FOLDIE – THE LAUNDRY FOLDING ROBOT

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PITT | SWANSON ENGINEERING
MECHANICAL & MATERIALS SCIENCE

ABSTRACT

This project addresses the issue of folding clothes. Utilizing the designs of industrial folding machines as inspiration, a machine able to fit within a cubic yard was constructed with the ability to fold towels and shirts. This design was accomplished by utilizing many mechanical and electrical engineering principles. While the system does not work perfectly, our group started from a concept and made that concept a reality.

INTRODUCTION

Our team started brainstorming problems that we could address for a self-directed senior design project as far back as the spring semester of 2016. We came to the realization that folding clothes, even though it takes a significant amount of time, has never been addressed on the residential scale.

Breaking down the numbers, the average human takes around 30 seconds to fold an article of clothing, has around 45 clothing items per load of laundry, does laundry every 1.5 weeks, will fold laundry for 75 years of his/her life, and will fold laundry for two kids for 18 years a piece. These are approximations, but their foundations are sound. Crunching these numbers, that means that the average person will fold laundry for nearly 60 days of his/her life. This proves that it is an issue worth addressing.

There are certain companies that are attempting to address this issue already; however, they have not yet been released to the market, are large, and will cost a substantial amount of money. These include companies like Foldimate, Laundroid, and CloPeMa.

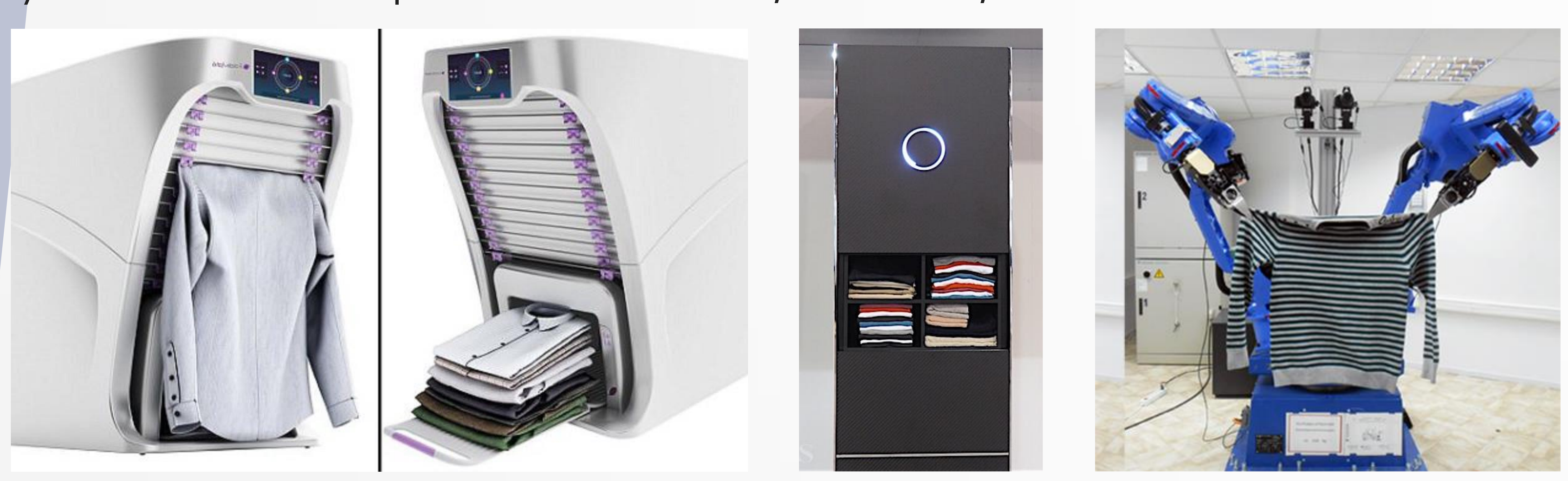


Figure 1: a) Foldimate, b) Laundroid, c) CloPeMa

OBJECTIVE

The goal of this project was to develop and design a machine for residential use to aid in the folding of towels and shirts. The machine must be able to fold multiple times with high satisfaction and quality of fold.

DESIGN CRITERIA

Assuming that the clothing item is a towel and that the clothing item is inputted into the machine by an external method (e.g. humans, loading machine, external attachment, etc.), there are certain design constraints that had to be met for the project. These were the criteria used for the design of the entire system.

