Request for Technology Fee Funds

NOTE: A separate request should be made for each initiative.

I. Department Number/Department Name: 360 College of Computing

Title of Request *(please be brief):* Prototype Lab -3D Printer

Amount of Request *(formula from detailed budget below):* $86,445

Executive Summary of Request (100 words or less):

We request funds to purchase a new, more capable 3D printer to replace the decade-old printer in the GVU Prototyping Lab and to provide portable prototyping toolkits for student checkout.

Specific class and/or lab initiative(s) if applicable: CS 1301, CS 4605, CS 3651, CS 7470

Contact person for this request (incl. phone #): Brennan (5-7610), Turk, DiSalvo, Moore, Summet, S

Indicate priority per department if applicable: Number ___ of ___

Indicate priority per college or unit: Number 2 of 11

II. Impact on Students - Provide an estimate of how many students will be impacted if your request:

	No. of Students
Graduate	115
Undergraduate	765
Total	880

III. Narrative - Provide narrative justification for your intended use of the technology fee funds. Include narrative on how the education or research of the students will be enhanced. Also include how the request aligns with the Strategic Plan of Georgia Tech. Continue in the block below if necessary.

The GVU Prototyping Lab is one of the big successes of the Technology Fee Initiative at Georgia Tech. The lab offers unique collaboration space for planning, brain storming and construction of projects. Unfortunately, some of the equipment in the lab is aging, and this is especially true of the lab's crown jewel, the 3D printer. We wish to replace our old 3D printer with a newer, more capable device. Newer 3D printers have vastly expanded capabilities, including significantly higher resolution features and a wide variety of print materials, and this will vastly expand the kinds of devices and parts that students can create. Learning to use a 3D printer can be a transformative experience, and we wish to give this opportunity to a new generation of students. While the GVU prototyping lab provides an excellent resource for fabricating projects, its size and layout does not lend itself to uses a collaborative space for group projects. To address this problem we propose to prototype and build 20 easily portable toolkits that can be checked out.

A new 3D printer would enhance both classroom projects and research at the undergraduate and graduate level. These uses naturally fit with Georgia Tech's goal of scholarship and research excellence from the university's Strategic Plan. In addition, the ability of students to build new prototype devices also plays to the goals of innovation and entrepreneurship. By allowing students to create real, physical appliances and devices, they learn the joy of physical fabrication, and they are nurtured to innovate.

IV. Detailed Budget - Requested Items by Category *List separately list any equipment, software, and other allowable expenses (see Tech Fee Guidelines). There is a formula in the "total column" that multiplies the number of items times the unit price. You may enter a figure into the total column if the unit pricing is not applicable. If you need additional rows, contact the Budget Office to receive a modified form.*

	Proposed Number of Items	Estimated Price per Unit	Total ($)
Object30 Pro 3D Printer	1	$74,865	$74,865
Micro controller toolkit	10	$764	$7,640
Prototyping toolkit	10	$394	$3,940
			$0
			$0
Total *(linked to the total amount of request line above)*			$86,445

Please return form via e-mail in Excel format to: tina.clonts@business.gatech.edu 10/12

III. Continuation of narrative justification, if necessary

The GVU Prototyping lab currently houses an old 3D printer, the Dimension SST 768. This printer was purchased nearly a decade ago, and is sorely in need of replacement. The field of 3D printing is exploding, and 3D printers are now considerably more capable than 10 years ago. Our old printer uses layers that are approximately 250 microns thick. The Objet 30Pro printer that we are requesting funds to purchase prints in 16 micron layers -- almost 10 times finer resolution than our old printer. This added resolution makes a world of difference in the types of items that can be fabricated. The old printer has poor adhesion between layers that allows liquid to pass through and has poor structure rigidity. In addition, fabricated parts made with the old printer such as gears and ball-and-socket joints must be large and unwieldy due to the coarse resolution of the printer. The thick layers form textured stripes on the printed object's surfaces, which hinders smooth motion of one part against another. The ability to print more fine layers with strong adhesion will enable the creation of rigid moving parts that interface smoothly and have the potential to be waterproof, thus allowing a much wider range of student projects.

Another important capability of the Objet 30Pro printer is that it can fabricate parts using a variety of different materials, including a transparent material, a high-temperature material, a polypropylene-like that allows snap fitting and materials that vary in flexibility/rigidity and texture. Our old printer uses just a single material, ABS plastic. These new materials will allow new applications such as light housing (using transparent material) and air and fluid ducts (using high-temperature material). These wider 3D printer capabilities will enable students to produce devices that are substantially different from what the old printer will allow, thus leading to new avenues of innovation.

While the GVU prototyping lab provides an excellent resource for fabricating projects, it can only support a very limited number of group projects at any given time. To address this problem we propose building 20 easily portable toolkits that could be checked out. This would allow students to engage anywhere they see fit to collaboratively prototype class projects. 10 portable toolkits would be designed to allow for microcontroller based prototyping, and 10 portable toolkits would be designed to allow for rapid physical prototyping. These kits would provide greater access to flexible design tools that could be used for classes or other projects.

The old 3D printer currently services at several courses that are taught each year. CS 4605 / 7470 (Ubiquitous Computing) is a mixed undergraduate and graduate class that makes heavy use of the 3D printer. This course is taught yearly, and enrollment for the last three years has been: 84, 87, and 55 students (for 2014, 2013, and 2011). CS 3651 (Prototyping Intelligent Appliances) has been offered every spring for at least the last three years. This course typically has an attendance of 30 students. Each of the students gets hands-on experience with the 3D printer.

As part of CS 1301 (Introduction to Computing), the students have been learning to use a parametric and programmable 3D design systems called Open SCAD. Each student designs a 3D object using this system, and the best of these are fabricated on a 3D printer. The instructor of CS 1301, Jay Summet, plans to use the proposed new 3D printer to fabricate these student-designed models. CS 1301 is taught twice a year, with a total yearly enrollment of about 650 students.

In CS 3750 / CS 6750 (User Interface Design and Human-Computer Interaction), some of the student projects make use of the 3D printer. Some of the past projects in these courses that used the 3D printer include: an interactive game to encourage children to exercise, a wearable alarm system for elderly people that detects when they have fallen and notifies caregivers, a smart lighter that tracks cigarette usage for those trying to quit, and a measuring device for cooking that automatically calculates calories and fats in foods for healthy diets. In fall 2013, CS 3750 had 47 students, and CS 6750 had 45 students.

Many research projects that are undertaken in the school have fabrication needs that were carried out using the old 3D printer. For instance, Karen Liu and Greg Turk have a half-dozen graduate students who are learning fabrication techniques this year, with heavy use of the 3D printer. These students have formed a fabrication study group, and projects from this group include a walking robot, a fabricated miniature bicycle, and a robotic manipulator that is modeled after the human hand. Melody Moore and Thad Starner's students have used the 3D printer for their FIDO project research: creating sensors with moving parts for dogs to activate, making protection devices for sensors, and creating custom cases for vest-mounted electronics for working dogs.

We estimate the number of undergraduates per year that will benefit from the 3D printer at around 765 (40 from CS 4605, 30 from CS 3651, 45 from CS 3750 and 650 from CS 1301). We estimate the number of graduate students to be about 115 (40 from CS 7470, 45 from CS 6750, and 30 from various research projects). The co-PI's of this proposal are Sean Brennan (staff) and eight faculty members: Greg Turk, Betsy DiSalvo, Melody Moore, Jay Summet, Keith Edwards, Thad Starner, Gregory Abowd, and Karen Liu.