

# Capstone - The Steerable Walker Project

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 Sponsored by Michael McCarthy, Ph.D. and Kevin Chen

## Introduction

- Robots walkers, also known as legged robots can come in many shapes and sizes.
- Choose the robot walker as the project to use for Dr. Michael McCarthy's project-based approach in teaching kinematic synthesis to mechanical engineering students.

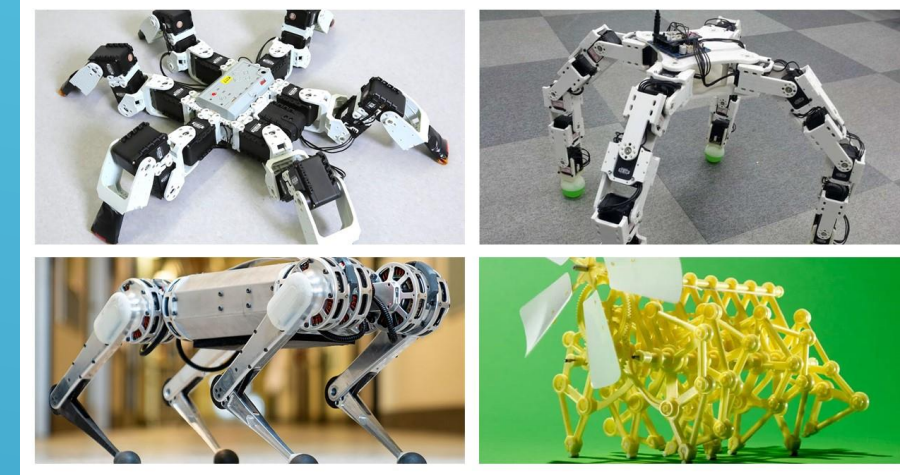


Figure 1: (Top Left) Six legged Robot by Evan Ackerman  
 (Right) Quadruped Robot created by Bokeon Kwak  
 (Bottom Left) MIT Mini Cheetah Right) Theo Jansen's Strandbeest

**Objectives:** Design a robot walker that can steer left and right.

**Challenges:** Robot walkers can be built with simple crank-rocker mechanism, but without complex structures, simple robot walkers are not able to turn in different directions or control their speed.

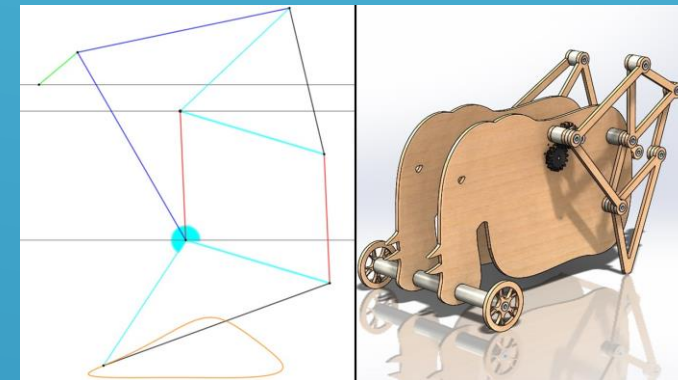


Figure 2: (Left) Simple line drawing of crank-rocker leg used. (Right) Final Solidworks Model of Robot walker

## Project Statement

The prototype:

- Should consist of :
  - one drive motor and one steering motor
  - RC control to define forward, backward, left and right movement
- Should be able to:
  - Walk at minimum 1ft/sec
  - Walk in a straight line for an extended period of time
  - Be able to walk in a circle
  - Be able to walk in a figure 8 formation without stopping

