

Thesis-project Demonstration Laboratory

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More and more thesis project students are interested in the development of Cyber-physical systems (both at bachelor and master levels). There is a need to provide these students with a laboratory for demonstrating their developments. We are able to locate the space and some of the very basic equipment is already available. This request for equipment is for allowing further innovation simulation and opening of existing demonstrators for more thesis projects. This will increase the visibility of student innovation in the new media (e.g. YouTube, LinkedIn, Chalmers Website) and accelerate synergies with similar regional efforts (Education and Industry).

Project description

Cyber-physical systems (CPSs) are systems in which collaborating computers control physical elements. CPSs are related to diverse areas, such as energy, transportation, civil infrastructure, healthcare and manufacturing to name a few. We will further build capabilities in the following areas.

Energy: We are including a smart-grid-enabling ICT technologies because students show great enthusiasm and innovation potential for thesis work on smart grid networking technologies, such as wireless protocols, sensors (monitoring the consumption of individual devices) as well as on data collection and processing in special-purpose embedded devices and general computing server. We request a number of electronics hardware compatible with the popular Arduino platform. Devices based on this hardware are intended to be used as a kind of electronic Lego blocks that will allow the students to build, evaluate and demonstrate their custom solutions in a lightweight fashion, while interfacing to and reusing equipment already available. We would also like to have a number of gateways, which work as an intermediary between wireless devices, such as the ones described above and the end user. These devices will add realism in the developed projects and help the students develop projects in the context of smart homes.

ICT: Using student thesis work, we have achieved two orders of magnitude improvements in energy efficiency for computing systems. We wish to further work with students on radically new energy execution models forming foundations for energy-efficient computing paradigms. For this effort, we request a multicore server where students will be able to work colliding with research experiments that often require exclusive access to such systems.

Transportation: Students often want to demonstrate cooperative functions involving, for example, automotive, e.g., automatic driving, avionic, agricultural machines, nautical, e.g., automatic docking. We request to build a scaled automotive testing track with eight scaled vehicles. The scaled vehicles are available and this request for equipment is for building a high-fidelity indoor position system.

Expected benefits

Improving student graduation-rates. One of the greatest benefits of having an attractive thesis demonstration lab is that we will be able to keep our thesis students, both at bachelor and master levels, well-motivated. These projects are very much related to the local industry. We expect to have the possibility for joint thesis with the industry. Moreover, we would like to be able to provide an effective alternative for students that decide to work for their thesis on campus, as needed for such projects.

Learning environment. This project will improve laboratory equipment and provide a stimulating student environment. Besides opening the door for realistic demonstration projects, the requested equipment will give to the students the opportunity to meet each other and collaborate.

Currently we have every year at least 12 thesis students at the bachelor and 5 at the master level, working on projects on these topics. With this lab we could have several times more of this activity.

Course development. Currently, there are at least two master-level courses (DAT295 and DAT300) that can benefit from having access to a demonstration lab, but the main focus is on thesis students.

Cost estimation.

Project during 2014: In order to kick off the project in 2014, we request the following.

Item	Cost per item (K SEK)	Quantity (units)	Subtotal (K SEK)
RCM (time domain)	15	4	60
SONARs low opening angle	0,5	20	10
LIDARS	8	4	32
ARM SBCs	1	10	10
Discovery Boards	0,5	10	5
Firewire / USB3 cameras	9	4	36
Server	50	1	50
IMUs	5	8	40
Arduino	1	25	25
Arduino addon board	0,5	50	25
Technician	0,45	100 (hours)	45
		Total	338 K SEK for 2014

Extensions for 2015 to 2017: We propose to use this demonstration lab for synergies with other education institutes in Sweden. For example, together with "Kraftsamling Smarta Nät" at Sötåsen, we had a number of exchange visits on ICT Support for Adaptiveness and (Cyber)security in the Smart Grid and Synergies. We also had exchange visits with KTH, Linköping University and Halmstad University on Cooperative CPSs in transportation. Our industrial collaborations network includes Göteborg Energi, E.ON, ABB and we would like to integrate these ongoing synergy processes in this project.

We wish to increase the visibility of Chalmers CPS projects via the new media but also build on existing collaborations and further build such contacts for (1) Common simulation platform for cooperative CPSs; (2) Joint education projects; (3) Technology exchange. For supporting these exchange visits, we request for 20 daily visits a year (2,5 K SEK per visit), i.e., 50 K SEK a year.

Requested: 338 K SEK for 2014, 50 K SEK for 2015, 2016 and 2017. Total of 488 K SEK for all 4 years.