Leveraging Robotics Education to Improve Prosperity in Developing Nations: An Early Case Study in Myanmar

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***Abstract*— Robotics can be a powerful educational tool: the topic is exciting, timely, and highly engaging. Research has shown that robotics courses can drive students' interest in science, technology, engineering, and mathematics (STEM) careers. While many successful outreach and introductory programs exist in developed countries, an open question is how best to leverage the appeal of robotics to improve educational outcomes (and, ultimately, prosperity) in developing countries. What material is most relevant? How should that material be presented to engage with students? And how do we measure the impact of such initiatives? In this paper, we report on the design and delivery of a short course on self-driving vehicles for a group of students in the developing nation of Myanmar. The pilot program was facilitated through cooperation with Phandeeyar, a unique innovation hub and startup accelerator based in Yangon. We discuss the motivation for the program, the choice of topic, and the student experience. We close by offering some preliminary thoughts about quantifying the value of this type of robotics outreach effort and of robotics education, both in Myanmar and beyond.**

I. Introduction

Robotics is a compelling topic that can provide students with an exciting, hands-on, and rewarding learning experience. Pedagogical research has shown that participation in robotics courses encourages students to pursue science, technology, engineering, and mathematics (STEM) careers [1]. This potential has been recognized in developed countries, where many successful outreach and introductory programs (for K-12 youth and undergraduate students) are well established. An open question, however, is how robotics education can best be implemented and leveraged to benefit developing countries.

In this brief document, we describe the design and delivery of a short course on robotics (focussed on self-driving vehicles) to a group of students in the developing nation of Myanmar, formerly known as Burma. After decades of political turmoil and isolation [2], Myanmar is now beginning to emerge from the shadows; this transition is being driven, in large part, by technology. Myanmar's smartphone penetration rate is substantially higher than that of any other country in the region, for example. The short course was organized in collaboration with Phandeeyar (literally "creation place"), an innovation hub and startup accelerator based in Yangon.

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Although a handful of related and emerging global initiatives exist (such as WeRobotics) to promote robotics as an agent of change, Phandeeyar is largely unique—it is a 'grassroots' organization, operating on the ground in Myanmar. As such, Phandeeyar has unparalleled access to, and involvement with, the local community. This situation offers numerous advantages when compared to wholly external efforts, where individuals may not be familiar with the social and economic complexities of operating in a specific country or region.

Based on the success of the pilot short course, we posit that this type of knowledge transfer, by experts from outside of a developing nation, can support the formation of a thriving regional (and potentially national) robotics community. However, establishing such a community is dependent upon the existence of a strong local partner. At present, assessing the overall impact of such initiatives is difficult, but the preliminary signs are very positive.

II. Robotics Education in Myanmar

Myanmar has the potential to become a technology leader in Southeast Asia. There is strong interest in tech and a palpable energy in the country. Despite this strong interest, however, there is a lack of expertise in robotics within Myanmar, as none of the major universities currently offer undergraduate or graduate programs in this area. Phandeeyar, in an effort to boost the nascent tech ecosystem, has sought to bridge this gap by i) working to build student-focussed robotics programs within Myanmar, and ii) creating partnerships with international educators.

In 2017, a team of engineering students from Myanmar, supported by Phandeeyar, competed against groups from 163 other nations at the FIRST Global Robotics Olympics in Washington D.C. Although they had entered the competition for the first time, the team finished in sixth place. More recently, Phandeeyar launched a national robotics competition in collaboration with the Myanmar Ministry of Education and Rectors Committee and supported by USAID. The Myanmar RoboLeague includes student teams from all 14 states in the country; the winning team will represent Myanmar at the next FIRST Olympics in Dubai in October 2019.

At the event announcing the new RoboLeague, Phandeeyar CEO Jes Kaliebe Petersen noted that "STEM skills are going to have an important impact on the future of the Myanmar workforce, and Myanmar RoboLeague will play an important role in helping students to contribute to this development."

