Engineers' Forum

August/September 2013 | Volume 33 | Number 1

Letter from the Editor

Hello fellow Hokies!
As the new Editor in Chief of the Engineers' Forum, it is my privilege to welcome you all to another year at Virginia Tech! I hope you all are excited as I am for a new semester, one hopefully filled with unique opportunities and the chance to create new and lasting friendships among our peers.

In our first issue of this year we want to start you off right with the best and latest topics concerning the sciences and what is happening in the college of engineering. Ryan kicks this issue off with a faculty spotlight on Dr. Percival Zhang and the promising future of Hydrogen energy. Want to know what the major obstacles and issues facing the development of more advanced Hydrogen energy systems? Hear it straight from a major source of research at Tech!

If you are a programmer or computer science buff, turn to Jordan's point of view article on the increasing role assistive software plays in the educations and lives of programmers, and the dangers it poses.

For the book lovers out there, Avery has written a piece about a new novel recently published called Emery's Treasure, written by one of our very own engineer alumni Cliffie Coates!

In a retrospective view Kanika features a fascinating piece on the evolution of the smartphone and the history behind why mobile devices went from being science fiction to becoming an everyday device.

Interested in robotics and the technology behind drones? Time to turn to Dennis's piece on Drone research at Tech! This article takes the latest look at the technology and applications of unmanned flight right from our own backyard.

Next we turn to some interesting architecture in our local region in Richmond. Eileen has covered some of the oldest and most unique buildings from the capital of our state, along with some interesting facts behind the construction and visionaries of these historic icons. Tune in to see a great photo spread!

Lastly Sarah has written a fantastic article on the risks and dangers of diet in relation to the development of breast cancer in future generations. Watch what you eat and know your science with this spotlight on the latest research in Electrical and Computing engineering!

Please keep tuned in to our Facebook and Twitter pages for more updates on what the Forum is doing this year. We depend on viewers like you to make the best magazine possible!

Coleman Mann

Coleman

Table of Contents

Staff

Engineers' Forum is a member of Engineering College Magazine Associated. The opinions expressed in Engineers' Forum do not necessarily reflect those of the administration, faculty, or student body of Virginia Tech.

Engineers' Forum is Virginia Tech's student-run engineering magazine, published four times during the academic year. The editorial and business office is located at 223 Femoyer Hall Virginia Tech Blacksburg, VA 24061. Please feel free to stop by anytime, or phone us at 540.231.7738.

Research Spotlight: Dr. Percival Zhang

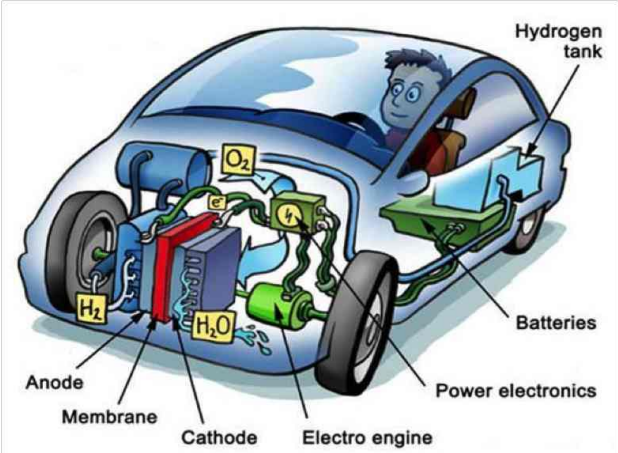
Ryan Martin is a sophomore in Life Sciences, Undecided

With all of the hustle and bustle around campus as students and faculty return from the summer break, it is hard to fathom the amount of energy being used during this lengthy process. From the gasoline used to fuel cars, to the coal that powers much of the campus's electric needs, many of us seem to forget where this great amount of energy comes from; even as gas prices dig deeper and deeper into the consumer's wallet and echoes the proverbial cry of wanting more. Much effort has been put forth to find alternatives to the current use of non-renewable resources and making the existing infrastructure "greener". Such alternatives include solar energy, wind energy and even types of biofuels made from organic matter. Luckily, a research team headed by Dr. Percival Zhang, an associate professor in the Department of Biological System Engineering at Virginia Tech, has finished a landmark research project that produced more efficient enzymes for extracting hydrogen from plant material.

Dr. Zhang's research is a culmination of seven years' collaboration with a professor at the University of Georgia. According to Dr. Zhang, "hydrogen is easy to understand and is a component in many industrial compounds already." He went on to explain that Hydrogen is a "$100 billion market already, but is mostly used as an ingredient in fertilizers and diesel fuel." Dr. Zhang believes that the future is bright and that we will soon enter the "hydrogen economy" where hydrogen will be used for energy "due to its high efficiency and the fact that the only products from a hydrogen fuel cell are water and electricity." This fact in and of itself is a huge benefit of hydrogen-based energy when compared to the conglomerate of harmful pollutant byproducts from current energy production methods. However, this form of energy creation does come with a few problems that future research should resolve.

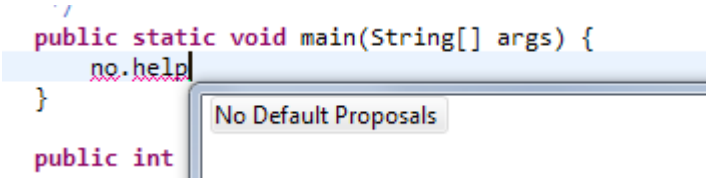
These four main obstacles have been outlined by Dr. Zhang: we need to produce this energy in a renewable way because the hydrogen is currently produced from natural gas; a method of storing the energy is required because the hydrogen is currently stored in gaseous form, but optimal storage conditions would have a higher density; the infrastructure would need to be overhauled due to incompatibility of current engines and factories; and fuel cell cost and longevity needs to be accounted for and improved.

Zhang's team altered enzymes to better the extraction of cellulose from plant matter which can then be used for the creation of energy. Zhang describes this as a "game-changer" that can be used to create energy in a green way. He added that with this, "hydrogen is the carrier of the energy, so when you need it you can generate it." His future research ambitions include breaking down naturally produced wood's cellulose structure and converting this to edible starch to feed the world's ever increasing population. Who knows? Soon we could be riding a bus that emits water and West End could be serving pizza made from oak trees.



