Innovative strategies for teaching wireless applications on the software-defined radio platform to multilevel cohorts

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CONTEXT
In this paper, we describe innovative teaching methods that led to a successful delivery of the advanced level Master of engineering coursework in wireless communications at the Electrical and Computer Systems Engineering (ECSE) department in Monash University. Our novel teaching approach aims at delivering industry relevant wireless communications coursework using the state-of-the-art prototyping software defined radio (SDR) platform to novice and experienced professionals entering research and development in wireless telecom world.

PURPOSE
Using state-of-the art software defined radio platform to teach Wireless applications to multilevel cohorts.

APPROACH
Recognizing that learning is not a spectator sport, we took the approach of "active learning" strategy for delivering the new course. We moved away from the conventional lecture-only model for teaching and adopted integration of active learning strategies into our mode of instruction.

RESULTS
Our practice of active learning strategies to teach advanced theoretical concepts on the USRP-RIO SDR platform is proven to be particularly effective. Some of the positive outcomes of our approach include improved understanding of practical aspects of wireless communications concepts, ability to identify technical problems and discuss them with like-minded professionals in the classroom. Interact with engineers from industry and form connections with other professionals with similar career aspirations. We provide analysis on the information collected from the student's feedback on their learning outcomes.

CONCLUSIONS
In conclusion, our teaching methodology presented in this paper was successfully practiced in delivering the advanced level course to engineering cohorts. This innovative strategy proved to be particularly effective in enhancing student engagement during contact hours with the instructor.

KEYWORDS
Theory to practice, SDR, active learning, industry relevance and Masters cohorts.

CONTEXT

Rapid developments in modern telecommunications field present exciting opportunities as well as new career challenges to graduating students of engineering discipline. More than ever, it is important for the current student to undertake advanced training courses that widen their scope and gain expertise in translating theoretical concepts into practical implementations. In this paper, we describe innovative teaching methods that led to a successful delivery of the advanced level Master of engineering coursework in wireless communications at the Electrical and Computer Systems Engineering (ECSE) department in Monash University. An important measure for success of the course is the increase in student enrolments into the unit and the feedback from students provided via the online system student evaluation of learning units (SETU) last year. Our novel teaching approach aims at delivering industry relevant wireless communications coursework using the state-of-the-art prototyping software defined radio (SDR) platform to novice and experienced professionals entering research and development in wireless telecom world. The new Masters Course curriculum we designed, encompasses needs of a broad range of students with different levels of engineering skills, career aspirations and time commitments.

PURPOSE

The design goal for the Master's coursework in wireless includes methods to realize practical implementation on the hardware of complex theoretical concepts. Conventional coursework design at the advanced level places more emphasis on the theory but not enough importance is given to teaching practical applications that are relevant to the emerging needs of research and development organizations [1]. One of the main reasons for this is difficulty in accessing appropriate prototyping hardware platforms which are suitable for teaching practical aspects in a classroom environment. The hardware platforms that are user friendly, robust and have the capability to run advanced high-speed signal processing algorithms are very costly making them less accessible to teaching large groups of students. To the best of our knowledge, ECSE department in Monash University is first in Australia to make this investment into securing the high quality equipment and further use it to teach Masters level wireless coursework. The advanced software defined telecommunication Lab was established with a number of universal software radio peripheral reconfigurable input/output (USRP-RIO) hardware units [2] for the purpose of teaching the new Master's coursework.