III. Short Course Content and Achievements

The pilot short course was delivered during one week in February 2019. An overarching goal of the program was to provide a compelling introduction to modern robotics concepts; as such, a focus on self-driving vehicles was chosen (since self-driving cars are a hot topic at the moment). The program lectures, shown in Figure 1, included:

- two introductory modules covering background material (autonomy concepts and a mathematics review),
- three core modules related to self-driving vehicle design (vision, navigation, and multisensor fusion),
- a module on the ethics of self-driving, and
- a hands-on programming exercise, in which students built a simple Kalman filter-based state estimator.

In total, 25 students participated throughout the week. All materials (slides and software) were made available to the students. The course content was sufficient to give participants a basic understanding of self-driving cars, enabling further self-study (through, e.g., edX or Coursera).

The pilot program was well received, with students enthusiastically participating in the lecture sessions and the hands-on exercises (and asking many excellent questions). There is a clear opportunity to expand and extend the program to cover more material and run over a longer duration. Co-authors Mr. Htoo Wai Htet (Makerspace Community Manager, Phandeeyar) and Mr. João Dutra (Accelerator Director, Phandeeyar) have already begun working with the first author to coordinate the development of a more comprehensive course for next year. A followup assessment will be conducted in late August, to determine which aspects of the program were the most valuable and which could be improved upon. Feedback will be solicited from Phandeeyar staff and from the students themselves.

IV. Conclusions and Future Plans

The pilot course was deemed to be a success, based on early feedback from the students and from Phandeeyar. Nonetheless, to evaluate the impact of this type of outreach activity, it is critical to deliver the program over multiple years (since more can be accomplished over several years than within a single year) and to evaluate outcomes (in terms of student job placements, etc.). With the goal of sustainability in mind, the first author has recruited a colleague, Prof. Ryan Smith (Fort Lewis College, Colorado, USA), to assist in the organization of future courses (for 2020 and beyond). In the upcoming years, it is also expected that robotics experts from other countries will join the effort.

In keeping with the theme of self-driving vehicles, Prof. Smith and the first author have been engaged in discussions with the non-profit Duckietown Foundation to acquire a complete Duckietown kit, including eight Duckiebots—this hardware will be shipped to Phandeeyar in Yangon, where it will be made available to students. The Duckietown model has been highly successful with user communities that span the globe (making it very easy to obtain technical support). The present plan for 2020 is to deliver an intensive

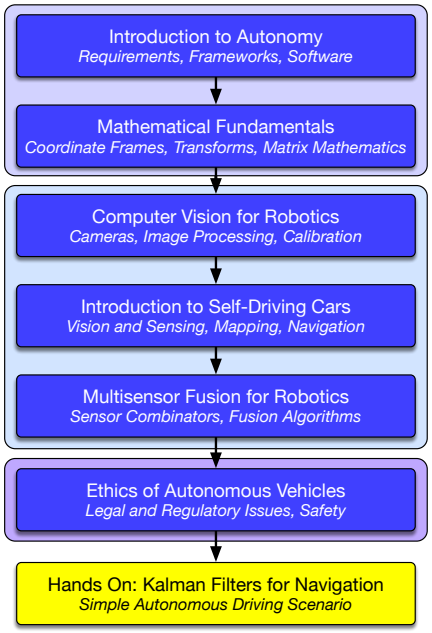

Fig. 1: Outline of short course topics, grouped into four categories (background material, autonomy, ethics, and hands-on hacking). The program was delivered over one week.

'hackathon'-based program over two weeks, during the break between university semesters.

Funding to support the initiative going forward will likely need to come from a variety of sources. The first author has written a proposal for submission to Global Affairs Canada (formerly the Canadian International Development Agency, CIDA); this proposal includes a cross-cultural student exchange component, in which graduate students from Canada visit Myanmar, and undergraduate and graduate students from Myanmar have an opportunity to spend several weeks in Toronto over the summer. Similarly, Prof. Smith is investigating funding options in the United States, including those available through USAID.

Given that the outreach effort is in its early stages, it is not yet possible to claim that this type of (short course) program leads to significant increases in local or national prosperity, for example. However, data from similar programs in developed countries do show that the outcomes are positive—there is reason to believe that the impact may be even more substantial in developing nations.

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References

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