Biomechanical Electricity Generator for the Knee Joint

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Introduction

How can energy from human motion be captured and turned into electrical energy that can power small devices?

Solution: Build a biomechanical device that utilizes the oscillatory motion of the knee joint while walking to create mechanical energy and converts that into electrical energy.

Goal: Generate a consistent flow of electrical current while a person is walking. The reach goal is to generate a current strong enough to charge a cellphone

Methods

- Designed 3D-Printed mechanical device with ball bearing rotation
- Added 27x voltage amplifier with LM741 OpAmp
- AC/DC LM317 Adjustable Voltage Regulator
- Wrote Arduino software code to monitor power
- Tested system on its own to ensure all components functioned together
- Tested system practically while walking

Applications

- Power body sensors and wearable tech
- Physical Therapy
- Exercise (running, hiking)
- Power sensors for prosthetics
- Renewable energy source

Contacts

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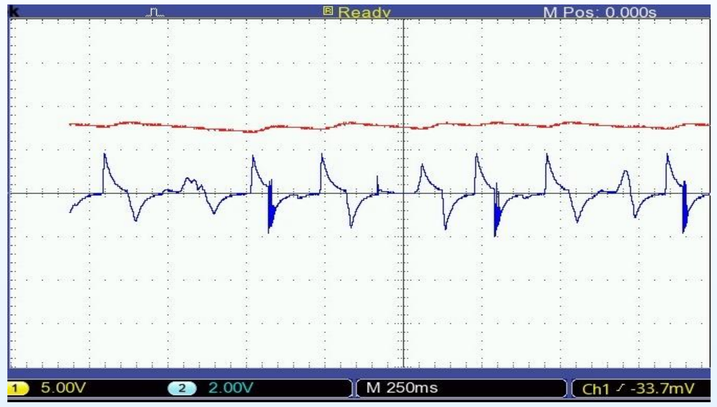
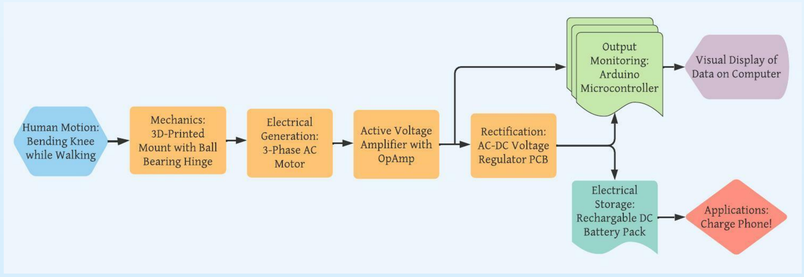
Results

- AC motor output measured at 390mVpp
- Voltage amplifier: 8.49Vpp AC
- Final DC output of 3.5V



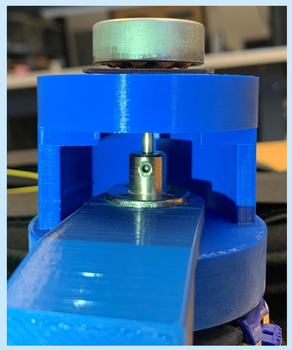
Voltage Amplifier Output (Blue) vs. DC Voltage (Red)



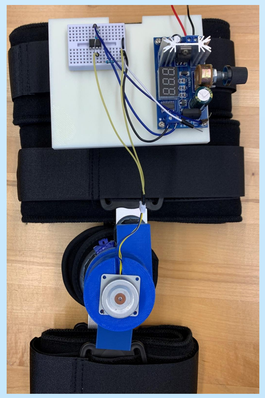
Complete System Flow Diagram

Hardware Components

Hinge and Ball Bearing



Motor Stator (Top) and Rotor Axel



System Secured to Knee Brace

Discussion

- Voltage regulator handled distorted AC wave
- A constant electric current was successfully generated
- The self sustained AC motor output was too small for any practical application
- Rate of power generation did not meet demand for rechargeable battery
- The knee brace did not fit securely on the leg
- The most challenging aspect of the system was the mechanical design

Future Improvements

- Develop a more efficient mechanical system
- Propose the project to Mechanical Engineering
- Design a smaller, enclosed housing/mount for all electrical components
- Utilize plugs and connectors to reduce wiring
- Make system easier to put on the leg and improve user experience

Acknowledgements

- ECE Department Chair Dr. John LaCourse
  - For advising the project and consistent availability
- ECE Technician James Abare
  - For extensive assistance and resources provided
- UNH ECE Department
  - For providing project funding and resources
- Brian Keegan of Oyster River Cycle & Sport
  - For lending his time and insight, as well as the spare parts