The Case Against Assistive Software

Written by Jordan Sablan, a junior in Computer Science



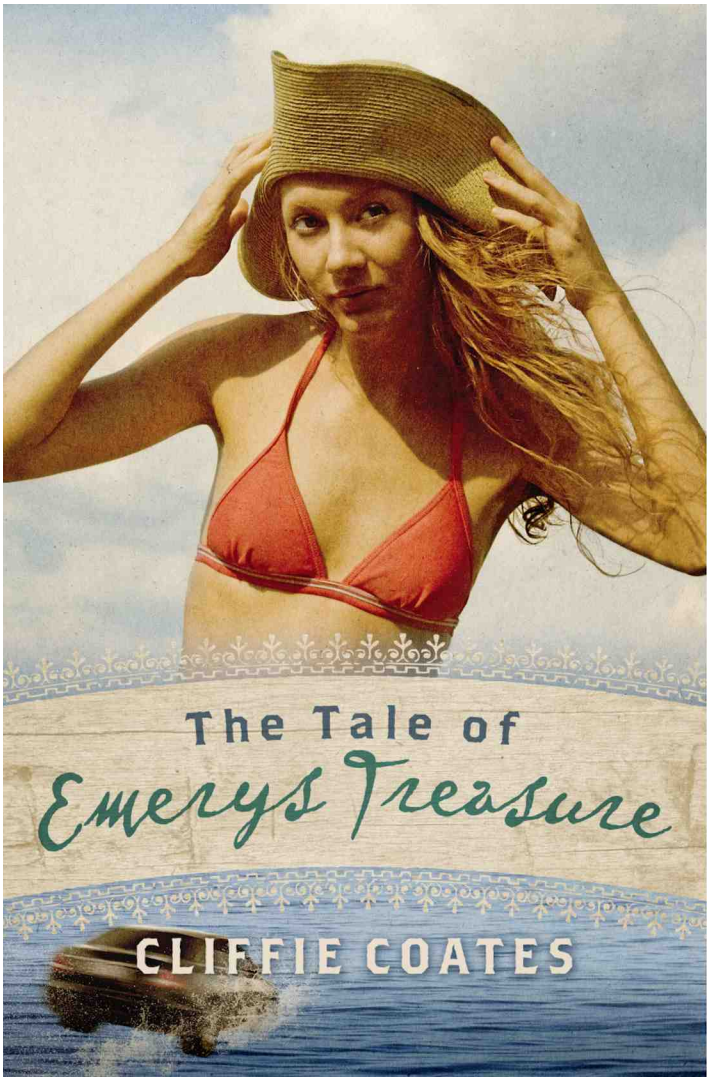
A little while ago I made a startling discovery. After a semester of Java programming, I realized that without the programming software we used I could not have written any standalone programs, not even a simple Hello World. I began to wonder where this problem stemmed from. The answer came rather quickly. I was dependent on BlueJ (Virginia Tech's intro to Java Programming software of choice) to handle the running, creation, and handling of all my coding. The most startling discovery of all was my inability to create a Java program that would run by itself (without the use of BlueJ). Eventually I realized that I had not implemented the main method. While this may sound like Greek to those who aren't familiar with programming, it is equivalent to trying to start a car without a key. The Java main method is the method that is run when you initialize a Java program. Without it, Java does not know how to run the program because it looks for it to initialize and give its base instructions. How could I have had an entire semester of programming and not learned one of the simplest and most important parts of Java? The answer was simple: BlueJ.

Assistive software is an excellent practice in theory, but assistancewith programming can have disastrous consequences. One of the most important skills to learn as a programmer is the ability to structure your syntax correctly. Syntax is the key to almost every computer language. This entails anything from correct spacing to matching the cases of each letter. Although it is a tedious task to undertake, it gives the programmer a much more intimate feel of the language and instills habits important to writing code. As I found out, failure to learn these skills can cripple the ability to write any software. To give you an idea, in my current job as a programmer we have a large development environment where we can write code using whatever software we please. While we have the choice to use softwares such as Netbeans or Eclipse, the majority of the office uses nothing but a plain text editor. The reason is really rather simple: it gives them the ability to write code, and that is all they need. No helpful tips on what methods to use; no assistance fixing possible problems; just the user and their keyboard. In this environment, a programmer has to learn to write syntax the correct way and how to troubleshoot any failures in their code. It is difficult at first, but becomes easier once you learn the basics.

So what does this have to do with education? It's really rather simple. The majority of programming classes make use of software that aid the user and take care of the less important things that a user must do on their own. This may not sound like a bad practice, but it does have negative consequences. It encourages dependence in the user and takes away the importance of learning the various semantics of computer languages. Assistivesoftware encourages ideals that go all the way down to programming starter applications. They actively encourage and lead to ignorance of important knowledge. Just as a smoker should seek to wean themselves off of deadly cigarettes, programmers and programming teachers should shrug off the habit of assistive software.

Books for Engineers: Emerys Treasure and the Engineer Turned Writer

Avery Nelson is a junior in Materials Science & Engineering.



Emerys Treasure is a short novel written by Virginia Tech graduate Cliffie Coates. The story begins with the protagonist, Losten Deforest, making a difficult decision and evolves into an adventure he never expected.

As the story progresses, Losten begins life at his new college in Norfolk where he meets new people and makes a few friends. One of the people he meets is the beautiful and enticing Emerys Treasure. The two eventually become close as a result of a tutoring arrangement. In time, he discovers that there is far more to Emerys than meets the eye.

There is plenty of action along the way. From near-drownings to a car crash, an explosion, a kidnapping, a dance that is definitely not prom and, of course, a touch of the supernatural, readers will have a hard time putting the story down as the plot begins to unfold.

Emerys Treasure is an effortless read and is both funny and exciting throughout. Additionally, it is easy to recall characters and past events even after not reading the story for an extended period of time. It is also the only romantic fantasy novel I have ever read where the boy was the human protagonist, while the girl was supernatural. Furthermore, Losten's reaction once he finds out Emerys is no average human is the most realistic I have ever encountered in a story of this genre. The foreshadowing throughout the story is well executed, leaving the reader guessing without giving anything away.

