HAMPTON UNIVERSITY

Amazon Robotics Gift Proposal Response

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1 INTRODUCTION

In today's technology-driven world, preparing students for the future workforce is more important now than ever before. Introducing young students to technology before they reach higher education can increase their ability to become innovative critical thinkers and more creative members of the future workforce. As the government and private sectors address the need and importance of robotics, programs and laws are emerging that incorporate this technology into their public education system. Hampton is teaching students the basics of robotics and thereby exposing them to the realities and exciting opportunities of a future that includes robotics in science, engineering, and business.

As one of the fastest growing career areas, industry seeks partnerships to increase the diversity of the pool of students selecting robotics as they explore the STEM field. Amazon Robotics (AR) is one of the growing industries that recognizes the need for new and innovative individuals with ideas. AR understands that without robotics education in schools, K-12 and at the university level, the pipeline of potential innovators with the requisite skills and competencies will hamper their ability to realize their mission and corporate goals.

This document addresses AR's requirements as follows: Section 1 provides an introduction and discussion of the purpose and need and outlines Hampton University's technical response for each proposed area. Section 2 describes our budgetary response. Section 3 offers a discussion of the key personnel assigned to support and ensure Hampton achieves the proposal objectives. Lastly, Section 4 provides a high level timeline to support the HU AR's requirement.

1.1 BACKGROUND: PURPOSE AND NEED

According to the July 31, 2020 AR proposal engagement statement (*see Appendix A*), "Robotics is transforming the industrial and commercial landscape across a variety of domains allowing for faster and more efficient operations." In developing relationships and partnering with a small group of universities, AR has established a program that is performing foundational research and teaching related to robotics and automation. Recent engagements with Hampton University resulted in a proposal to add this school to their overall university proposal.

Background and Purpose

- Establish a Pipeline
- Create the Senior Capstone
- Identify Faculty Support
- Launch Research Laboratory
- Define AWS Credits
- Create Portfolio STEM Program
- Support Drone Project

By investing in developing Hampton's Robotics program, AR seeks to support building a more robust program that supports cloud-based robotics research, infrastructure improvements, and STEM based activities to increase the overall talent pipeline. These activities will simultaneously support Hampton's own digital transformation. AR's objective is to invest and fund activities with a goal to create opportunities for increased internship enrollment, enhance university wide brand awareness of AR, and provide AR staff more avenues for interaction on campus. Ultimately, AR seeks to ensure more opportunities for deserving Hampton students with the goal of securing the best students as new full-time employees at AR.

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1.2 TECHNICAL APPROACH

Hampton University offers the ideal laboratory for the AR's proposed collaboration. While we have the ideal setting with well qualified faculty and intellectual curious students, our current program of study will benefit from a partnership with an industry partner that is well-established Robotics field of study. Bridging the gaps between scholarship and practice by partnering with AWS Robotics will help our faculty build a more robust program of study, help our students to solve real world challenges, and propel the university to be a leader in this dynamic field.

Hampton University proposes a coordinated technical approach facilitate AWS Robotics goal to increase diversity in the field of robotics. The University's IT department, working jointly with the School of Engineering and Technology and School of Science, will manage activities so that the schools equally benefit from a Hampton and AR partnership. The following sections outline the technical approach. This combined collaboration benefits AR through a mechanism of combining multiple academic disciplines. The AR diversity pipeline for future interns, employees, research, and STEM will increase because the student population will include all Engineering and Technology and Science majors.

1.2.1 Establishing the Hampton University (HU) – Amazon Robotics (AR) Pipeline

The Hampton University – Amazon Robotics Pipeline

A true partnership to establish a robust pipeline between Hampton's engineering and computer science programs and Amazon Robotics will be developed using a three-prong approach that includes Junior Year Workshops/Information Sessions, Rising Senior Internship Opportunities, and Senior Year Capstone Projects based on internship experience. Below are descriptions of the three approaches:

- ***Junior Year Workshops:*** Amazon's Robotics recruitment team will work with Hampton's engineering and computer science faculty and career center personnel to host three robotics workshops and information sessions. The targeted workshops will be for juniors that are currently enrolled in ELN 303 (Engineering Electronics) and/or CSC 301 (Operating Systems) and have completed EGR 213 (Digital Electronics) and/or CSC 252 (Data Structures II), 205 (Computer Architecture II). The goal is to introduce students to Amazon Robotics through presentations, hands-on activities, and teambuilding projects. Participating students will be encouraged to apply for AR internship opportunities.
- ***Rising Senior Internships:*** Hampton faculty and career center personnel will assist Amazon with the recruitment of 6 to 8 rising seniors for Amazon Robotics internships. Students that participate in the junior year workshops and have maintained a GPA of 3.0 or higher will be invited to interview for the positions.
- ***Internship Inspired Senior Year Capstone Projects:*** Hampton students that participate in the Amazon Robotics internship will have an option to continue working on their summer project or to propose a capstone project that is inspired by their internship experience. Funds will be provided to support the projects. Amazon Robotics personnel will be invited to serve as technical mentors.
- ***Fulltime Employment upon Graduation:*** The activities described are intended to create an authentic partnership and a robust pipeline that will lead to full-time employment opportunities for Hampton students and well-prepared new employees for Amazon Robotics.