## Part Solution for Steerable Walker

Figure 1&2: Drive Train

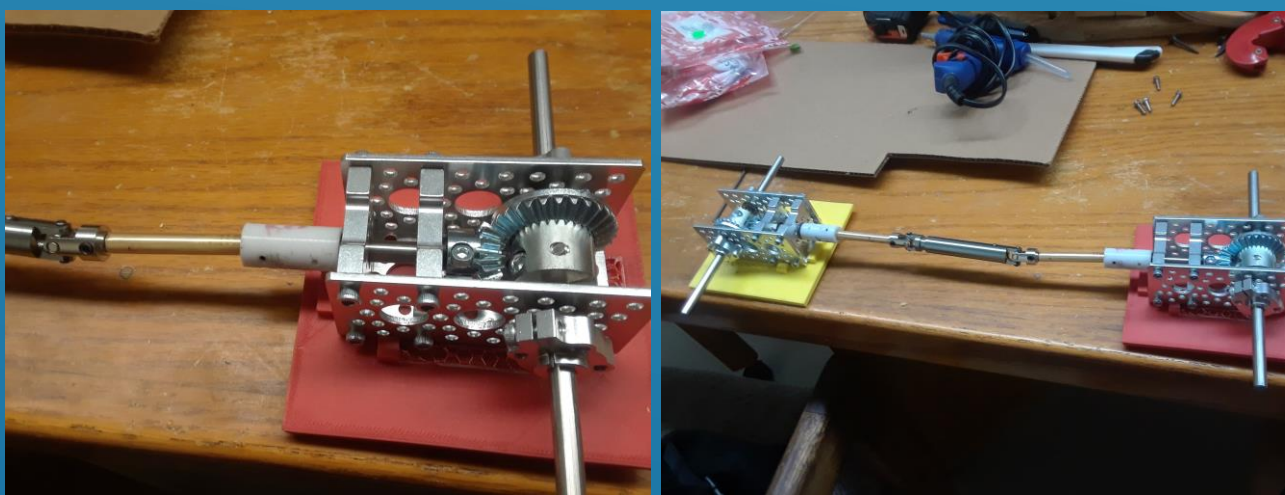
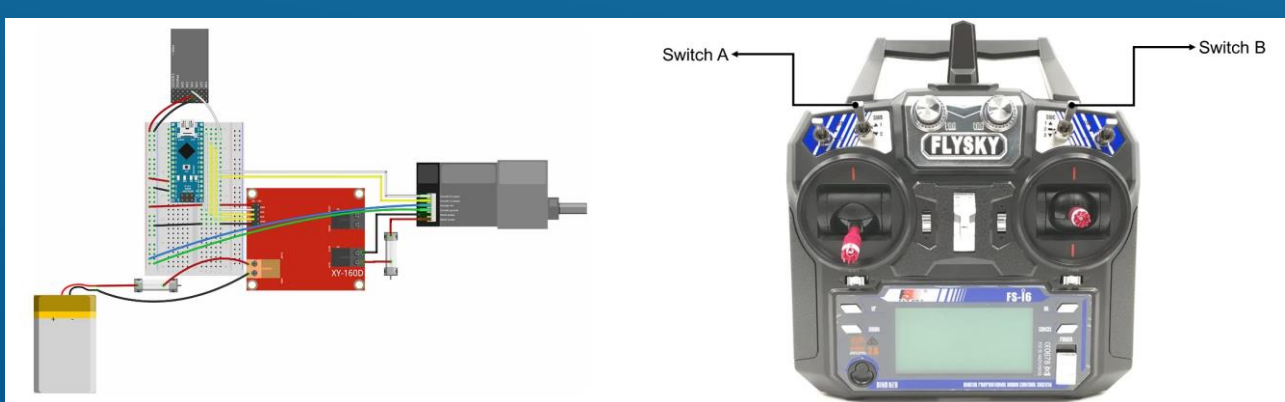


Figure 3&4: Chassis



Figure 5&6: Electrical Schematic (L) & RC Controller (R)

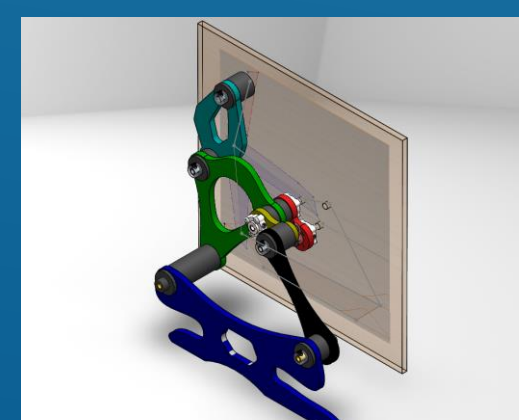


## Solution:

In general, we will use -

- A universal joint shaft and two bevel gear boxes to build the drivetrain;
- Split the body board, and use four cranks and three gears in series to steer the walker
- RC controller, Arduino, a motor driver, and two motors (one for drivetrain, one for steering chassis) to control the walker

Figure 7: Leg Mechanism



## Overall Success of our Steerable Walker:

Due to limited time, We made a complete CAD simulation of our steerable walker and a actual walker with wheel replacing the legs to test power and steering system.