Despite being a great read, like any self-published first novel, the final product was not entirely flawless. At times, the fantasy elements took an extra suspension of belief. Small portions of the plot and some of the characters' behavior are difficult to justify. Nonetheless, the story is fresh, entertaining, unique, and is the perfect leisurely read for any engineer.

Not all engineers and science majors are readers, but there are many who enjoy reading (and I suspect, if you're reading this, you do) but haven't had the opportunity to finish a book in a while. Emerys Treasure is short and easy to read, but engaging enough for those who are pressed for time and cannot commit to a lengthy novel.

The author's background, along with the fact that Losten is an engineering major, definitely makes the novel more relatable for engineering majors. As Coates says, "I like to think of my story as how an engineer looks at fantasy and romance novels. Losten displays a bit of humorous skepticism towards the events around him, which is how I look at things and I think many engineers do." As a result, this novel stands out amongst fantasy romances, especially when the page drips with ironically cloying dialogue and deliberately contrived situations; or when it denies convention by avoiding illogically romantic behavior entirely. Most important, however, the novel is sincere when necessary.

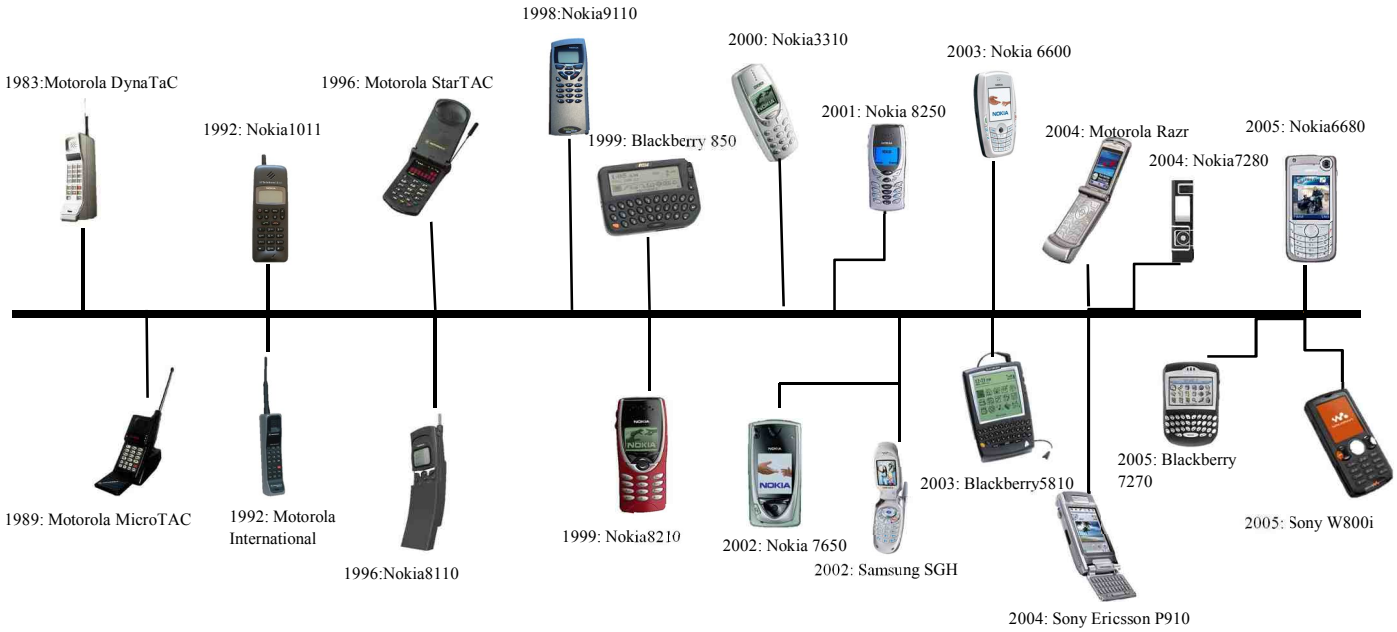
Cliffie Coates graduated from Virginia Tech in May 2004 with a bachelor's degree in Mechanical Engineering. For six years after that, he worked as a quality control engineer before deciding to explore environmental science. While taking several graduate courses, he realized he

wanted to do something different with the rest of his life. He decided to become a novelist, which goes to show that you can change your mind about your career at any time in your life if you know a different path will be more personally rewarding.

Currently, Emerys Treasure is only available electronically on Amazon and through Coates' website, cliffiecoates.com.

The Evolution of the Mobile Phone:

Kanika Saini is a graduate in Electrical Engineering



Life is incomplete without a cell phone. Like a Swiss Army penknife, this device has multiple uses, such as calling, texting, camera, weather, etc. As technology progresses these devices become smaller and smaller, adding multiple features into one small device. However, mobile technology has notalways been this way . This article will take you on a brief journey into the development and innovation of this peculiar device, which has become an important part of our lives.

It all began in 1973 when Dr. Martin Cooper, a senior development engineer at Motorola, called a rival telecommunication company and said that he was calling via mobile phone. Despite the new breakthrough, the phone used weighed 1.1kg and gave 30 minutes of talktime after 10 hours of recharging. In 1982, federal commission approved the establishment of the mobile phone system and allocated analog frequency to be used by network. This opened up tremendous opportunities in the area of radio communication and mobile phones. At that time, Motorola released commercial mobile phone which offered thirty minutes of talk time, six hours of standby and could store thirty phone numbers. It cost a grand total of $3995. In those days, mobile phones were for the affluent, rather than the average middle-class person. Additionally, their performance was not even close to that of the present day phones.

By late 1990s, mobile phones started to become increasingly available to the general public. The big players at the time were Motorola and Nokia. Sony Ericsson, Panasonic, LG and HTC would soon enter the market, followed by Samsung, Apple and Blackberry.