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1.2.2 Creating Senior Capstone

Senior Capstone in Engineering

The Department of Electrical and Computer Engineering curricula require all majors to complete a two-semester senior capstone design project. The first semester entails students identifying a need or problem and developing a full proposal that includes a technical design, methodology, timeline, and budget. The second semester requires students to execute their plans by building a prototype, presenting to stakeholders, and submitting a final report. At Hampton, students are only allowed to work on projects that will afford them the opportunity to demonstrate an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

All projects must be approved by the Capstone Design Committee. The committee includes the Program Chair, Lead Faculty, and one additional department faculty member. Students may suggest a topic or select an industry – sponsored topic. All industrial partners must complete the "*Project Proposal Form for University Senior Design Project*" and their project idea to student. See Appendix B for more information on the requirements for completing the Project Proposal Form.

Senior Capstone in Computer Science

The Department of Computer Science curricula requires a two-semester capstone project, Software Development and Design I and II. The Capstone begins with the seniors receiving requirements and prototypes from the previous Hampton spring semester graduates. The teams review and critique all developed projects and select the project they choose to continue for the semester. An appointed Project Manager directs the project teams who selected by the faculty and each team. Because requirements might change, the collaborative faculty will intentionally add and re-adjust them as appropriate. To facilitate the process, the faculty serve as instructors as well as the client.

Structuring the teams is critical to mirroring the business setting for successful outcomes. As such, each team consists of four-to-six members with at least three teams per semester. With five iterations throughout each semester, the last iteration culminates with a final exam. The exam includes a formal presentation, coding, and providing the client with final documentation. In constructing the second semester with newly created teams and project managers, the teams start with a "blank sheet" with a new project and list of basic requirements. With the objective for the teams to create and develop solid requirements from project concept that results in a viable prototype, the project is passed to the next year's senior class for completion. At the end of the second semester for the Capstone's timeline, all students will have rotated through the Software Development Life Cycle. Lastly, the Agile is used methodology to simulate a real world team environment project management process. In culminating the software development for the Senior Capstone Project, the collaborative effort of self-organizing and working with cross-functional teams is intentionally for the student and their client.

1.2.3 Identifying Faculty Support

Robotics Professor - Joint Appointment (Computer Engineering/Computer Science): Identify a professor with expertise in robotics, automation, and/or cloud-based computing that would support the educational and research requirements needed to build and develop a robust robotics program.

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Hampton University's Chairs of the Department of Computer Science and Engineering and Technology will select a candidate for a joint appointment at the Assistant/Associate Professor level in Robotics. The individual selected for this position will be expected to contribute to the educational missions of the Departments of Electrical & Computer Engineering and Computer Science through teaching, curriculum development, and research related to Robotics. The ideal candidate will have earned a Ph.D. in Robotics, Computer Engineering, Computer Science, Electrical Engineering, or a closely related field with expertise in robotics, automation, and/or cloud-based computing. The selected candidate will be granted funds to support a graduate student and will be required to work with the Engineering and Computer Science faculty to develop the Amazon Robotics Research Laboratory.

1.2.4 Launching and Managing a HU AR Research Laboratory

In partnership with the School of Engineering and Technology (Department of Electrical and Computer Engineer, Department of Aviation) and School of Science (Department of Computer Science), Hampton University proposes a Collaborative Robotics Research lab which will be hosted by the Center of Information Technology. Each department has a mature history of instructing robotics courses and supporting basic research for their students in their respective majors. The Department of Electrical & Computer Engineering has received funding from the U.S. Army Aviation (UAV) Development Directorate to support robotics and autonomous systems education. The Army project supports robotics –based senior capstone design projects and helped with the establishment of a UAV club.

The Department of Computer Science participated in the Advancing Robotics and Technology for Societal Impact (ARTSI) project funded by the National Science Foundation. With a goal to increase the number of students in computer sciences in robotics programming through an introductory course, research, robotics competition and outreach program, this collaborative project included eight Historically Black Colleges and Universities (HBCUs) and seven Carnegie Research I Institutions (R1s). As a part of the introductory course, the students learned programing iRobot Roomba without vacuum module, and used Tekkotsu framework, C^{++} programming, and Chiara robots. The outcome and expectations for computer science students was to gain cognitive skills in robotics programming.

The HU AR Research Laboratory's focus will include expanding the science and technology of effective, robust, and scalable robotics systems that collectively impact society. Further, exploring and developing applications that provide assistance, training, education, environment monitoring, emergency response, and entertainment are critical outcomes and objectives for this on-site research laboratory.

