

Summer 2018 Project Proposal
Laboratory for Embedded Machines and Ubiquitous Robots
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Big Picture

Making custom robots is currently a task that requires a wide range of expertise, knowledge, time and money. These reasons make it difficult and uninteresting for the general public to build robots.

This project aims at making robots easily accessible for the general public by using cheaper, faster and more intuitive design tools. The goal is to simplify the process of building a robot to the extent that a casual user can quickly and easily create a custom robot.

The general approach to this solution has been to develop a design system to easily print and fold 2D patterns into 3D origami like structures. A graphical interface allows users to drag-and-drop electromechanical components and connect them from a library of predesigned parametrized components to describe the robot's design.

This makes for a much less time-intensive task and largely facilitates robot designing and building for an average user. This will help extend the world of robotics into users' daily lives, plus open doors for creativity and further research.

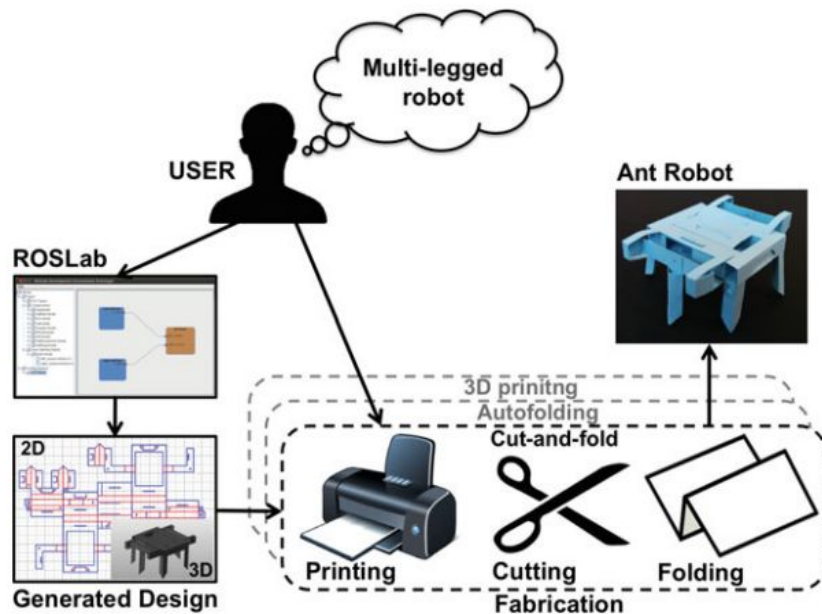


Fig. 1. Overall idea for making robots more accessible and intuitive for the general public.

Specific Project Scope

Although a lot of research has gone into making the actual paper robot a user-friendly system, its applications are still unclear. Finding ways to apply robots in different fields could steer the research and design of the paper robot in a more specific direction for generation of definitive features.

A field in which applications of the paper robot would be useful is education. Middle school students are the world's future leaders, so introducing robotics to them at an early age would spark their interest and create more awareness. This would help generate fresh ideas for ways robots could be integrated into people's daily lives and enhance robotics early on.

Designing a course that gives basic guidance on how to use the graphical interface to design the robot's electromechanical components and assemble the body of the robot together would give students an easy and fun introduction to robotics, and they would learn by doing.

If students are able to follow the course and successfully build a robot, it would be a good initial push to continue building more robots. They will definitely have a clear understanding and could move on to more difficult projects.

Goals, deliverables, tasks

- **Goals:**

- In the coming 10 weeks, we hope to design a course/set of instructions tailored for middle schoolers to build a two-wheeled paper robot. The course will teach them how to use the easy graphical interface to design specific parts of the robot's body, print, cut out and fold the 2D shape into a 3D figure and connect the electrical modules after using the component libraries. We can come up with group activities and individual activities. The course will be designed in a fun manner that will appeal to middle school students (they could possibly have a race with the two-wheelers they build).
- Having a kit with all the components ready for the students can also be a possible goal.
- Being an SUSP student, I also hope to make a scientific poster and write an abstract based on my work.

