STEM Education with Innovation and Entrepreneurship

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Abstract

We offer a compelling vision for bringing together like-minded faculty members across our several university campuses and colleges, to develop smart phone/ mobile applications in domains that are underrepresented but have substantial potential to succeed, with social, economic, or technological impact. A university is uniquely qualified to address such Apps given the close proximity of experts in non-overlapping and distinct fields. However, the close proximity is offset by silos built for administrative purposes. A group of faculty members and/or students drawn from the colleges of arts, business, education, and engineering have worked together over the past two years, not only to build bridges, but also to chalk up several positive outcomes. Our model has potential to be self-sustaining so it can be used to expand/scale up our model to include other groups and colleges in the ensuing years. The infrastructure built will benefit the university, partnering colleges, faculty, & students, while strengthening the social fabric of the university and lowering technology barrier so one can continue to focus on their passion, while benefitting from the rapid advances in science and engineering.

Introduction

Smart phone applications are growing exponentially, fueled by several trends: quick and easy start-up, free/low cost and open source software and hardware, easy access to a rich library of application components, rapid prototyping, social networking, on-line marketing at multiple sites, and a large global market. We show here how these trends can be utilized by a university to realize more of its potential from the infrastructure.

Background

A university is a bastion of knowledge; however, knowledge grows vertically in each domain, with insufficient communication across the domains. This leads to brittle solutions to real world problems and compromises any opportunity for useful innovation. Further, students graduate with limited appreciation of other skills, perspectives, and solutions that could have been brought to bear upon on a given problem. This is not unique to our university; but we are small enough to explore new ways of collaborations, without impacting academic efficiencies. Further, in bigger universities, there is depth in various colleges to duplicate some of the non-core capabilities and become self-sufficient. Our process presented here will help our and other mid-sized universities to find opportunities to collaborate and establish a unique brand of innovation that distinguishes us from others. Academic, financial, and economic returns to the participants and the local community are welcome additions.

This has potential for financial and economic return to the participants; however, equally importantly, this will build bridges for better understanding of each others' domains, setting up future research and teaching collaborations. Also, students involved in such projects, while taking courses in their colleges, will work in teams across domains, thus gaining important real-world experience. These collaborations may also lead to small business formations and a cottage industry that could impact the local economy positively.

Methods

Over the past two years, we have taught Android related courses to graduate and undergraduate engineering students, and high school students, in a synergistic manner. Based on this experience, we believe that our development cycle will follow this one-year cycle:

In the spring semester, a group of faculty members drawn from engineering, arts/graphics, business, and/or an application domain come together to teach and mentor a group of about 20 to 30 undergraduate engineering students. These students take on the roles of a programmer, graphic designer, or project manager, in groups of three students. By semester end, seven to ten Android smart phone application platforms are developed. As can be appreciated, these are code-intensive projects, and it is expected that all the students will contribute to the programming effort, in addition to the effort pertinent to their roles.

During the ensuing summer semester, we teach a three-week course to 30 high school students; they will take these application platforms and use their creativity and imagination to develop marketable smart phone Apps. A group of faculty members and undergraduate students, with core expertise in engineering, graphics, and business, as pertinent to smart phone Apps, will teach, mentor, and support this intense effort. The students in each three-student group are asked to choose their roles (programming/ graphic design/ project management) in their group, and learn and contribute in that role. At the end of the three-week session, a group of distinguished academic and business leaders judge presentations of these student groups. The groups discuss and demonstrate their App, and present a marketing video. These student groups are presented with award certificates based on the evaluation of the judges and internal evaluation of the teaching staff.

During the fall semester, a group of engineering and graphics undergraduate students, savvy in Android programming and graphics design, will use feedback from student focus sessions to fine tune the Apps and add university related information. Business majors will help with the focus sessions and marketing the Apps.