Core Research Areas

- Robotics Systems (design and build) – including mobility and coordination in networked, multi-robot systems, on-body networks, aerial robotics (e.g. drones) marine/environmental robotics
- Automation and Planning – including planning and control of multi-robot systems, multi-robot coordination, intelligence systems, decision making, machine learning
- Human Robotics Interaction – including user modeling, human-machine interaction, interface, speech processing and recognition, imaging, image processing

Many K-12 schools are now integrating technology into their curriculum. Beginning in elementary school, student often learn how to program using Scratch, middle, and high-school provides opportunities for students to extend their understanding by learning programming languages such as

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Java, Python, HTML, and JavaScript. The theme typically centers on games, apps, and web development. High school students often take Computer Programming and Computational Thinking courses as part of their AP credit curriculum.

Increasing the interest in STEM by introducing computer and engineering before the student enters college is critical to meeting the future workforce demands for more technology workers. According to the College Board 2019 Exam, out of 2,825,710 students, 69,685 students (2.47%) took AP Computer Science A, and 96,105 students (3.40%) took Computer Science Principles. For AP Computer Science, only 6% of students took this exam. In contrast, more high school students took the AP Calculus AB or BC (15.57%) during the same year, and even more students took the AP in Science (e.g., Biology, Chemistry, Physics, or Statistics) exams (32.08%).

To support the growing demand, increase student interest, and support the future need for technology professionals, we propose starting the pipeline at the K-12 level. Integrating topics such as robotics into the school curriculum for all students is the first step. STEM programs that are inclusive for all students, not just those who show interest, is one way to increase applicant pool. Programs like FIRST Robotics, LEGO League, and others can help facilitate student learning in STEM. Hampton University will engage the K-12 populations to introduce opportunities where students can learn to write a program, control or manipulate the robotics, and foster a longer-term interest in STEM. The following area outlines our approach for using the HU AR Research Laboratory to support a Robotics infused program at each educational level.

Elementary Schools (K-5): Research shows younger students attention span is shorter when compared to older students. Hence, we understand the need to captivate the younger student's interest and offer instantaneous results. Quick visual results can include the robot's movement or action, and the tools offered in this section will inspire the younger student's intellectual curiosity in robotics.

Cubelets are ideal robotic blocks that can be snapped together with built-in magnets to make an endless variety of robots. Because no programming or wires are needed, using this tool is quick and easy. Using three or more color-coded Cubelets blocks to make a more complex robot, students can attach a black "Sense" Cubelet to a gray or green, "Think" Cubelet and add a clear, and "Action" Cubelet to create a working robot. Also, combining multiple Sense and Action blocks allows the student to create a more complex robot. The objective for these younger students is to build robots that drive on a tabletop, respond to light, objects, and temperature.

Sammy is a robot that allows K-2 students to program using a sequence of physical code cards. As the robot drives over the code cards, an object identifier (OID) optical scanner on the bottom of the robot reads the code cards one by one and loads the program. Next, the robot is placed on a grid made of map cards, and the robot runs the program. There are 38 different map cards included, allowing for executing more complex programs once students are more familiar with the program. With

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approximately 30 lessons included that are aligned with standards for computer science education, "Sammy" is an excellent coding and robotics introductory tool.

MOSS is an intuitive, fun robot construction system from Modular Robotics that allows students to quickly and effortlessly design and build robots. MOSS blocks are each mini robots that communicate with their neighbor robot. Because each MOSS block has "rare earth" magnets in the corners, they can connect together easily using steel ball bearings.

Cozmo is a robot that is infused with AI. As such, this robot can express hundreds of emotions, recognize the student, and remember the student's name. Cozmo evolves more as the student uses the robot. With a beginner-friendly interface, this is the perfect educational robot for younger students as well as for adults who want to learn to creatively code. Ideally, K-6 students code with App Code Lab, while 7-12 and college students can program Cozmo using Python/ OpenCV to recognize markers and objects as well as to use speech recognition.

Finch Robot inspires and engages students in learning computer science by providing them a tangible representation of their code. This tool provides hands-on learning into the classroom through physical computing by programming embedded lights, sensors, and motors. Coding includes using Scratch or Snap (block-based) for grades K-9, and Python or Java programming languages for grades 10-12 and college aged students. More importantly, the Finch Robot includes lesson plans for these programming languages.

Middle Schools (6-8): With this age group, maintaining interest is critical. At this stage, we plan to introduce tools that continue engagement and allow the student to build a robot themselves.

Blue Bot is used to introduce students to an authentic, real-world robotics and computer science experience. This classroom robotics kit explores problem-solving. In particular, the student is introduced to the fundamentals of building circuits, powering motors, and how robots capture and respond to information about their surroundings. Using the accompanying lesson plan, the instructor facilitates the fundamentals of teaching robotics in the classroom. The lesson plan and robotics curriculum is aligned to the Next Generation Science Standards (NGSS). The plan offers a step-by-step robot assembly and exploration of the electromagnetic spectrum using the robot's sensor. Supporting comprehensive teacher tools (e.g., videos and slideshows) facilitate the lesson prep and class time.