Towel Size **– fold towels of variable size**
- Wash cloth: 13" x 13" (~1 ft 2)
- Bath Sheet: 35" x 60" (~15 ft 2)

Folding Time **– time to complete fold**
- Fold towel in < 90 seconds

Fold Quality **– a wrinkle-free high quality fold**
- Visually appealing
- Final fold length + width < 27"

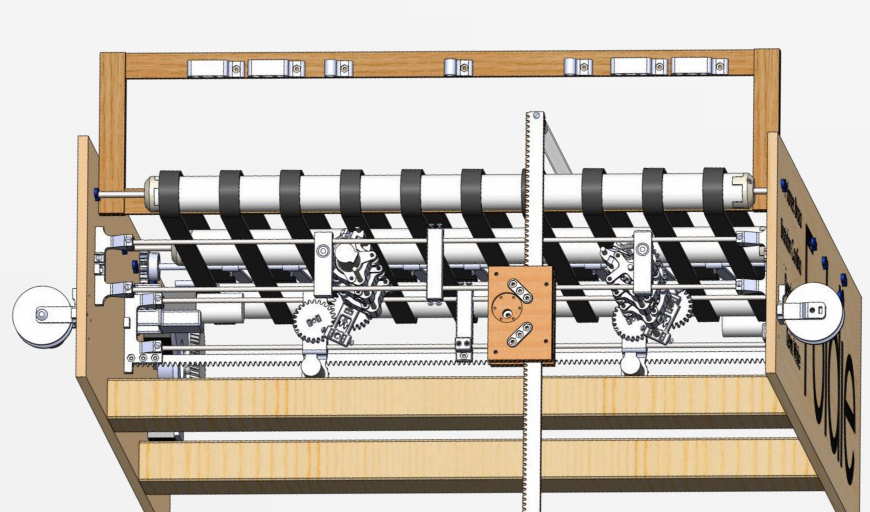
Cost **– total cost for entire system**
- Must cost less than $600

Towel Material **– fold independent of cloth material**
- Cotton to polyester

Footprint **– able to fit in laundry rooms**
- Entryway can accommodate any towel
- Total Volume < 1 yd^3

Power **– run off outlet power**
- Available in households

Noise **– less sound than a washing machine**
- Sound Volume < 78 dB

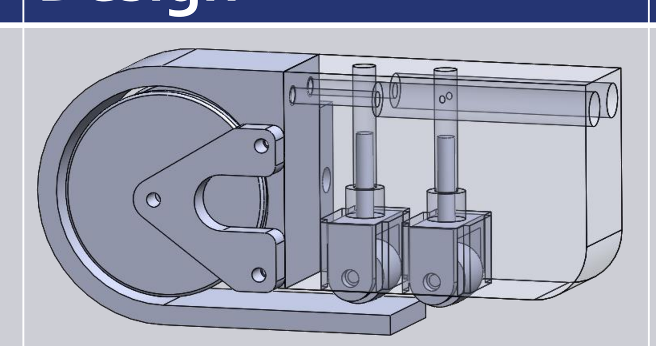
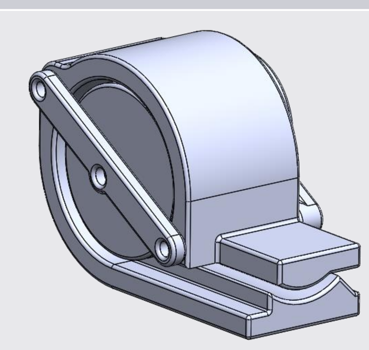
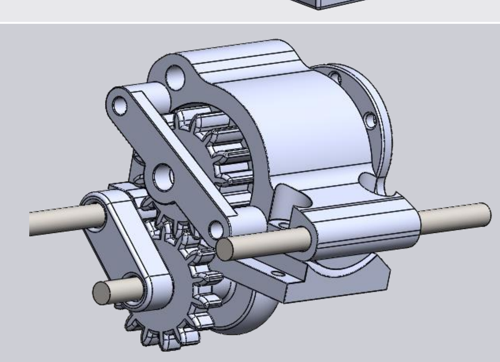
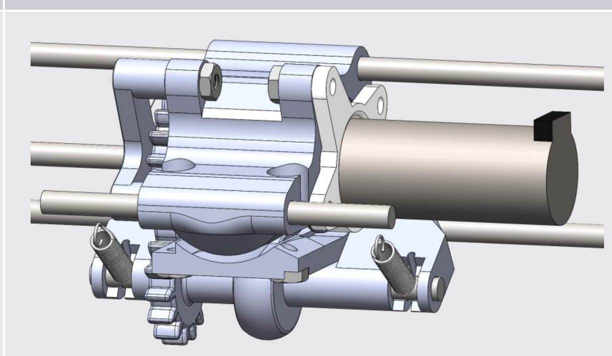


DESIGN PROCESS

With our idea and design criteria, we brainstormed ideas for machines able fold laundry – coming up with greater than 100 ideas over the course of two months. Some of these ideas seemed better than others, so we tested the ones that seemed the most feasible. In doing so, we ultimately decided on our design which is shown at the end of the previous section.