Figure 8: CAD simulations of Steerable Walker with wheels and legs

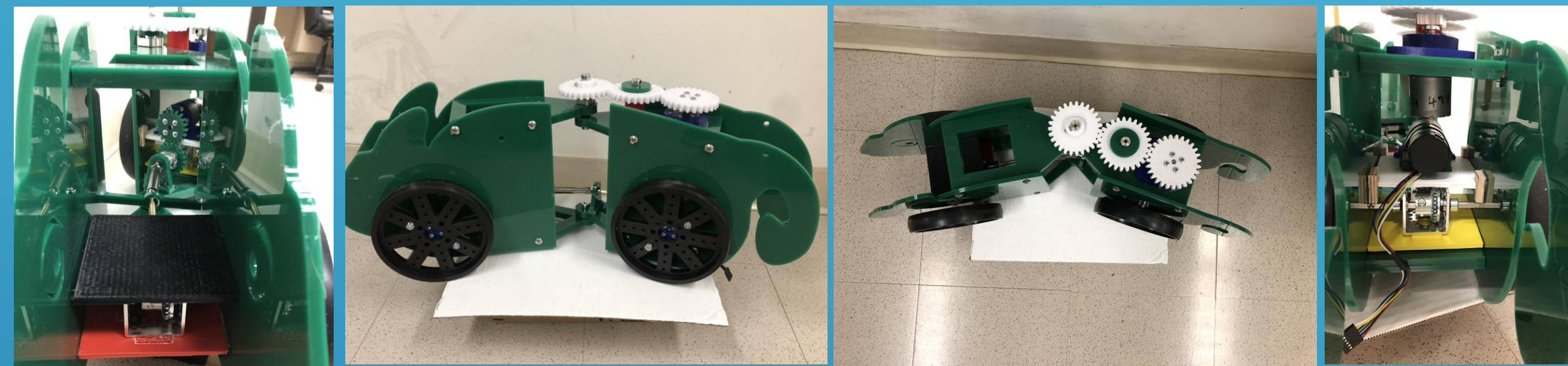


Figure 9: Actual Assembly of Steerable Walker using wheels

## Assembly:

Although we didn't finalize the entire steerable walker, all components are prepared after 3D printing, laser cutting, and using off-the-shelf products. The purpose is to make a feasible kit that will help such students to build the steerable walker.