All the authors, viz., undergraduate and high school students, and the faculty members, involved in the App development will share in the revenue generated from the marketing effort. A portion of the revenue will be channeled to the faculty group involved to seed their continued collaboration, to develop proposals and offer these courses during the ensuing year. Remainder of the funds is used by the university to help other faculty members.

Notes: 1. Graduate courses have been used so far to develop new components in the areas of the semantic web, and data acquisition & signal processing. These will become building blocks for future one-year programs as described above. These define new and challenging areas that smart phones will find increasing applications in. 2. During the spring '12 semester, we have planned to offer concurrent courses in engineering, graphics, business, and an application domain (social science) for students in those individual disciplines. However, the idea is to facilitate students' cooperation and collaboration across these disciplines to develop more realistic and authentic applications. 3. The students and /or their parents have signed photo/video release forms and intellectual property forms of the university.

Figure 1. A visitor tries an App during 'Show & Tell'.   **Figure 2**. First Prize Winner App (1 of 2): Block Drop

Results

During fall '09 and spring '10 engineering undergraduate students developed ten base App platforms (for fun games), while engineering graduate students developed Android components and libraries to ease the development process further. During summer '10 high school students used their creativity and imagination to develop marketable Apps from these base App platforms. They were ably supported by four faculty members (from engineering and arts) and four undergraduate students well versed in Android application development. We used Burnette's book [1] as the Text. Four of these Apps were then fine tuned during fall '10 by four engineering undergraduate students. We expect to market these by December '11, after having satisfied all the requirements of the university and the Android On-line Store. This first effort was financed with funding from an SBA grant for one year, during 9/09 – 8/10, and funding from the university during 9/10-12/10. A total of $12,000 (from the SBA grant) was distributed to these high school students, based on evaluation of their Apps by a group of judges [2]. We hope that marketing these Apps will generate sufficient funding to continue to refine and develop new fun game Apps for smart phones. We repeated this process this summer, which culminated with 30 high school students (from 9 high schools) developing ten more Apps. We will market six of these Apps. We will present at the conference the marketing videos of three Apps that were adjudged to be the best by a panel of academic and industry leaders [3].

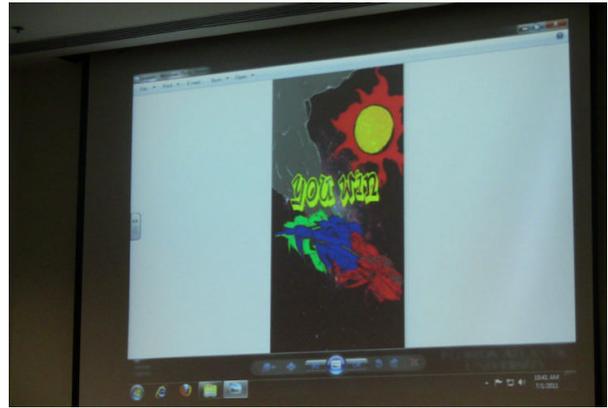**Figure 3:** A student team demonstrates during 'Show & Tell'

Figure 4: Art in another App: Nuclear Madness

We also developed 7 Apps in an undergraduate class during spring '11 that were focused on games with social impact. This involved three professors, one each from engineering, graphics, and social science. Several similar collaborations have sprung up since then and will address Apps in others areas such as K-12 education, patient care, hearing aids, productivity aids for the disabled, and the semantic web [4]. In terms of impact, our Android website, rich with tutorials, application code, and videos, has had ~80,000 visits since its inception in Feb 2010 [5].

Conclusions

From a national perspective, US competitiveness in science and technology can be enhanced by increased involvement of the millennium generation in science and technology, not just as end users, but also as developers of modern gadgets and smart phone applications. Our experience shows that we can assemble students and faculty members from core domains pertinent to smart phone Apps, viz., arts/graphics, business, and engineering, and application domains, to build marketable gadgets and applications that bring them revenue, confidence, and excitement in shaping their future, and also increase their involvement in science and engineering, thus reducing the apprehension of non-engineers and non-scientists toward science and technology.

Bibliography

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