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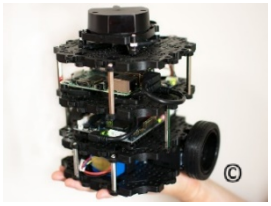
Thames & Kosmos Robotics Workshop Kit uses sensors, motors, a core controller, and hundreds of snap-together building pieces. Following the instructions to assemble ten different robots, the versatile parts allow students to build robots according to their own designs. Once created, the robots can be controlled directly in real time and programmed to perform a series of commands using an easy-to-use, free downloadable app on iOS or Android tablets and Windows PCs. The coding is fast and easy to understand because the app uses the open source visual block programming library, Google Blockly.

High School (9-12): As students become more interested in programming, Hampton University will move towards a more advanced platform for robot construction and programming.

TurtleBot3 is a small programmable mobile robot powered by the Robot Operating System (ROS). Carrying lidar and 3D sensors, TurtleBot3 navigates autonomously using simultaneous localization and mapping (SLAM).



Edison robot features a host of sensors and can be programmed using an increasing number of FREE software applications. Some of the freeware includes:

- EdBlocks offers a great way for students to learn programming fundamentals.
- EdScratch provides a versatile block-based visual programming language.
- EdPry is a highly versatile text based programming for the Edison robot.

Each programmable Edison robot interacts with the world via infra-red (IR) transmitters and receivers, line tracking, barcode reading, playing sounds and music, plus sound detection. This robot is also equipped with two motors with variable speeds, left and right red LED lights and three control buttons. One Edison can communicate with another over IR. The units can also be programmed by and controlled with TV and DVD remotes.

We recognize that as we move to support the higher education robotics requirements, the undergraduate student must align their project with Hampton University's unique school needs. Appendix D offers other robotics equipment for consideration. For example, we will modify the equipment needed to align with the Senior Capstone Project selections. The technology also needs to support programming, and controlling the robots will include tablets (or iPads) and laptop computers. All data and software for the HU AR Research Laboratory will be stored on a computer that will be periodically backed up by the University's information technology department.

1.2.5 Defining AWS credits to support AR Robotics

During the spring 2020 academic semester, Hampton University introduced cloud infused AWS courses (CSC 404 and 405) in the Computer Science curriculum. To support Hampton's future AWS requirements with the HU AR Project, the Center for Information Technology created an AWS account

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and established an ongoing relationship with the AWS EDUCAUSE team. By establishing an AWS credit account, we partnered with AWS to support exploring research, education, and infrastructure opportunities that will expand our understanding of AWS for our faculty, students, and staff.

We will plan to continue to use the "Pay-as-you-go" credit model to facilitate remaining agile and responsive to the needs of the campus and to scale appropriately to meet the requirements of the HU AR Proposal. Our understanding of this credit pricing is that we can adapt the robotics program needs and minimize the risk of overprovisioning or missing capacity. By allocating the payment (i.e., credit) for the services on an as-needed basis, we will focus on each project presented by the Capstone project in the HU AR Research Laboratory.

The credit model pricing, based on several factors, offers five different categories of computing. For example, the type of processor, the number of cores, the amount of memory, the type of disk storage, the amount of disk storage, and the amount of time used in seconds are some of the categories used as a basis to estimate credit pricing. Because of the AWS credit model's complexity, we will initially use estimates of the spring semester students' actual use as a baseline.

1.2.6 Creating a Portfolio STEM program

Ready to Use STEM Robotics Activities:
The School of Engineering and Technology proposes to create a portfolio of ready-to-use STEM educational experiences for high school children and/or teachers to engage in robotics through a series of hands-on learning modules.

- ***Arduino Creative Kits (CTC 101)***
  Arduino CTC 101 is a modular STEAM program consisting of a toolbox with 26 projects and easy-to-assemble experiments, an online platform, and guided training/support for educators. The program, tailored for ages 13 to 17, has five modules and introduces students to the foundations of programming and basic coding, Arduino boards and digital signals, analog signals and serial communication, robotics, power systems and motors, wireless communication via Bluetooth, and advanced sensors.
- ***UKIT Beginner Class Pack***
  The UKIT Beginner Class Pack serves 12 teams of two students, offering each group of students their own UKIT Beginner to work with. Using the sets along with the instructions from the free app, students work collaboratively to engineer and program autonomous robots.
- ***Cue Robots***
  With a growing library of in-app demos, tutorial, and challenges, Cue supports kids' self-guided exploration of programming languages, robotic capabilities, and personally meaningful projects.
  The School of Science proposes to create a portfolio of ready-to-use STEM educational experiences for K-12 equipment for teachers to engage in robotics through hands on activities that include the following equipment to support the STEM Portfolio program:

    - For K-6: Support robots for students to use
        - iPad/Tablet to control robots
        - Building block code to control robots