Phones in the 1990s: Initially mobile phones were large in size and had long antennas similar to today's cordless phone. In 1996, mobile phones became more refined with shortened antennas and upgraded features and models. Thereafter, with the introduction of internal antennas, they became more sophisticated and occupied less space. Amongst the popular models were those by Nokia, such as the 1011, 5110, 6110 , 7110, 8210 and 3210, which were mainly GSM based and had basic functionalities such as text messaging, calculator, games, phone book etc. The Snake game had become immensely popular and was found on all of Nokia's handsets.. In 1997, Mo-

torola released the Motorola StarTAC. This was the world's first clamshell/flip handset. It was successor of Motorola MicroTAC (1989) design which introduced a new innovated design where the mouthpiece is folded into the keypad.

Early 2000s: 2001 began with the introduction of monochromatic display technology (Nokia 8250); that is a phone with different background colors, rather than the old black and grey display. In 2002, camera was integrated to the phone producing the world's first camera cell phone (Nokia7650). Later in 2002, developed a clamshell phone which had a small screen on the outside to notify the user of incoming calls and messages. It also had a big screen on the inside for the user to type messages and carry out other functions. In 2004, Motorola introduced the world's slimmest phone: the Razr. This phone had a dual screen, slim shape, and a VGA camera. It was at this point that the mobile phone completed its transformation from being a long and heavy device, to one that was slim, stylish and could fit easily into one's pocket. Alongside the development of the Razr, Research in Motion (RIM) introduced models such as the Blackberry 5810 and 7270, which introduced the QWERTY keyboard, Wi-Fi feature and the business phone concept. Nokia also came up with upgraded models like the Nokia 6600, 6680 and N-gage, which were similar in regards to multifunctionality. All of Nokia's phones had the Symbian operating system and came with data facilities like email and MMS (Multimedia Messaging Service). In 2005 came the world's first Walkman phone introduced by Sony. The Sony W800i delivered great music and had buttons specifically for the playback. Memory Stick support also helped to make it a great gadget. Despite the number of advancements in mobile phone technology during this period, there was still more to come.

Late 2000s:

As a new decade approached, mobile phones became a stylish gadget. They began their role as an accessory to match the personality of its user. Models like Nokia N95, Samsung Blackjack and Nokia E90 were released. However, in 2007, Apple unveiled the world's first iPhone, which is a touchscreen smartphone. This phone was the first of its kind and it enabled users to run apps (applications) designed for specific purposes. Apps exist for wide range of things including movies, books, games, navigation and security. The year 2011 marked the return of touchscreen which dominated the mobile gadget scene with its powerful and sleek look. Samsung introduced the Galaxy SII which became a major competitor to the Apple iPhone. It had 8 MP camera, AMOLED (active-matrix organic light-emitting diode) Display and was less than 1cm thick. In 2012 came the Nokia Lumina 800 which included the Windows 7 mobileoperating system . In such a short span of time, mobile phones have gone from being alternatives to landlines, to becoming a mini computer that is still able to fit in our pockets.

Mobile phones have evolved considerably in terms of technology. They began as simple devices for making calls to all-in-one handsets that make the our daily lives easier. They have not only enhanced communication, but have made our lives easier.

TORC advances in DARPA Robotics Challenge

Written by Staff

Felipe Bacim and Doug Bowman are part of the Virginia Tech College of Engineering team participating in the Defense Department-sponsored robotics challenge.

Two Virginia Tech College of Engineering teams have advanced to the second phase of the futuristic Robotics Challenge sponsored by the Defense Advanced Research Projects Agency, or DARPA, a subsidiary of the U.S. Department of Defense dedicated to high-tech research. The goal: Create rescue robots that can easily maneuver disaster scenes and save lives.

Each team within the competition -- one based in the Department of Computer Science, the other in the Department of Mechanical Engineering -- combines both a strong partnership with additional university research groups and private companies, and includes alumni of the College of Engineering.

Team ViGIR -- short for Virginia-Germany Interdisciplinary Robotics, a collaboration between College of Engineering spin-off company TORC Robotics – based at Virginia Tech's Corporate Research Center; computer science's Center for Human-Computer Interaction, and German-based Technische Universitat Darmstadt, a longtime student-exchange partner with the College of Engineering. ViGIR built software and control tools for use in the simulation-based Virtual Robotics Challenge. From 26 total competitors in this track, ViGIR was one of seven teams to advance and receive a robot that will be supplied by DARPA.

The team is headed by TORC's David Conner, a two-time Hokie graduate of mechanical engineering with bachelor's and master's degrees, and an adjunct assistant professor in the Bradley Department of Electrical and Computer Engineering. Co-leading the team is Doug Bowman, professor of computer science and director of the Human-Computer Interaction center; and Oskar Von Stryk, professor of computer science and director of a robotics lab at Darmstadt. TORC engineer and two-time graduate of the College of Engineering Jesse Hurdus serves as project manager for the team.

The second Virginia Tech-based team to advance in the two-year DARPA Robotics Challenge is Team THOR, an international team of academic and private roboticists headed by Dennis Hong of the Robotics and Mechanisms Laboratory, or RoMeLa for short. The team's advancement to the second round of the robotics competition's physical portion was announced today in Boston at a DARPA-spon-

sored event, with five other teams moving onward from a total seven.

Team THOR must design and build a new, semi-autonomous robot that will be tasked with driving a jeep-like vehicle, and then exiting the vehicle, walking over rubble, clearing objects blocking a door, and entering a building. The robot then must locate and shut off a leaking valve, install a hose, and climb an industrial ladder. Finally, it must use a power tool and break through a concrete wall.

Teaming with Hong's lab is The University of Pennsylvania's robotics lab, named GRASP, which previously worked with Hong for three continuous championship wins at the international autonomous robot soccer competition RoboCup; ROBOTIS, a Seoul, Korea-based robotics company that partnered to develop an open-platform version of Hong's 18-inch soccer-playing humanoid robot, DARwIn-OP; and Harris Corp. headquartered in Melbourne, Fla.

According to DARPA, recent disasters such as the March 2011 earthquake in Japan that led to the meltdown of a nuclear engineering plant highlighted the limited responses humans could perform in highly dangerous environments. The agency, citing the Defense Department's Humanitarian Assistance and Disaster Relief mission, believes robotic response units can allow humans to quickly respond to such disasters, but from a remote, safe location.

