Engineering Student Technology Committee

http://www.engr.colostate.edu/ESTC

College of Engineering

Colorado State University

1. Title of Proposal: ***Zynq ARM/FPGA boards to train students for the IoT Era***

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):

Zynq represents a lightweight, economical, and powerful computation platform with a general-purpose ARM microprocessor and an FPGA for fast reconfigurable computing in hardware. This platform is a representative of contemporary hardware used in emerging internet-of-things (IoT) devices, video/image processing, industrial motor control, automotive systems, and networking equipment. This proposal seeks to purchase Zynq-based hardware boards as technology vehicles for students to learn about designing powerful computing systems for the IoT era, and provide a hands-on approach to 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

ZedBoard Zynq-7000 ARM/FPGA SoC Development Board (15 units; with academic discount): $319/unit x 15 = $4785

Link to the Zedboard:
http://store.digilentinc.com/zedboard-zynq-7000-arm-fpga-soc-development-board/

If the budget permits, I would like to have an additional 5 units, to replace faulty components and wearout related problems.

Dollar or percentage amount requested from ESTC:

$319/unit x 15 = $4785

If budget permits, an additional 5 units, for a total cost of: $319/unit x 20 = $6380

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 electronics applications. As an example, over the past six years I have supervised 20 full-year senior design projects, many 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 Xilinx FPGA boards, Arduino boards, or Raspberry Pi boards. In addition, every year since 2008 in my "CS/ECE561: Hardware/Software Design for Embedded Systems", at least 20 open-ended hands-on projects (average course enrollment is around 30-40 students, lately around 60-70; a mix of graduate and undergraduate students) are based around some form of electronics controller boards such as Raspberry Pi. *But these existing boards are severely underpowered and not as useful for the upcoming era of Internet-of-Things, which requires powerful and compact computing platforms that are interconnected to each other and the cloud.* This observation has motivated me to consider using Zynq Zedboard platforms that are powerful, flexible, and accessible, as a new 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 Zynq-7000 ARM/FPGA SoC Development Board platforms for students to work with in my courses. The reason for choosing this platform is that it not only allows designing intelligent software to run on the ARM software processor but also allows for designing hardware using the integrated FPGA fabric. Thus students have a lot of flexibility in implementing functionality in either hardware or software, or both. Moreover this platform is significantly more powerful than other boards such as Arduino, Raspberry Pi, etc. The Zynq-7000 Zedboard comes with a free software toolkit (Vivado® Design Suite) to help design hardware/software for the board. Also, there is a free book with tutorials on creating computing applications to run on the Zynq-7000 Zedboard (http://www.zynqbook.com/). *Thus students will not have to spend any money when working with this platform, if they can use the purchased boards and download the free software toolkit and free book.* The Zynq-7000 Zedboard platform is beginning to be used to design internet-of-things (IoT) devices, video/image processing systems (e.g., HDTVs), industrial motor control platforms, automotive systems, and networking equipment. I believe that the Zynq-7000 Zedboard 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 and course projects.

My funding request of 15 (+5 more if funds permit) Zynq-7000 Zedboards will allow students to work in teams on these platforms in courses offered by me and others. I plan to initially use the platforms for open-ended projects in my "CS/ECE561: Hardware/Software Design for Embedded Systems" course in Fall 2016, 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 hope to integrate these platforms in my "ECE452: Computer Organization and Design" course by Spring 2017, where I teach undergraduate students about the challenges of designing hardware and software components in contemporary computer system platforms.