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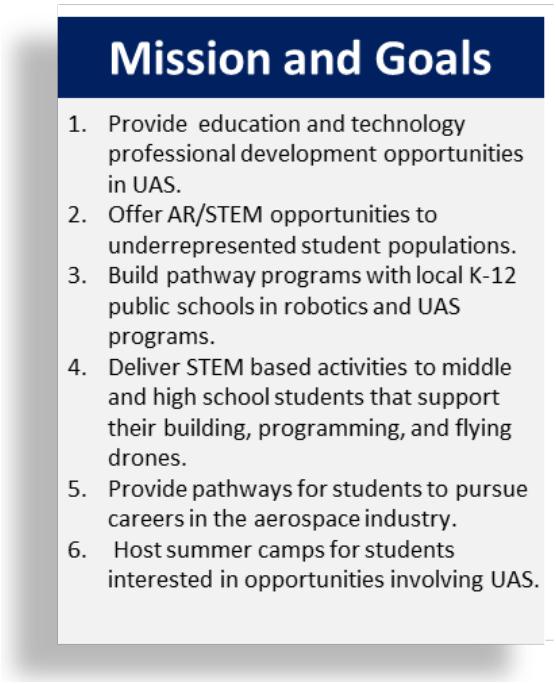
- For 6-12 graders: Integrate robot construction
  - IPad/Tablet to control robots
  - Plug-in code modules to support building and program robots

1.2.7 Supporting a MassRobotics and Brown University Drone Camp

The MassRobotics and Brown University Drone Camp proposal plan includes the provisions for training, travel, and equipment for Hampton University's Aviation Department (HU-AVN) and selected faculty and students to earn their FAA Part 107 UAS Pilot license. Hampton University is prepared to send 2 faculty and 6 certified student drone pilots to work with MassRobotics and Brown University's hosted summer "Drone Camp." The Aviation Department continuously seeks opportunities to reach underrepresented students through the use of simulators and robotics; this proposal seeks to accomplish that goal. Amazon Robotics funding for HU's Aviation program participation at MassRobotics and Brown University's Drone Camp will provide our faculty and students with knowledge and expertise to organize a Summer Drone Camp for diverse STEM K-12 students throughout the Hampton Roads, VA region. Instruction and interaction between MassRobotics and Brown University will strengthen the academic relationship with Hampton University as it strives to become a leader in Unmanned Aircraft Systems (UAS) and Autonomous Systems.



Training supports the outlined missions and goals for MassRobotics and Brown University Drone Camp. Specifically, the training for this project will provide a six-week Instructors UAS Training Course. This will include 2-2.5 hours per week for HU-AVN faculty and students. Training will offer an introduction to the commercial drone market and applications, drone design principles and the ardupilot ecosystem, soldering instructions, assembly, programming, and flying the drone and running a programmed mission for Return to Home and Auto Land.

2 BUDGET

The Project team reviewed the "Hampton University Engagement Ideas" v1.2, 29-July-2020 document in preparing the technical approach and budgetary response. Section 2.1 is a summary crosswalk for each requirement discussed in our response with pricing as outlined by the AR Robotics team's engagement document. Appendix C provides line item details for each section with quantities, per item costs, and summary notes to offer further justification of the HU AR Proposal Budget.

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2.1 BUDGET JUSTIFICATION

HU AR Budget Justifiation Summary	Totals
1.2.1 Establishing the HU – AR Pipeline	
Total: 1.2.1	$8,000.00
1.2.2 Creating Senior Capstone	
Total: 1.2.2	$92,000.00
1.2.3 Identify Faculty Support	
Total: 1.2.3	$100,000.00
1.2.4 Launching and Managing a HU AR Research Laboratory	
Total: 1.2.4	$199,830.00
1.2.5 Defining AWS Credits to Support Robotics	
Total 1.2.5	$11,000.00
1.2.6 Creating a Portfolio STEM Program	
Total: 1.2.6	$50,000.00
1.2.7 Support a MassRobotics and Brown University Drone Camp	
Total: 1.2.7	$38,384.00
Total HU AR Proposal	$499,214.00

3 KEY PERSONNEL

The following personal will be dedicated resources to support the HU AR Project.

3.1 DR. ALISSA E. HARRISON

Dr. Harrison is the Vice President for Information Technology and will be responsible for establishing the project management framework for all tasks issued under this proposal. The framework is the Project Management Institute (PMI) Project Management Body of Knowledge (PMBoK). Through these controls, Dr. Harrison will provide management and individual plans for each task. She will establish objectives, assign tasks, allocate budgets and develop timetables for achieving intermediate and overall goals. She will also set review dates to ensure that projects/tasks remain on target.

3.2 DR. DEMETRIS GEDDIS

Dr. Geddis is the Assistant Dean of the School of the School of Engineering and the Chair of the Department of Electrical and Computer Engineering at Hampton University. He has extensive research experience in the areas of Integrated Optoelectronics, Optics, Microelectronics, and Electromagnetics. He will have the co-responsibility for the faculty / student collaborative capstone project, and will lead the effort to identify faculty support for the AR and Hampton collaboration. In addition, Dr. Geddis will work in partnership with the School of Science to help guide, mentor, and develop community outreach opportunities for students interested in robotics project based learning.