Team ViGIR

For the Virtual Robotics Challenge, Conner and Bowman's team led the design of software to monitor and control a virtual robot in a simulated world, attempting to complete tasks exactly mirroring those of THOR's physical goals – driving, traversing difficult terrain, and manipulating a hose and valve. The goal: the software platforms should allow human operators to remotely control a robot without interruption.

Continued on page 12

TORC advances in DARPA Robotics Challenge

Cont from pg 10

Having passed the first phase of the multi-year competition, ViGIR soon will receive a government-furnished robot – nicknamed ATLAS -- built by Boston Dynamics, with which they will compete in the upcoming phases of the competition.

"One of the biggest challenges was that both the robot and simulator were being designed concurrently with our efforts to develop the control software," said Conner of the team's efforts since the challenge began in fall 2012. "Our team maintained its focus on developing the fundamental controls for the robot, and designing an interface that allowed the human operator to focus on things humans do best, such as perception, in order to allow the humans to work with the robot as a team."

Added Bowman, "The goal is to design tools, algorithms, and processes that could be used to allow a humanoid robot and human operators to work together to respond to a real-world disaster … quickly and effectively, without requiring the robot to be fully autonomous. A carefully designed user interface for the human operator is critical to achieving that goal."

Team ViGIR placed sixth among the top nine groups from an original pool of 26. One of the lead software developers and designers on the team was Felipe Bacim of Porto Alegre, Brazil; a doctoral student in computer science, assisted by several undergraduate students including Benjamin Waxler of Palos Verdes Estates, a recent bachelor's graduate of mechanical engineering; Jacob Sheppard of Winchester Va., and a recent bachelor's graduate in computer science ; and Lindsay Blassic of Oak Hill, Va., and a senior in computer science.

Hong's team advanced to the second stage of the robotics challenge after a June 13 test visit by members of the DARPA judging panel. During the visit, RoMeLa demonstrated functional subsystems of THOR – a state-of-the-art leg, robust arms, and dexterous hands – that will be part of the completed robot.

THOR – short for Tactical Hazardous Operations Robot – will operate under supervised autonomy, and be "light, agile, and resilient with perception, planning, and human interface technology that infers a human operator's intent," said Hong, director of RoMeLa, and an associate professor of mechanical engineering.

"Something always goes wrong when you are doing a live demo with robots," said Hong after the DARPA visit. "But every single thing went well and worked exactly as planned. All of the team was exhausted with sleepless nights working in the lab, but at the same time we were all pumped and excited to show off all the incredible technology we have developed. How can one not be excited when showing off robots that will save people's lives?"

In one test, the RoMeLa team demonstrated SAFFiR, the Shipboard Autonomous Fire Fighting Robot funded by the U.S. Office of Naval Research, walking on gravel, plywood debris, and Astroturf. It is planned for SAFFiR to be used to extinguish onboard Navy ship fires in tandem with human firefighters. Similarly, THOR will be capable of traversing the difficult terrain encountered in disaster relief scenarios.

Team THOR is preparing for a more stringent competition this December, as is Team ViGIR. "Time is the biggest challenge," Hong said. "We are developing new robotic platforms based on new technology, and the tasks it needs to do are things that no one could ever do. We need to do all this in just a few months' time." The final competition date is set for December 2014.

Team THOR consists of many of the graduate- and undergraduate-level students that have worked on previous robot platforms. One former student, J.K. Han, now an engineer with ROBOTIS, also will work on the team. Han received his doctoral degree in mechanical engineering from Virginia Tech in spring 2012, and was the chief architect of CHARLI,which debuted in spring 2010. He is developing a second, more publicly accessible robot named THOR-OP with commercial open-platform possibilities.

"We truly believe that this is why we do robotics -- developing technology that will save the world," he added. "Though it is a competition with big cash prizes at stake, winning is not the most important thing. Whether we win or lose, if the technology we develop through this project can save even just one person's life, then everything is worth it."

Inside look: Virginia Tech's Drone Research

Dennis Elias is a Junior in Finance

Over the past decade, people at Virginia Tech have seen the development of the campus and educational curriculum. With this growth, there has been an increased focus on the research taking place at the university as well. As times and technology change Tech is looking to keep up with the rapid rate of discoveries and advancements in all fields of research. One of the areas that researchers at the university have begun to increase their focus on is that of unmanned aerial vehicles, more commonly known as drones. When thinking of drones, many think of war and the drones that are used for dropping bombs and spying on other countries. Though this has become one of the main uses for drones, it is not what Virginia Tech researchers are focused on. The focus of this research is on improving the overall technological advancements of drones as well as what they can be used for; such as surveying areas damaged by disasters and surveying agricultural terrain for things such as disease.

Led by mechanical engineering professor Kevin Kochersberger, the unmanned aerial vehicle team consists of both graduate and undergraduate researchers. Together they work on the eight different drone aircrafts they have under their supervision. This includes both helicopters and planes. These eight projects range from an undergraduate design project to an aircraft whose design has been dictated by the Bureau of Land Management to monitor endangered animals. Under Kochersberger, students also partake in national and international drone competitions against students from other universities. For example, in one of the competitions student use a drone to carry a certain payload and drop it as close as they can to a target. Students must sync themselves well because the winning prize will of course go to whoever is closest to reaching the target. Some of the more exciting competitions consist of search and rescue type missions with the use of the unmanned aircraft that the researchers have spent hours of work perfecting.