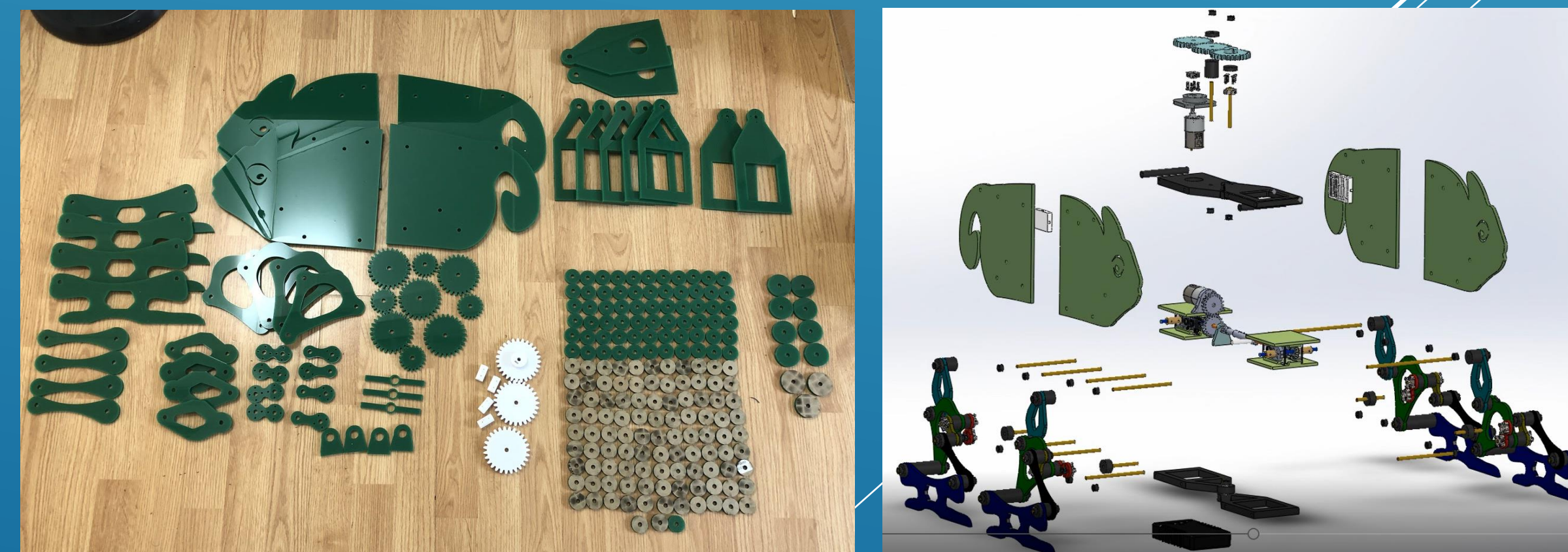


Figure 10&11: Chassis and Leg Components (L) & Explosive View on SolidWorks (R)

## Progress:

The progression of our steerable walker is as follows: the cardboard prototype, the SolidWorks prototype, the wooden prototype, and the final Prototype Amade from Acrylic.

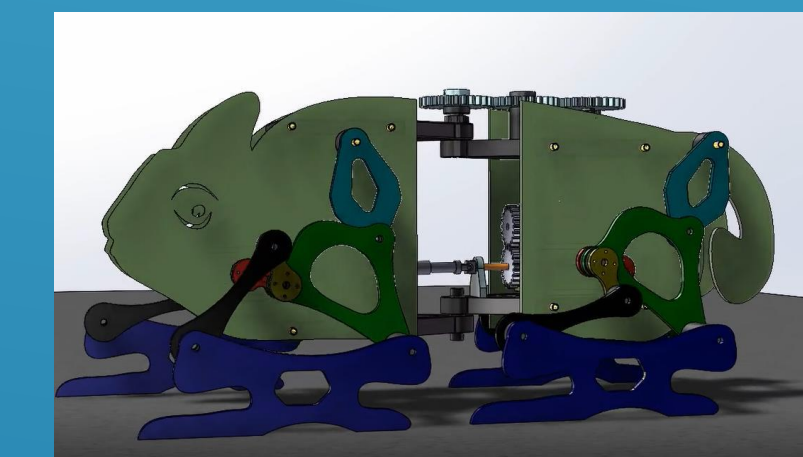
## Team Organization

- |                           |                             |
|---------------------------|-----------------------------|
| Myia                      | Dylan                       |
| • Manager and Electrical  | • Drive Train and Testing   |
| Jeremy                    | Justin                      |
| • Drive Train and Webpage | • Chassis and Manufacturing |

## Analysis Results:



For the actual model we made, we have tested the steering function and normal advancing function. They all work properly. We further tested it on the ground, made to turn left and right, move forward and backward. For further video, Please Scan the QR code in the bottom corner and visit our website.



SolidWorks model of the Steerable Walker. A motion analysis can be found on our website. Scan the QR code in the bottom corner.

For Motion Analysis and more:



## Sponsorship

The sponsors of this project are Dr. Michael McCarthy and Kevin Chen. Dr. McCarthy is the primary sponsor of this project providing the funding and advising on the project. Kevin Chen is a previous student of Dr. McCarthy's Robotics and Automation Lab also provides advice and support to the team as needed.