3.3 DR. JEAN MUHAMMAD

Dr. Muhammad is the Chair of Computer Science and has the co-responsibility for the faculty / student collaborative capstone project. She also actively participates in the robotic outreach initiative. Dr. Muhammad will plan, identify and support each iteration for the implementation of the capstone

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software development process. Additional responsibilities will include working with Hampton University computer science and engineering students and guiding, mentoring, and developing community outreach opportunities for students interested in robotics project-based learning.

3.4 Dr. Chutima Boonthum-Denecke

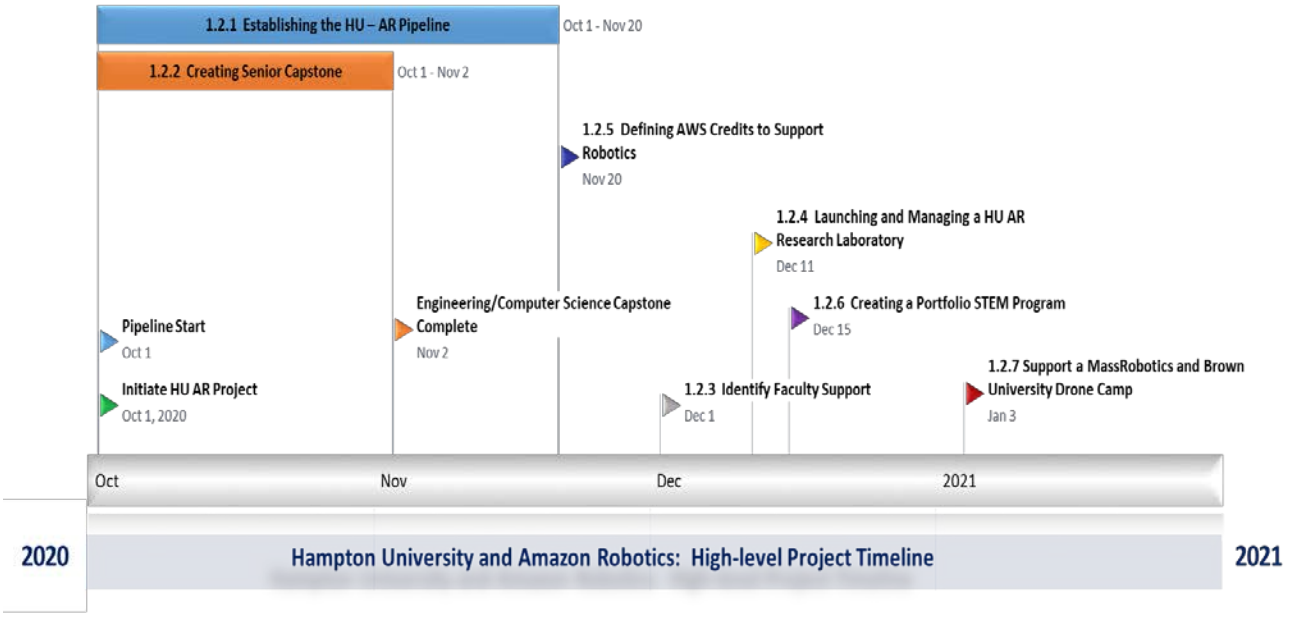
Dr. Boonthum-Denecke is a professor in the Department of Computer Science in the School of Science and will be Hampton's technical AR lead for this proposal. Her involvement with several NSF-funded Broadening Participation in Computing (BPC) programs, the Advancing Robotics Technology for Societal Impact (ARTSI), and the Students and Technology in Academia, Research and Service) Alliances. (STARS positions her to be significant contributor for the AR project. Dr. Boonthum-Denecke is also the Director of the Information Assurance and Cyber Security Center for Hampton. In leveraging this role, she will assist in directing the AR research laboratory and guiding the activities that stem from this project.

3.5 Mr. John Murray

Mr. Murray is the Chair of the Aviation Department and its three accredited Bachelor of Science, Aviation Degree programs, and the Principal Investigator for the Aviation-Collaborative Research Network (AVN-CRN). He has extensive experience designing, managing, and negotiating air operations within complex airspace environments by ensuring aviation safety protocols across domestic and global agencies. As Hampton's specialist in Aeronautical Curriculum and Workforce Development, he will be responsible for preparing a HU-UAS team for travel to MassRobotics and Brown University as well as providing the classroom/outdoor instruction for "Drone Camp."

4 HU and AR High Level Project Timeline

The high-level Gantt chart below reflects a start date of October 1, 2020 that will be baselined upon approval of this proposal and Project Kickoff.



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Appendix A – Hampton University Engagement Ideas

Hampton University Engagement Ideas[1]

V1.3, 29-July-2020, Tye Brady (bradytye@)

Background and Purpose

Robotics is transforming the industrial and commercial landscape across a variety of domains allowing for faster and more efficient operations. Even so, robotics is still in its infancy and will be transformed by needle moving research and talented staff. Amazon Robotics (AR) has developed strong relationships with a handful of partner universities performing foundational research and teaching related to robotics and automation. Through recent contact, we have been engaged with Hampton University (HU) and are considering adding the school to our overall university portfolio. Investment is proposed to further engage HU in cloud-based robotics research, infrastructure improvements, and STEM based activities to increase overall talent pipeline while supporting HU's own digital transformation. We believe that the investment will create opportunities for increased internship enrollment, enhance university wide brand awareness of AR, and provide AR staff more avenues for interaction on campus. Ultimately, we seek to ensure more opportunities for deserving HU students with the goal of securing the best students as new full-time employees at AR.