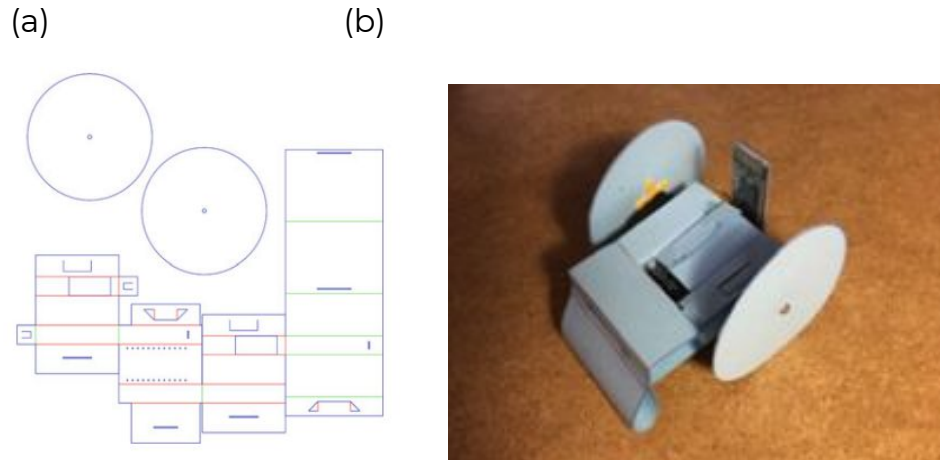


Fig. 2. The goal is to teach students how to generate the 2D pattern in (a) to ultimately cut and fold in the electrical components to produce the paper robot pictured in (b).

- **Deliverables:**

- In the coming 10 weeks, we will have established a written structured chronological outline for the course. We will break it down into its different areas - software, mechanical components and physical components. We will also connect it back to the science and math the middle school students are currently studying by taking an easy and fun approach to teaching the process. We will try following the course ourselves and see if we can successfully build the robot with the mindset of a middle-schooler in a given time frame.
- We will also possibly have a kit with the foldable pattern and some electrical components in it.
- I will have made a scientific poster by the end of 8 weeks.
- I will have written an abstract by the end of 8 weeks.

- **Tasks:**

- In order to achieve these goals and deliverables, we will need to learn more about the paper robot's history and current status of its user interface. Reading the publications on the LEMUR website and talking to students who have been working on the project will be a good start.
- We will learn to build the race car robot ourselves in order to find a simpler approach that will appeal to middle schoolers and make the process less time-intensive. This means learning how to use a paper cutter as well as the software required to program the microcontroller.

- We need to find current methods being used to integrate technology into education so that they can be followed by middle school students with ease. Professor Miryung Kim's work could help us achieve this.
- We will need to look at what middle schoolers are currently learning so that we can connect the different aspects of robotics to their daily math and science classes.
- Making the poster and writing the abstract based on technology in education would require me to look at examples of the same.

Weekly Milestones:

- **Week 1** - Familiarize myself with the paper robot, finalize the project proposal and learn more about technology in education.
- **Week 2** - Read up more about the paper robot using the publications on the LEMUR website, build the two-wheeler robot and understand its different components.
- **Week 3** - Prepare the instructions for cutting, folding and adding in the electrical components of the robot, decide what goes in the tool kit, work on the first draft of the poster and abstract.
- **Week 4** - Tie in concepts from math, science and programming that building the robot helps explain.
- **Week 5** - Look up more about the Jimu Robot by UBTECH and see if we can make it with paper. Otherwise find another robot that is slightly advanced to build off the race car robot, work on the second draft of the poster and abstract.
- **Week 6** - Prepare the instructions for cutting, folding and adding in the electrical components of the robot, decide what goes in the tool kit, finalize the abstract.
- **Week 7** - Tie in concepts from math, science and programming that building the robot helps explain.
- **Week 8** - Finalize the poster and presentation.
- **Week 9** - Enhance the course outline and make it more engaging/interactive.
- **Week 10** - Wrap up of the project.

References

1. A.M. Mehta, N. Bezzo, P. Gebhard, B. An, V. Kumar, I. Lee, and D. Rus. "[A Design Environment for the Rapid Specification and Fabrication of Printable Robots](#)". In: Experimental Robotics, Nov 2015, pp. 435-449.