Engineering Student Technology Committee
http://www.engr.colostate.edu/ESTC
College of Engineering
Colorado State University

1. Title of Proposal: *Raspberry Pi Controllers to Enhance Computer Systems Education*

2. Proposal Participants:

Name: Sudeep Pasricha_____E-Mail: sudeep@colostate.edu _____

Department/Major: Electrical and Computer Engineering_____

Check One: ___X__ **Faculty**   _____   **Staff**   _____   **Student**

3. Proposal Abstract (limit to 100 words):

Raspberry Pi is a lightweight, economical, and powerful computation and communication platform with a general-purpose ARM microprocessor and a graphics coprocessor. This open source hardware platform is a representative of contemporary smartphone and tablet computing platforms, as well as embedded computing systems that are pervasive in almost all electronics around us. This proposal seeks to purchase Raspberry Pi hardware platforms as technology vehicles for students to learn about computing systems, and provide a hands-on approach to designing and optimizing the behavior of software and hardware components. The platform will be used in multiple ECE courses with Engineering-wide undergraduate student enrollment.

4. Proposal Budget

Raspberry Pi Open Source Platform Ultimate Kit (40 units): $80/unit x 40 = $3200

Link to the Ultimate Kit:
www.amazon.com/gp/product/B00DLUXD64/ref=oh_details_o04_s00_i01?ie=UTF8&psc=1

If the budget permits, I would like to have an additional 10 units, to replace faulty components and wearout related problems.

Dollar or percentage amount requested from ESTC:

$80/unit x 40 = $3200

If budget permits, an additional 10 units, for a total cost of: $80/unit x 50 = $4000

5. Full description of proposal:

Electrical, computer, and mechanical engineering students at CSU are increasingly making use of electronics to impart intelligence to existing robots and vehicles, as well as when designing new smart embedded electronics applications. As an example, over the past five years I have supervised 12 full-year senior design projects, almost half of which included collaboration between electrical, computer, and mechanical engineering undergraduate students, and all of these projects employed some type of smart electronics controller boards such as Arduino or Raspberry Pi. In addition, every year since 2008 in my "CS/ECE561: Hardware/Software Design for Embedded Systems", at least 10 open-ended hands-on projects (average course enrollment is around 30-40 students; a mix of graduate and undergraduate students) are based around some form of electronics controller boards such as Arduino or Raspberry Pi. This experience has motivated me to consider using one of these open-source hardware platforms as a technology vehicle, to provide students (especially undergraduate students) a hands-on experience with using these platforms for interesting projects, as well as learning how to design and optimize software and hardware components, which is a skill that is increasingly valuable for all engineering students that are impacted by technology.

As part of this proposal, I am requesting funds to purchase the Raspberry Pi open-source hardware module for students to work with in my courses. The reason for choosing this platform is that Raspberry Pi is not only inexpensive, but is also significantly more powerful than the other alternative: Arduino based boards. Having worked with undergraduate students that have used both these platforms, I have seen students gravitate more and more towards Raspberry Pi due to its powerful capabilities and thriving online community-based support. The Raspberry Pi platform has been used in numerous DIY projects, from home and vehicle automation, networking, gaming, robotics control, to environmental sensing (I have personally supervised several undergraduate projects that have used Raspberry Pi, such as airborne drones, tracking motion-capable robots, home security systems, and robots for rehabilitation from stroke/cerebral palsy/traumatic brain injury patients). I believe that the Raspberry Pi platform will prove to be an exceptional tool in the hands of our undergraduate engineering students to foster creativity, collaboration, and learning as part of senior design, course projects, and even research.

My funding request of 40-50 Raspberry Pi boards will allow students to individually work on these platforms in courses offered by me and others. If multiple courses end up using the platform, it is also possible to have groups of students share and work on these platforms. I plan to initially use the Raspberry Pi platforms for open-ended projects in my "CS/ECE561: Hardware/Software Design for Embedded Systems" course in Fall 2014, which in the past has been taken by undergraduate and graduate students from Electrical Engineering, Computer Engineering, Mechanical Engineering, Biomedical Engineering, Mathematics, and Computer Science. Subsequently, I plan to integrate these platforms in my "ECE452: Computer Organization and Design" course in Spring 2015, where I teach undergraduate students about hardware and software components in contemporary computer systems. I will also attempt to integrate this platform in the "ECE251: Introduction to Microprocessors" course, so that we have a unified platform on which undergraduate students interested in technology can work on and gain experience from, across courses being taught that are related to technology education.