Proposal

Amazon Robotics proposes that Hampton University:

(a) Share with soon-to-graduate students the opportunity to apply for AR's annual summer internship program. Applied rising seniors will be shortlisted for selection into the AR internship program with the goal of full-time employment upon graduation.
(b) Create a Senior Capstone opportunity for enrolled students to showcase their ideas to AR staff for transforming robotics through the use of cloud-based infrastructure. (100K)
(c) Identify a professor with expertise in robotics, automation, and/or cloud-based computing that would benefit from having an AR sponsored graduate student resident in the lab. (100K)
(d) Identify ways for AR to support HU technology improvements specifically related to modernizing research laboratory equipment devoted to robotics research and development. (200K)
(e) Identify the means, benefit, and budget for AWS credit to be applied to the classroom.
(f) Create a portfolio of ready-to-use STEM educational experiences for high school children and/or teachers to engage in robotics through a series of hands-on learning modules. (50K)
(g) Work with MassRobotics and Brown University to host "Drone Camp" on campus for students to see the world through the eyes of robotics. This highly successful and proven program invites underrepresented groups of high school age to build, fly, and test their own drone as a means to introduce them to the fundamentals of robotics. (50K)

Funding

Amazon Robotics proposes to gift $500K to support proposed items (a) through (g). In addition, AR will work with HU to donate equipment and/or facilitate AWS credit for HU proposed items (d) and (e).

[1] *Engagement ideas document submitted by Mr. Tye Brady, CTO AWS Robotics, August 7, 2020 to Hampton Team*

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Appendix B – Senior Capstone Project

SCHOOL OF ENGINEERING AND TECHNOLOGY
ELECTRICAL & COMPUTER ENGINEERING

HAMPTON PIRATES

Project Proposal Form for University Senior Design Projects

Project Title:	
Technical POC: (your name or the name of someone who has agreed to be listed as the POC)	
Department that should sponsor the project:	
Proposed Budget: (usually $1-3k based on the scope but can be more if separate funding is available)	
Engineering Disciplines Involved: (Electrical, Hull Outfitting Mechanical, Piping, Structural, Ventilation)	
Expiration Date: (when is the project no longer relevant)	
Brief description of the problem:	
Deliverables and description of what should be accomplished:	

Submitted By:	Click here to enter text.	Date:	Click here to enter a date.
Approved By:	Click here to enter text.	Date:	Click here to enter a date.

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Appendix C – Budget Justification Detail[2]

HU AR Budget Justification Details	QTY	Cost (per)	Totals
1.2.1 Establishing the HU – AR Pipeline			
Hampton - AR Pipeline			
Junior Year Workshops	4	0	$0.00
Rising Senior Internships	8	0	$0.00
Internship Inspired Capstone Projects	8	0	$0.00
Full-time Employment upon Graduation	6	0	$0.00
HU AR Pipeline Grants Management	1	8000	$8,000.00
Total: 1.2.1			**$8,000.00**
1.2.2 Creating Senior Capstone			
Senior Capstone Course in Engineering	8	5000	$40,000.00
Senior Capstone in Computer Science	8	5000	$40,000.00
Senior Capstone Grants Management	1	12000	$12,000.00
Total: 1.2.2			**$92,000.00**
1.2.3 Identify Faculty Support			
Robotics Professor – Joint Appointment			
Assistant/Associate Robotics Professor	1	80000	$80,000.00
Graduate Robotics Teaching Assistant	1	15000	$15,000.00
Faculty Support Grants Management	1	5000	$5,000.00
Total: 1.2.3			**$100,000.00**
1.2.4 Launching and Managing a HU AR Research Laboratory			
Robotics equipement to support HU AR Lab:			
Reseach (K-12) Robotics			
Elementary – K-5			
Cubelets	5	500	$2,500.00
Sammy	20	130	$2,600.00
MOSS	5	300	$1,500.00
Cozmo	5	400	$2,000.00
Finch Robot	10	139	$1,390.00
Middle School– 6-8			
Blue Bot	2	500	$1,000.00
Thames & Kosmos Robotics Workshop Kits	10	335	$3,350.00
High School – 9-12			
TurtleBot3	5	550	$2,750.00
Edison	10	174	$1,740.00
Totals: K-12	10	174	$18,830.00
Reseach (HU) Robotics			
Per Capstone Project (TBD)	8	2000	$16,000.00
Robotics Research equipment	1	100000	$100,000.00
Other software/hardware equipment	1	10000	$10,000.00
Research Lab Assistant (support)	1	40000	$40,000.00
HU AR Research Lab Grant Management	1	15000	$15,000.00
Total: 1.2.4			**$199,830.00**
1.2.5 Defining AWS Credits to Support Robotics			
AWS Credit			$0.00
HU AWS Credit Grant Management	2	5500	$11,000.00
Total 1.2.5			**$11,000.00**
1.2.6 Creating a Portfolio STEM Program			
Arduino Creative Kits (CTC 101)	1	2100	$2,100.00
UKIT Beginner Class Pack	1	3500	$3,500.00
Cue Robots	1	4400	$4,400.00
STEM Summer Program	2	12500	$25,000.00
iPad/Tablets (40)	20	500	$10,000.00
HU AR Research Lab Grant Management	1	5000	$5,000.00
Total: 1.2.6			**$50,000.00**
1.2.7 Support a MassRobotics and Brown University Drone Camp			
Drone Program: 2-Instructors/6-Undergraduate Students			
Courseware	8	200	$1,600.00
Instructors	2	1800	$3,600.00
Educational Drone Kits	8	650	$5,200.00
Total Training Cost: $10,400		2100	$10,400.00
Travel Costs: 2 Aviation Faculty/2-Undergraduate Students			
Airfare	1	3200	$3,200.00
Lodging (8 Rooms X 5 Days)	1	9600	$9,600.00
Transportation to/from Airport	1	300	$300.00
Meals Per Diem	1	1920	$1,920.00
Total Travel Cost: $15,020	1	2100	$15,020.00
HU MassRobotics Grant Management	1	12964	$12,964.00
Total: 1.2.7			**$38,384.00**
Total HU AR Proposal			**$499,214.00**