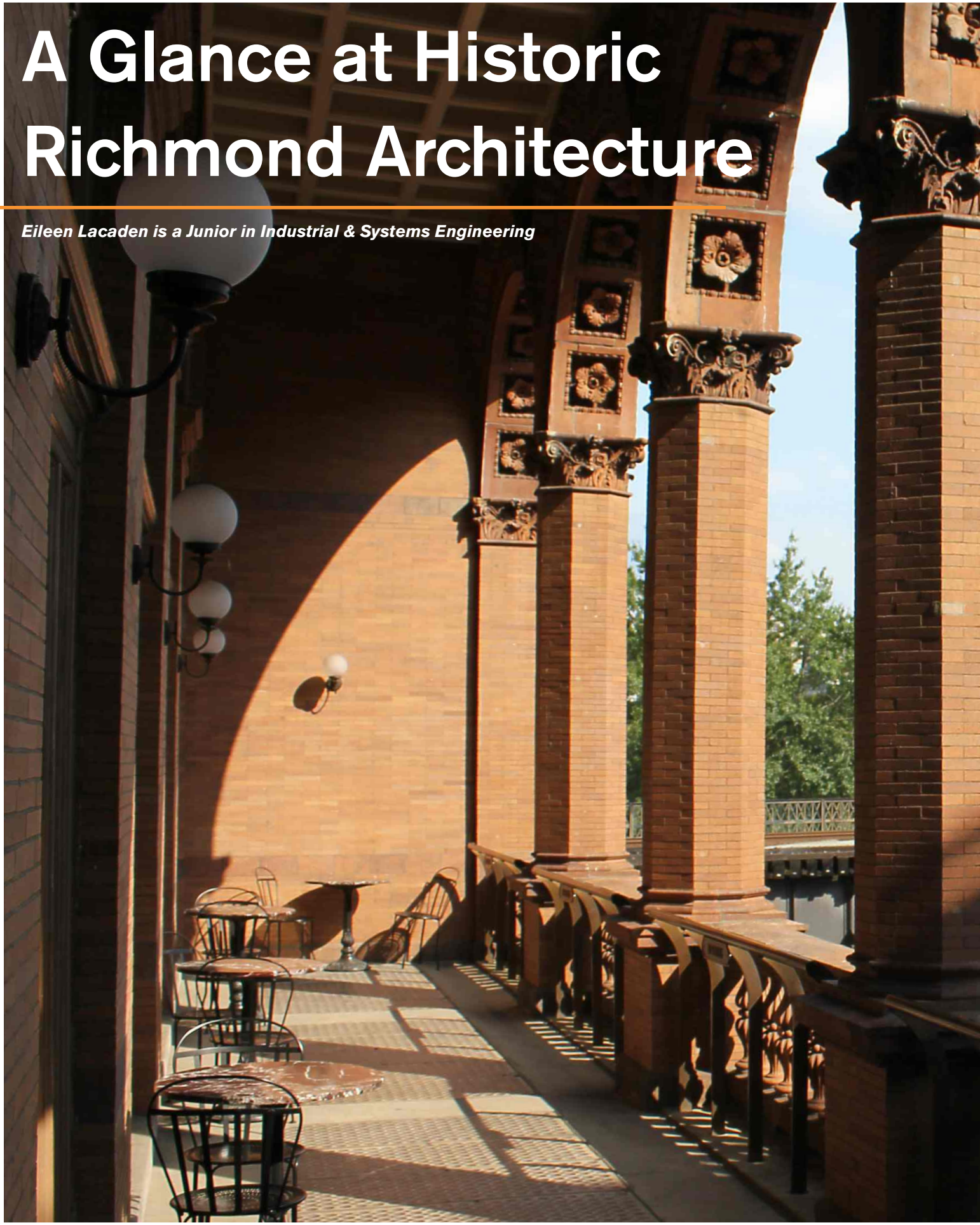
All of the work put into the unmanned aircarfts is not solely for

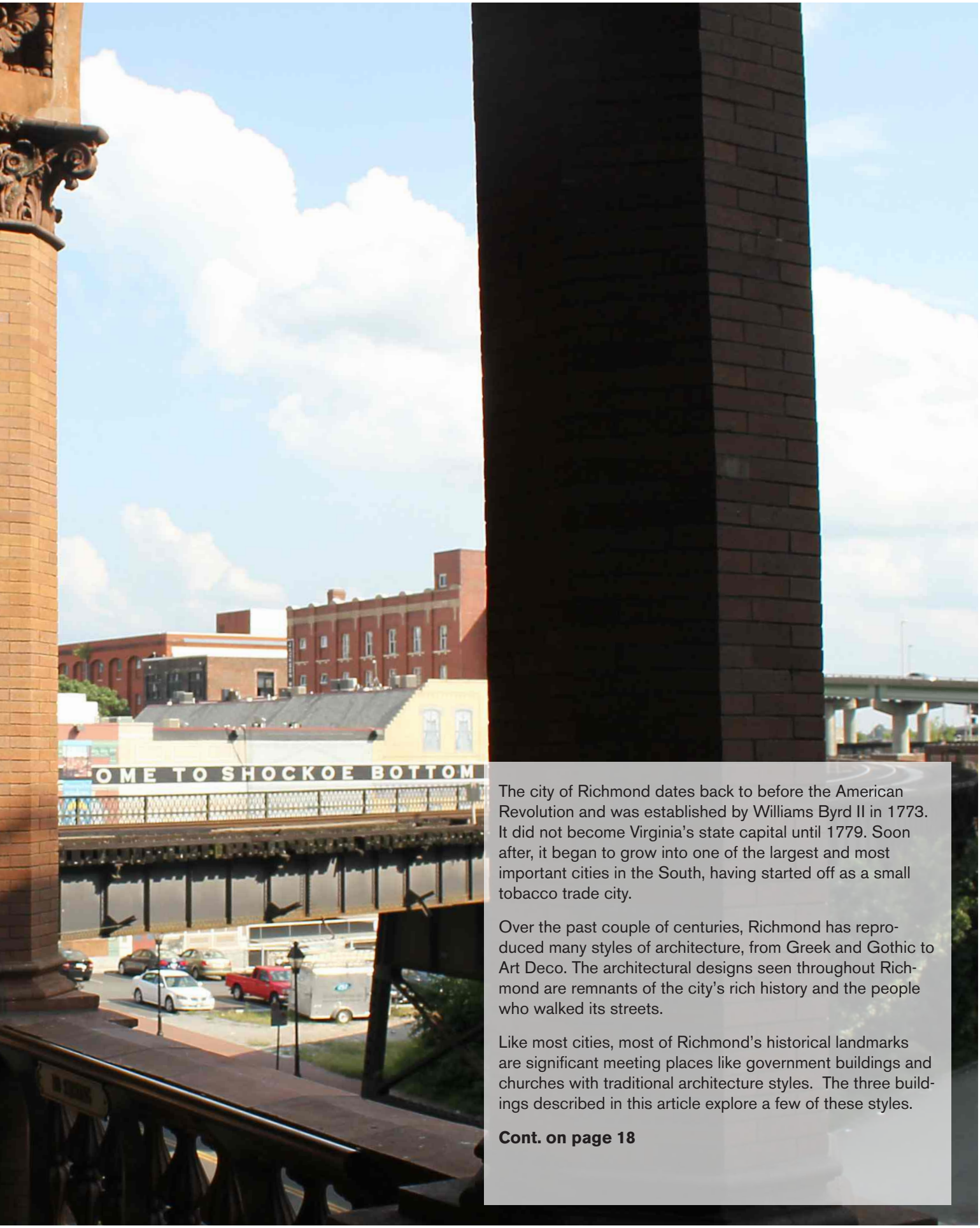
the purpose of winning competitions. On the other side of the spectrum, there are the government agencies who have sought out researchers to learn more about and improve some of the capabilities of these aircrafts. Government entities such as the Bureau of Land Managementt, the Defense Threat Reduction Agency, and the Air Force are backing these projects at Virginia Tech. One of the more interesting aircrafts that is currently under development at Virginia Tech is a government sponsored plane that has fully-morphing flight control. What researchers have done is completely eliminate flaps on a plane's wings; instead they have made the wings of a plane morph. As the plane flies the wing twists and morphs itself to turn left, right, up and down. Though pictures are not allowed, it can be said that this plane could possibly be seen in the future in a much larger scale, potentially changing how planes are built altogether.

