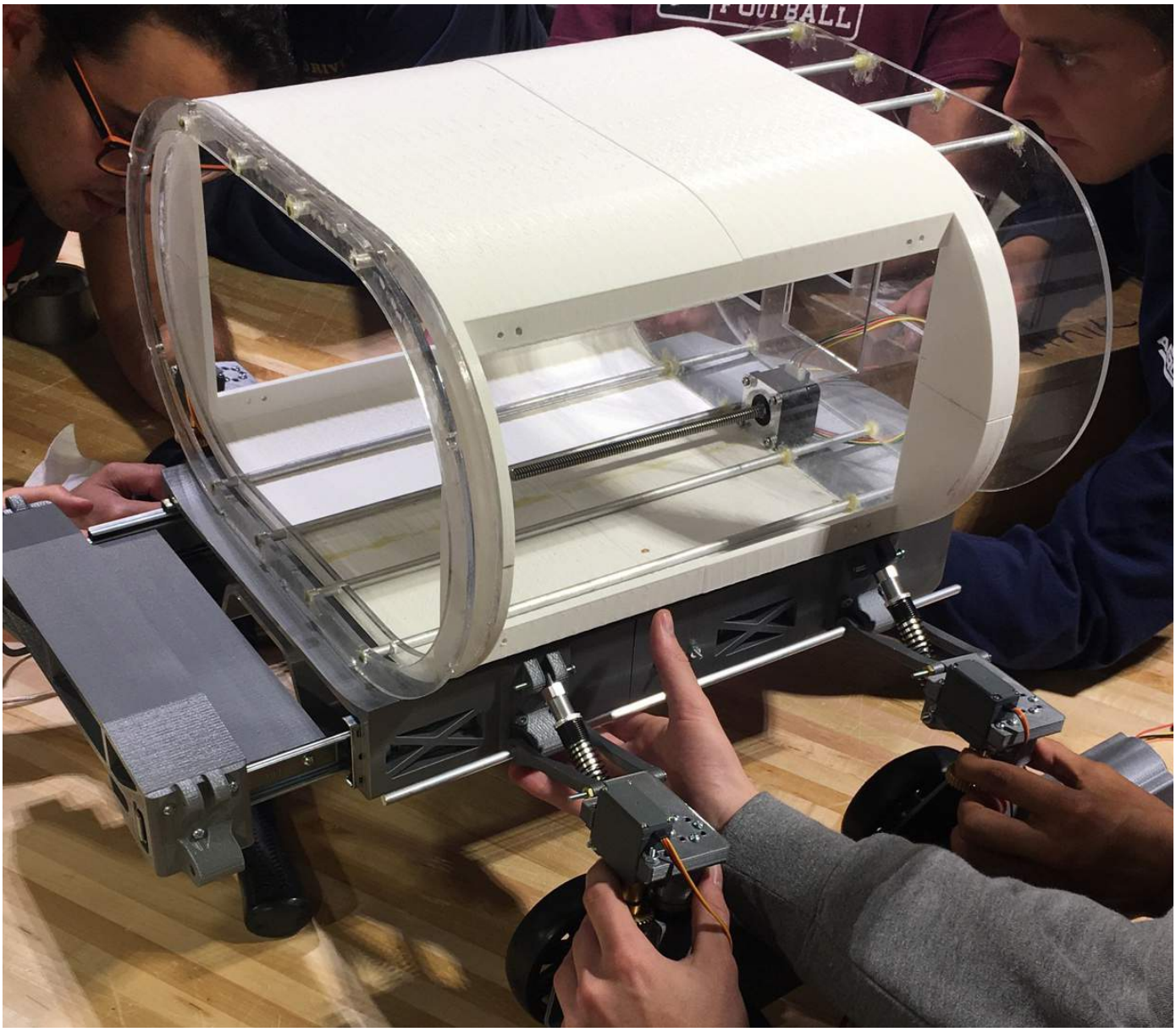


Lab, and with the assistance of graduate faculty advisor, Alex Matta, and graduate student, Jeffrey Feaster, the team met three times a week in the CRASH Lab for two hours to develop their prototype and work on the paper.

The students conceptualized a design for a Mars rover with a similar design as a motorhome with focused aerodynamic stability and packaging efficiency when stored in a rocket – a problem that NASA has had to deal with in their previous rover designs. The core principles of the design were to create a model that ensures the progress of the prototype and that the prototype should accurately resolve the limitations of the amount of cargo on a rocket. Guiding the design process were the constraints of height, width, and weight to make certain that the intended criteria was met when placed in storage components. During the prototyping process, the students received funding by NASA's System Analysis and Concepts Directorate (SACD) development and research program to guarantee they had the necessary resources to effectively use computer-aided design and 3D print various parts of the test model. The team also had the help of NASA research engineer Jamshid Samareh, who acted as the group's program director throughout the design process in order to assess the feasibility and efficiency of their potential prototypes.

Like a motorhome that functions as an automobile and living space, the team worked with Samareh to develop a small-scale Mars rover that operated as a mobile home and a vehicle, while simultaneously solving the problem of packaging inefficiency on a rocket. Throughout the development of the prototypes, the teams also attempted to stray away from NASA's inadequacy in previous bulky design aesthetics by developing a smaller, rigid prototype. A large portion of the parts were 3D printed, and included certain expandable pieces to reduce the amount of

Team members work on the expanding mechanism of the rover. The design calls for an expandable cabin to minimize the size and maximize the functionality of the rover.



space that the rover occupies in a rocket; the components of the design included individual sections that can expand in different operational modes. The cabin structure increases its volume through both longitudinal and lateral expansion to serve as a shelter when the rover is stationary. Despite the uniqueness of this rover, the students' kept similar design aspects of NASA's rovers that enable the rover to cross large portions of territory on Mars' terrain.

After the design process was finished, which incurred multiple reiterations and redevelopments of prototypes, the students finally could see their design in action. With the help of Samareh and NASA, the students' rover design was placed on a 56-foot Black Brant IX rocket to test it as a part of the SubTec-7 payload mission. For the lift-off, a sounding rocket that achieves lower velocities and remains in lower orbital levels in comparison to other rockets was used to assess the effectiveness of the placement and volumes of the rover. The rocket was launched from NASA's Wallops Flight Facility in Virginia on May 16th along with three other student-designed rovers and achieved an altitude of approximately 154 miles into space before parachuting in the Atlantic Ocean.

Once the designs and tests were fully completed, the team gathered their thoughts and translated it onto the technical paper for the AIAA Student Papers Conference Competition. The paper, titled "Virginia Tech-NASA Auto-Deployable Mars Rover Design and Development Project, was compared to several other teams at the competition with their own novel ideas and designs. Virginia Tech's team took first place and received the opportunity to attend the international AIAA Foundation's International Student Conference this January.

Organizations like NASA and AIAA are the leading proponents in compelling individuals to think about long-term solutions for creating safe and viable methods for space travel. Hopefully, as methods of aeronautics and space exploration continue to expand, Virginia Tech remains at the forefront of this scientific investigation.

The interior of the Mars rover is pictured here. The cabin is designed to act as a shelter and laboratory simultaneously.