This design still required a fair amount of alterations and experimentation. In fact, we broke the design down into eight different components: the frame, belts, pulleys, egg slicer, exit method, tape measure actuators (TMA), crease holders, and the circuit. Each component required its own design, prototyping, and analysis.

Perhaps the greatest amount of design iteration took place on the tape measure actuators. The TMA motorizes a tape measurer and utilizes this motion to fold an article of clothing in half. With a total of seven revisions, each design continually addressed the shortcomings and improved upon its predecessor. Seen below are three of the designs for the TMAs.

Rev	Design	Shortcomings
1		• Too large for design requirements • Tape had 20mm excess space • Pulley spun out of plane
2		• Much smaller but tape still had 5mm of excess room • Tape blade had no pushing force • Shaft mounts were to weak to hold multiple TMA's in parallel
4		• Method of attaching gear tensioner was not functional • 3D printed threads were tedious to tap and weak
7		• Inlaid nuts replaced threaded holes • Compression springs better tensioned • DC encoded motor was changed

CIRCUIT CONSTRUCTION AND ALGORITHM IMPLEMENTATION

There are predominately two circuits in the design: one for control and the other for power. The control circuit is seen in Figure 2, and the power circuit involved strategic combination of old power adapters and load balancing to power the machine.

The algorithm was executed on an Arduino Mega because of its low cost, extensive I/O pins, and short development time. Although currently a rough rendition, further iterations will result in an optimized, more robust algorithm.

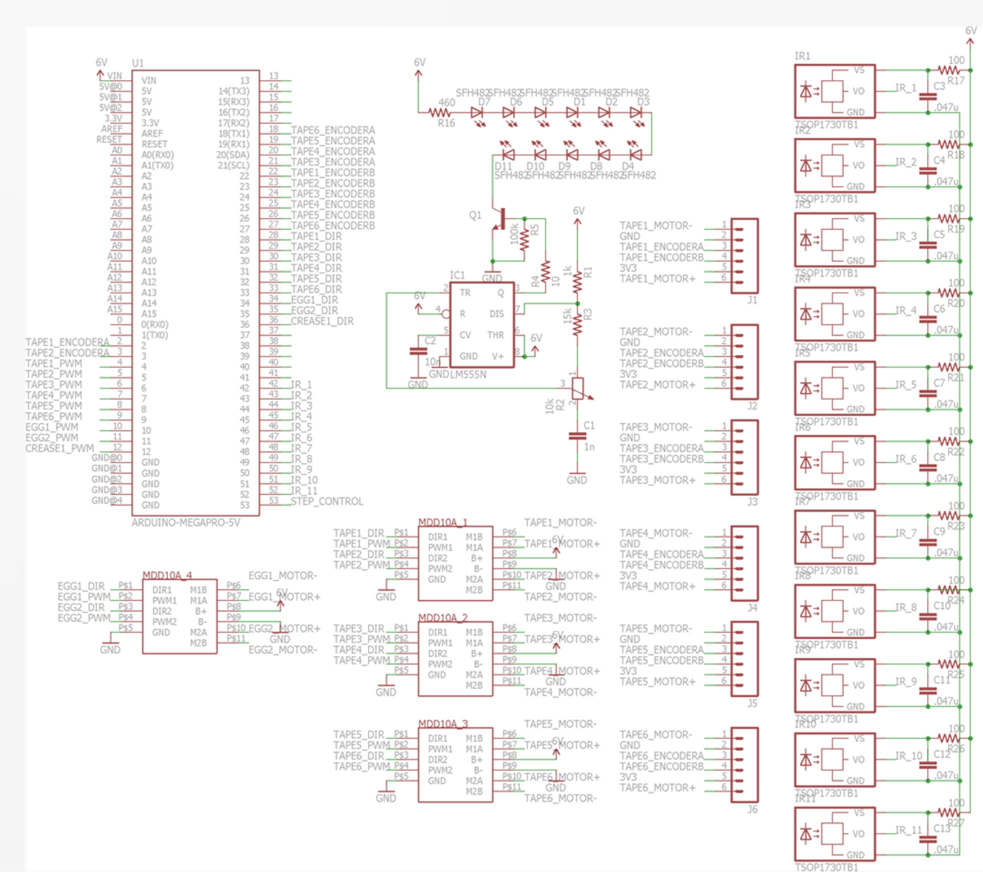


Figure 2: Schematic for the control circuit

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