After taking a look into these captivating projects taking place at Virginia Tech, it is easy to see why the university is expanding so rapidly. New innovative minds are playing a big role in showing people everywhere what Virginia Tech students and professors are capable of Many here at the university, including potential researchers, are still not aware of such research going on. For those of you who are interested, make sure to find out more about, and maybe even become involved, in some of these impactful projects taking place in our backyard.

A Glance at Historic Richmond Architecture

Eileen Lacaden is a Junior in Industrial & Systems Engineering



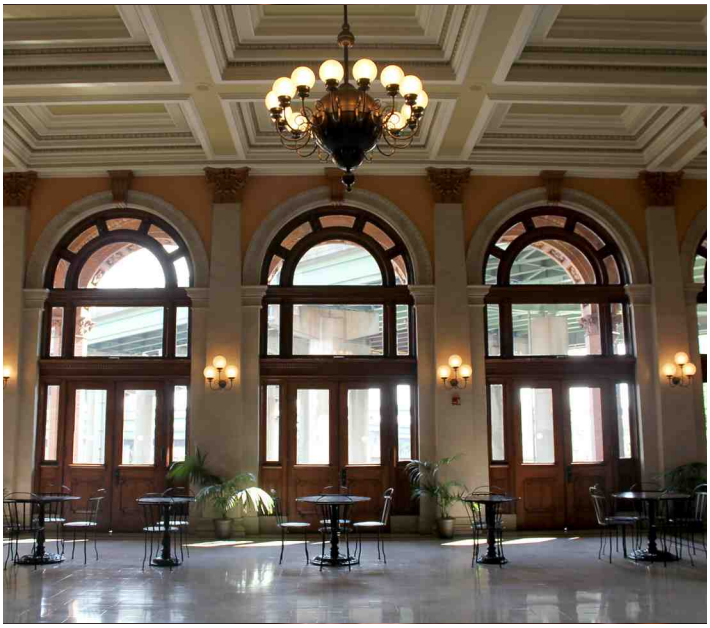


The city of Richmond dates back to before the American Revolution and was established by Williams Byrd II in 1773. It did not become Virginia's state capital until 1779. Soon after, it began to grow into one of the largest and most important cities in the South, having started off as a small tobacco trade city.

Over the past couple of centuries, Richmond has reproduced many styles of architecture, from Greek and Gothic to Art Deco. The architectural designs seen throughout Richmond are remnants of the city's rich history and the people who walked its streets.

Like most cities, most of Richmond's historical landmarks are significant meeting places like government buildings and churches with traditional architecture styles. The three buildings described in this article explore a few of these styles.

Cont. on page 18



Main Street Station

Representing the Romanesque Revival, the Main Street Station stands tall with its clock tower, round arches and inviting stone steps. It was built in 1901 by Wilson, Harris and Richards and is considered the "Gateway to Richmond". It has been the central train station in Richmond for fifty years. Main Street Station became a National Historic Landmark in 1976 after having survived the flood of 1972 and fires in 1976 and 1983. The bright orange brick and red clay tile roof liven up the traditional Romanesque style. This station has a train shed constructed with a gable roof, a design only seen in older American train stations. Its train trestle system is the biggest and oldest in America as well. Amtrak put Main Street Station back into action in 2003.

Old City Hall

Old City Hall, located on East Broad Street, is the most recognizable example of Gothic revival in Richmond. It took Elijah E. Myers and the building team eight years to construct it, starting in 1886 and finishing in 1894. Mostly locals worked on the construction team and used local granite mined from the banks of the James River. Four pointed towers dominate each corner of the castle-like building, one being a clock tower. Pointed arches and Corinthian columns identify each entrance. Many of the original fixtures on the interior survived the century. Old City Hall is quite the oddball compared to its neighboring buildings that do not come anything close to the dark Gothic style. As seen in the images, there is construction surrounding the building; new, modern style buildings are being put up all around. Luckily, Old City Hall is now on the National Register of Historic Places and will continue being used as a state office building.

Egyptian Building

Interestingly enough, Richmond represents Egyptian Revival style architecture with the Egyptian Building located on the Medical College of Virginia campus of Virginia Commonwealth University. When it was first built in 1845, it functioned as the medical school for Hampden-Sydney College. Designed by Thomas S. Stewart, the Egyptian Building has the front and back display two towering papyrus columns and minimal windows. The smooth, sand-colored stone walls hide the fact that this building is five stories tall. The interior walls exhibit hieroglyphs and traditional Egyptian hymns to the gods. The Egyptian Building is one of the oldest medical buildings in America, and is a National Historic Landmark. Some construction surrounds the grounds, as seen in the image, but it is in excellent condition.

