

# Knitting Robot Project Proposal

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Making Intelligent Things A

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## 1 Introduction

### 1.1 High-Level Description of the Project

The main aim of this project is the development of a **Knitting Robot** capable of knitting simple patches. The robot will consist of a Arduino-based system that controls actuators to manipulate knitting needles (or hooks), allowing it to produce knitted fabrics autonomously. The final result is expected to be a functional prototype that demonstrates the ability to knit given patterns, such as scarves or scalable fabrics, and can be extended to more complex knitting patterns with further development.

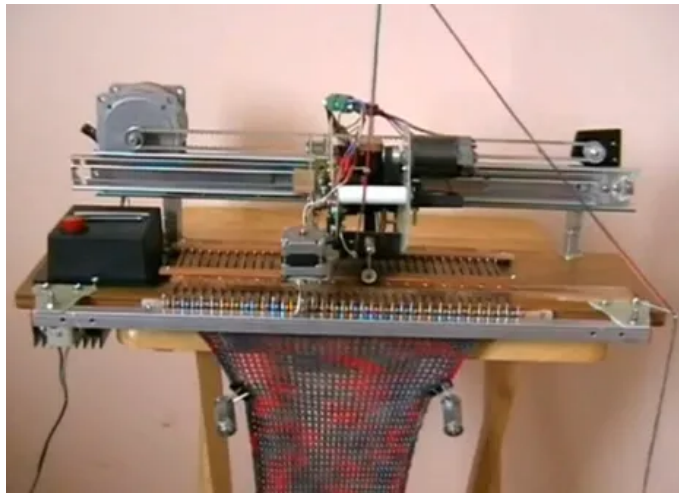


Figure 1: Existing design of a single axis knitting robot (ours should be able to make a rectangle fabric of any size)

### 1.2 Related Projects and Resources

There are several projects and resources already exploring the automation of knitting processes:

- **OpenKnit Project:** An open-source initiative that developed a digital knitting machine (<http://openknit.org/>). The project has the benefit of providing good insights into mechanical designs and control systems for knitting automation.
- **Kniterate:** A commercial digital knitting machine (<https://www.kniterate.com/>) created by OpenKnit developer, that automates knitting with computer-controlled patterns. While it's a more advanced system, studying its functionality can inspire potential future features for the project.

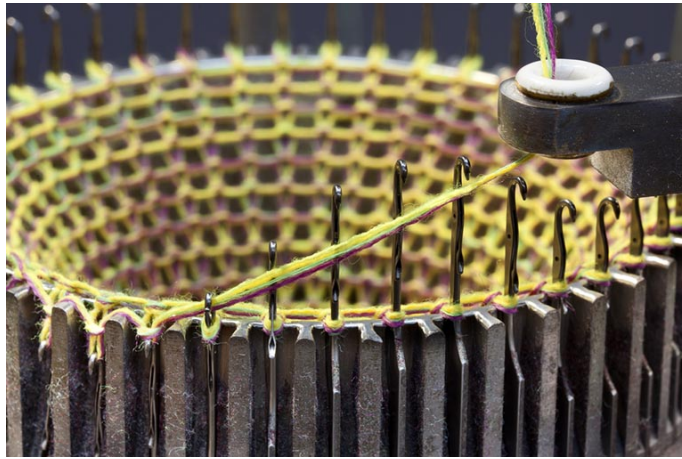


Figure 2: Round knitting machine. Creating round pattern is currently outside the range of this project though.

- **Hand-Cranked Knitting Machines:** Designs of traditional knitting machines (e.g. Brother KH series machines) provide foundational knowledge on the mechanics of knitting that can be adapted for automation.
- **Arduino Knitting Machine Conversion:** Projects where hobbyist have converted manual knitting machines into automated ones using Arduino microcontrollers (<https://youtu.be/-AjIKjxDDHE>).

These projects offer mechanical designs, control algorithms, and software that can be referenced and adapted for this project. Their strategies and resolved challenges can be studied to implement our one efficient solution of knitting automation.

## 2 User Stories

- **Hobbyist Knitter:** As a hobbyist knitter, I want a device that can knit simple patterns automatically so that I can produce scarves and fabrics without spending hours of manual labor.
- **Educational Tool:** As a prestigious teacher in robotics and automation, I want a demonstration project that showcases the integration of mechanical design, electronics, and software to inspire students about the possibilities of engineering.
- **EPFL Demonstrations:** As a member of the EPFL IC public relations team, I want a compelling demo that can attract prospective students by showcasing an innovative project combining computer science and mechanical engineering.
- **Business Owner:** As an owner of a knitting business, I find it useful to explore new solutions in hope of upgrading our factories.
- **Future Developers:** As a developer interested in advancing knitting automation, I want a modular and open-source project that I can build upon to create more complex knitting patterns or improve efficiency.

## 3 Product Management

From a long-term perspective, this project has the potential to evolve in several ways:

- **Educational Kits:** The Knitting Robot can be developed into an educational kit for teaching robotics, programming, and automation concepts in schools and universities.
- **Open-Source Platform:** By making the design and software open-source, we can create a community of developers and makers who contribute to improving and expanding the project's capabilities.
- **Basis for Startups:** With further development, the project could lead to the creation of affordable, consumer-friendly knitting machines, filling a niche in the crafting and DIY market.
- **Future Course Projects:** The mechanical and software components can be reused or expanded upon in future CS-358 projects, allowing students to work on pattern recognition, advanced motion control, or integration with computer vision for pattern customization.

## 4 Cost Estimate

A preliminary cost estimate suggests that the project can be completed within the CHF 250 budget limit:

- **Microcontroller:** Arduino Mega - CHF 14
- **Computer/Controller interface:** HC05 Bluetooth module - CHF 3
- **Multiplexer for more PWM output:** PCA9685 16-channel PWM Multiplexer - CHF 12
- **Voltage converter:** 8-channel logic-level converter - CHF 1
- **Sensor to ensure working area clearance:** HC-SR04 Ultrasonic Distance Sensor - CHF 2
- **Measuring motion of knitting needles:** MPU-6050 6 DOF Inertial Measurement Unit - CHF 5
- **Measuring motion of knitting needles:** CUI AMT-102-V Rotary Incremental Encoder - CHF 21
- **Controlling precisely the needles:** Chihai CHF-GM37-550ABHL Gear Motor with Encoder - CHF 25
- **Additionnal motors:** CHF 35
- **Knitting Yarns:** CHF 14
- **Total Estimated Cost:** CHF 132

This estimate leaves room within the budget for unexpected expenses or additional components and features. All components are standard and readily available, ensuring feasibility within the project's constraints.