First-Year Robotics Course Development for University of Michigan

Odest Chadwicke Jenkins[1,2], Priscilla Saarah[3], Sophie van Genderen[4]

I. INTRODUCTION

The University of Michigan-Ann Arbor has one of the best and ever-growing robotics graduate degree programs in the US. However, it has yet to produce an undergraduate degree in robotics. This is not surprising considering the multidisciplinary nature of the field. Robotics is a discipline that cuts across other disciplines like mathematics, physics, engineering and computer science and can sometimes require knowledge, understanding and application of advanced concepts which can be only achieved with higher education. However, a lot of schools are developing undergraduate robotics courses because of the increasing exposure of students, even at the middle school level, to robotics resulting in a triggered and possibly sustained interest in robotics (1).

[1]Robotics Institute, University of Michigan, Ann Arbor, USA
[2]Department of Electrical Engineering & Computer Science, University of Michigan, Ann Arbor, USA
[3]Biology Department, Dillard University, New Orleans, LA, USA
[4]Computer Science Department, Depauw University, Greencastle, IN, USA.
ocj@umich.edu
psaarah@dillard.edu
svangenderen_2021@depauw.edu

As such, it is expected that some students enroll in University of Michigan (Umich) for undergraduate studies with the goal of going on to pursue the master's or PhD degrees in robotics the institution offers. However, as interest can and does wane with little to no engagement in a particular content (3) - in this case the interest in robotics , it has become a necessity to develop an undergraduate degree program in robotics at Umich. Thus, this summer I worked with a team that is developing two first-year undergraduate robotics courses, namely ROB 102 and ROB 103.

Indeed, if we can create a first-year robotics course, we can sustain the interests of students already exposed to robotics and possibly develop the interests of the others as well as improve inclusion and provide a better first-year experience for students. However, as already stated, developing an undergraduate robotics program is challenging, especially with simplifying it such that students would understand, learn and enjoy the class even with their limited knowledge in the required disciplines - math, physics, etc. Moreover, since ROB 102 and 103 are to be taken in the first-year, there are no pre-requisite courses, so the students are not expected to have math or programming experience beyond high school. Another big challenge we faced was the fact that none of us working on this had knowledge on

course development and most members were seasoned programmers and roboticists and remembered little about what first-years know and do not.

ROB 102 and ROB 103 are being developed such that they would be taken in the same semester in the first year. ROB 102 would focus on the computational and programming basics of robotics while ROB 103 would teach the hardware and engineering aspects of robotics. My work this summer were tied mostly to the development of ROB 102.

II. METHODOLOGY

Following the findings of Clark et al. in *Putting Students On The Path to Learning* (2), we worked on making the classes follow the explicit guided instruction format. As such it was important that we know the skills and concepts students would need to know for the classes and for each project. Being the most novice in terms of programming and robotics in my team, I (as well as another member) served as the study models. Hence, I worked on the projects students enrolled in the course would most likely work on. For a start, I implemented the HeapSort and A* pathfinding algorithms (fig2). I followed Kinematic Evaluator (KinEval) stencils which are available at my mentor's course website. Then, I moved on to making a robot simulator (fig1), which I worked on with another member of my team. To follow a timeline for the class, I made a simple and basic simulator that takes keyboard inputs, converts them into robot velocity commands and updates the robot's state. A slam map was later added such that the robot was displayed and moved within the map. The robot movement was improved by applying trigonometry when updating the states and so the robot moved relative to its direction. I connected all the codes (the backend) and the display (the frontend) using Lightweight Communications and Marshalling (LCM) and Websocket respectively.

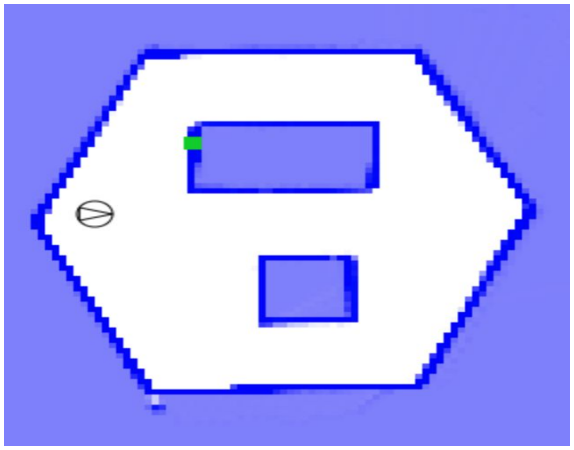

Fig1. Picture of the robot simulator.

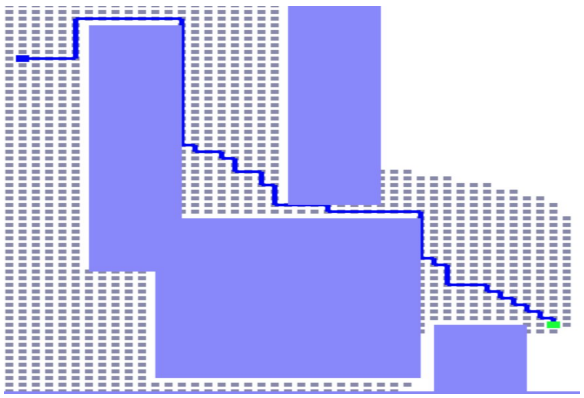

Fig2. Picture of the A* algorithm implementation

IV. CONCLUSION

During the ten weeks I worked on this project, I had the opportunity to learn about robotics and more about programming. I

interacted with master's students and PhD students who are working on cutting edge research. Generally, my team have realized the daunting task of and importance of course development. I have been able to simulate a robot; there are yet a lot left to do in terms of just other projects and setting up of ROB 102 and more discussions for ROB 103. Although my time is up, I am hoping to continue work and my next task is to simulate an IR sensor for a 'wall follower project' I am working on. I am looking forward to build, assemble and move my own physical robot as I did not get to see the robots at umich since the internship was remote.

REFERENCES

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