Effects of High-Fat Diet on Breast Cancer Risk in Future Generations

Sarah Stewart is a Junior in Industrial and Systems Engineering

Virginia Tech Electrical and Computer Engineering professors Dr. Jason Xuan and Dr. Joseph Wang are conducting research on the correlation of a high-fat diet and breast cancer risk in future generations. I found this topic to be very intriguing, so I traveled two hours to Virginia Tech's research center in Arlington, Virginia to find out more about it. The research began one year ago and is scheduled to last four more years. Virginia Tech's part in the research is entirely engineering related. The larger project, in collaboration with Georgetown University, Johns Hopkins University, the National Children's Hospital and the National Institutes of Health, is multidisciplinary and involves not just engineers, but doctors, biologists, and psychologists too.

Breast cancer risk has become even more of a hot topic recently due to celebrities like Angelina Jolie. Jolie had a double mastectomy in early 2013 after finding out she had the gene mutation that drastically increased her risk of developing breast cancer. But a mutated gene accounts for only 5 to 10% of the risk. Frightening statistics, such as one out of eight women developing breast cancer at some point in their life, make breast cancer a big concern for many women. Ten years ago, Dr. Xuan heard a personal account from a woman on a radio show about her firsthand experience with breast cancer. He was deeply touched by this story and knew he wanted to combine engineering with breast cancer research.

To research the effects of a high-fat diet on breast cancer risk in future generations, experiments are conducted using rats. Rats are fed a fatty diet, and a tumor is chemically induced in each rat in order to get more direct results rather than letting the rats naturally develop the cancer. Then data is collected on the next three generations of females. When comparing mothers and daughters, they look for both the number of tumors developed in the daughter and the number of daughters who developed tumors. They also study the gene expressions of the rats and count terminal end buds, bulbous parts of their genes that could potentially develop into cancer, to determine cancer risk.

The fatty diet is tied to the estrogen level and hormonal system of the rat. Diet is one disruptor that affects DNA methylation, one of the controlling mechanisms of the expression of genes. Disruptors such as a high-fat diet cause a change in the DNA methylation of the rat, and therefore alter their DNA. This alteration in DNA can be inherited by future generations, which is how they can be affected by the diet choices of a woman during her pregnancy.

So far, the experiment data demonstrates that a higher number of rats developed cancer if they had a mother who was fed a high-fat diet. In the control group (rats with tumors induced, but are fed a healthy diet), those who developed cancer had a larger number of tumors. So far, the experiment has confirmed that a greater number of rats born from a mother who ate a high-fat diet would develop cancer, but an unexpected complication comes with the number of tumors in the rats that developed cancer from both groups.

One big question I had about this research project was about the role electrical and computer engineering played in breast cancer research. I found out that engineering comes in for the measurements, screening, identifying, modeling, developing algorithms, and conducting and analyzing data. Dr. Xuan explained how this research was a big challenge because new engineering approaches for these problems had to be created since the research involves biological systems. Regular textbook methods cannot be used easily. A lot of engineering innovation is required. They have to take this breast cancer risk problem and translate it into an engineering problem that they can solve.

Ph.D. student Xiao Wang is one of the students working under Dr. Xuan and Dr. Wang. Her job is to link the rat experimental data and the data collected from woman patients and their babies. The pregnant woman patients were put into two groups based on their regular diets and hormone levels. Then after the babies were born they studied the babies' DNA methylation status and gene expressions to assess breast cancer risk. A big part of the research involves determining which specific subset of genes is responsible for the risk. This will allow researchers to obtain more accurate results, rather than trying to collect data from a random sampling of genes.

When I asked Dr. Xuan what comes next after this research has concluded, he answered that personalized medicine is the future for breast cancer treatment. Drugs need to be tailored to women in order to be most effective. There will probably never be one cure-all drug for every woman. Dr. Xuan projects that it will take about 20 years before personalized cancer medicine and treatments will become available. Currently, there is a hormone drug on the market that is used to help with breast cancer, but it is only helpful for five years or less, and there is no new drug to help after that time period.

I asked Dr. Wang the same question, and he answered that preventative medicine is of extreme importance, more so than a cure. He also commented on how preventive medicine would help with healthcare costs for Americans because less people would be getting breast cancer, and as a result, medical costs would decrease. Dr. Wang also proposed the idea of obesity being a potential link to cancer risk that should be researched, since obesity is already linked to so many other diseases.

All in all, researchers hope the findings from these experiments will lead to prevention and lifestyle guidelines. This would translate into diet guidelines for pregnant women and societal awareness of the detrimental effects that a poor diet can have on your descendants.

Ph.D. student Xiao Wang and Dr. Jason Xuan are working in the lab to link the experimental rat data and the data collected from women patients, and to discover which specific genes are responsible for cancer risk.

PotashCorp
AURORA

Employees power PotashCorp-Aurora. What powers you?

PotashCorp–Aurora, located in Aurora, North Carolina, mines phosphate ore and is the world's largest vertically integrated fertilizer enterprise, as well as a leading supplier to the agriculture, animal nutrition, and industrial chemical markets. Phosphate is used in a variety of everyday products including cheese, soft drinks, bread, toothpaste, vegetable oil, and jams and jellies. Commercial usage includes fire retardants, fertilizer, animal feed, wood and metal finishing, cleaning compounds and renewable energy products, such as solar panels.

PotashCorp-Aurora is dedicated to the safety of each of our employees. Throughout the years we have received numerous safety awards from the North Carolina Department of Labor; and instituted an accident prevention process, called the Light Keepers Program, which empowers employees to change behaviors and work safely. We are also committed to the environment, with our reclamation and wetland mitigation processes. We understand that when the mining is complete our work is far from over.

Our more than 900 employees include engineers, chemical plant operators, maintenance craftsmen, and heavy equipment operators.

If you are looking for a rewarding career opportunity, contact Betty Elzey at belzey@pcsphosphate.com.

Helping **nature** provide.

PotashCorp
AURORA