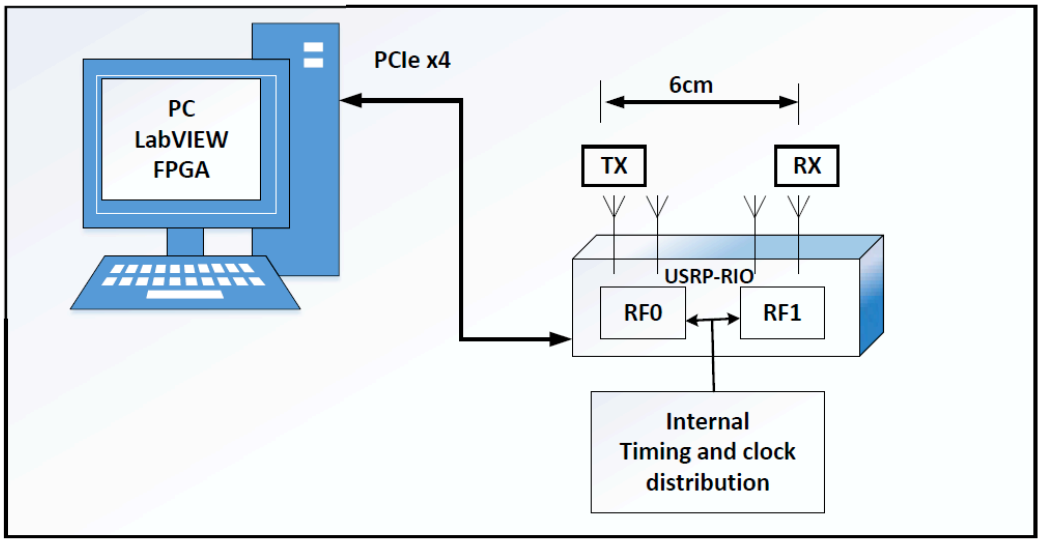

Figure 1: Software Defined Radio Platform

We developed novel teaching methodology for delivering the course content that focuses on implementation of wireless signal processing algorithms on the USRP-RIO hardware. A course curriculum based on interactive teaching philosophy was designed for the new advanced unit. Masters courses at Monash are open to a broad range of students from high achieving undergraduates to entry-level Ph.D. research scholars. In addition, one to two-year Masters Courses attract a large number of international students with different skill sets and career objectives. On the one hand, cohorts with multilevel skills and backgrounds make it difficult for instructors to design and teach the course, on the other hand, the cultural synergy and co-mentorship can create unique teaching and learning environment. The benefits of this synergistic learning environment was well utilized in our teaching methodology to enhance the quality of student learning outcomes.

APPROACH

Recognizing that learning is not a spectator sport, we took the approach of "active learning" strategy We moved away from the conventional lecture-only model for teaching and adopted integration of active learning strategies into our mode of instruction. In this paper, we describe our novel design philosophy which takes into consideration the inequality of technical standards of students and delivers practical implementation focused courses to Masters level cohorts. In conjunction with this novel course design, we offered lectorials [3] that allow for delivering lectures in labs and tutorials where all the action is. The lecture material contained purposeful questioning on critical areas to encourage discussions and improve student engagement during teaching sessions. As the cohorts consisted of students with diverse backgrounds, preparatory teaching material was made available to students in advance through the online learning system. Upon completing the pre-work, class times were utilized to extend their practical understanding while prototyping on USRP RIO. The preparatory material was carefully designed to intellectually stimulate student's self-learning capability outside of the class time. The material included exercises and questions on each technical concept which the student is expected to complete in their own time before the lectorial. This is particularly important for Masters cohorts as the beginners can use the background material to come up to the speed on a specific area while the advanced students can use the same information to fill gaps and do further investigations to deepen their understanding. Information on fundamental aspects of wireless systems and software programming tools is included in the preparatory material.

RESULTS

Our practice of active learning strategies to teach advanced theoretical concepts on the USRP-RIO SDR platform is proven to be particularly effective. Some of the positive outcomes of our approach include improved understanding of practical aspects of wireless communications concepts, ability to identify technical problems and discuss them with like-minded professionals in the classroom. The Faculty wide evaluation for achieving the learning objectives for the unit show a Median score of 4.75. Interact with engineers from industry and form connections with other professionals with similar career aspirations. Based on the results from the Faculty unit evaluation and SETU a median score of 5 is achieved for this unit for intellectual stimulation. Overall, student's satisfaction in relation to the unit teaching methodology, meeting student learning objectives and enhancing the scope on the subject achieved a high median score of 4.75. In addition to the good SETU scores, the success of this unit's teaching methodology is evident from rise in student numbers. There has been an increase in student numbers of over 250% from last year. Although the class size for the unit was small last year, it is still enough to get an idea on the strengths and weaknesses of the teaching methodology we used in the course delivery. The teaching evaluations for this year's course delivery hasn't been completed.

CONCLUSIONS

In conclusion, our teaching methodology presented in this paper was successfully practiced in delivering the advanced level course to engineering cohorts. This innovative strategy proved to be particularly effective in enhancing student engagement during contact hours with the instructor. We established advanced software defined telecommunications laboratory for the sole purpose of teaching the new Masters unit. Access to the high quality prototyping hardware platform facilitated teaching and learning of practical implications of theory and widened career opportunities for students who are looking forward to their career progression in research and development.

KEYWORDS

Theory to practice, SDR, active learning, industry relevance and Masters cohorts

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