[2] *Travel will be predicated by the Hampton University COVID-19 Policy and Guidelines*

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Appendix D – Other Robotics Equipment[3]

Item	Description	Estimated Cost
Wheeled Robots (2-4) [Small version of or something similar to Kiva Robots] 	Wheeled robots that allow students to learn programming for AR systems; able to integrate AI and ML and path planning. Amazon's Kiva robot (robot packer/smaller scale than Kiva) enables use for various robotics research areas   	TBD
Drones (4-6) 	Mavic 2 	TBD
Emiew 3 (2-4 Humanoid Robot) 	Emiew 3 is a robot that rolls along at human speed to help people (e.g. assist lost tourists at airports, workers in offices, or greet customers at retail stores).	TBD
TutleBot 2i 	The TurtleBot 2i offers the Pincher MK3 4 DOF Robotic Arm as a fully supported standard option that allows interaction with small objects in the real world and effectively transforms the TurtleBot into an extremely capable mobile manipulator.	$2,696/each

[3] *As the HU AR Project matures, Appendix D represents some of the additional robotics equipment to be added to the HU AR Research Laboratory to support STEM, used by students for the Capstone Project, etc.*

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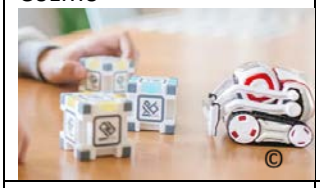
Item	Description	Estimated Cost
Cozmo 	K-12 grade students with App Code Lab College age students can program this robot using Python/OpenCV to recognize markers and objects, and use speech recognition	$375/each
Root, Coding Robot 	Root offers coders of any age or skill level can program this creative tool to defy gravity, climb walls, and move about on smooth surfaces to draw artwork, playing music, responding to touch and color or using many of its other unique abilities.	$200/each
HamiltonBuhl Edison Educational Robot Kit 	Each Edison robot features a host of sensors and can be programmed using a growing number of free software applications including EdBlocks, EdWare and EdPry.	$174/each
Artie 3000, the Coding Robot by Educational Insights 	Artie makes coding relatable and allows students to draw whatever has been coded.	$94/each
Thames & Kosmos Robotics Workshop Kit 	Using the instructions, students can using sensors, motors, a core controller, and hundreds of snap-together building pieces to assemble ten different robots.	$335/each

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Item	Description	Estimated Cost
Dash and Dot Robots by Wonder Workshop 	Turn virtual coding into tangible learning experiences in real time.	$150/each Note that Hampton A+ program used this during summer 2019.
Sphero Mini 	Sphero Mini includes a gyroscope, accelerometer, and LED lights, and the Sphero Edu app that allows the student to program the Mini's actions, controls, and operators.	$50/each
Finch Robot  Finch 2.0 	Finch Robot facilitates coding using;: • Snap (block-based) • Python • Java	$99/each $139/each
iPads/Tablets for controlling robotics 	For outreach program, we will have to install software on iPads/Tablets to allow students to control the robots/robotics. Most software / apps required are free or a part of the robot purchase.	$500-$1000/each

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Item	Description	Estimated Cost
Laptops for controlling robots 	Laptop to use for student outreach programs and programming in the Robotics Lab.	$1,200-$1500/each
 Workstation  Windows / Mac)	Workstations (Dell and Mac) to use for student outreach programs and programming in the Robotics Lab.	$1,500-$2,000/each