Measuring Electrical Current with an Arduino

Tim Dennis & Peter Tsun
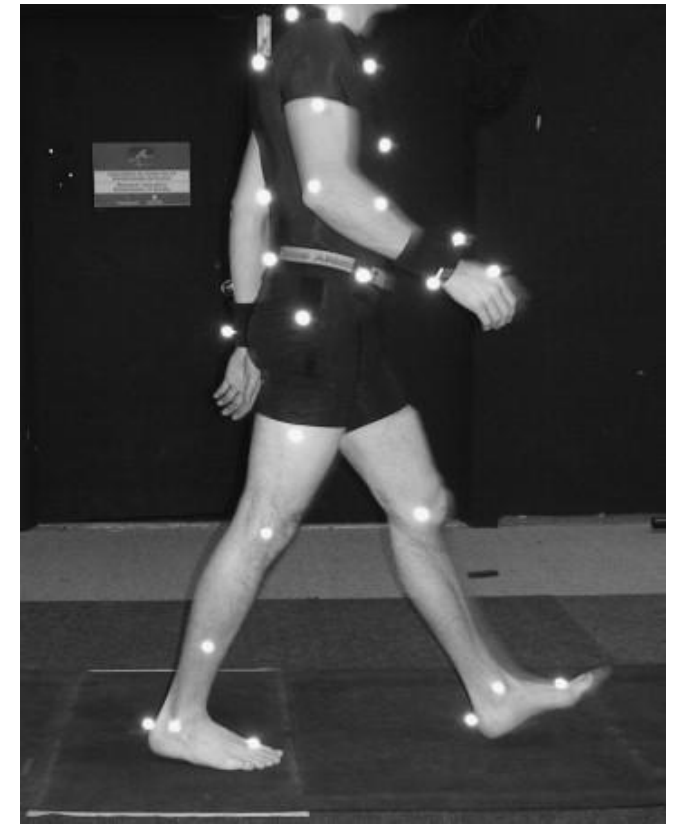August 16, 2013

Power and Energy

How much energy is consumed during walking?

- Health and Fitness

- Need quantifiable data that can suggest ways to improve performance

Gait Analysis

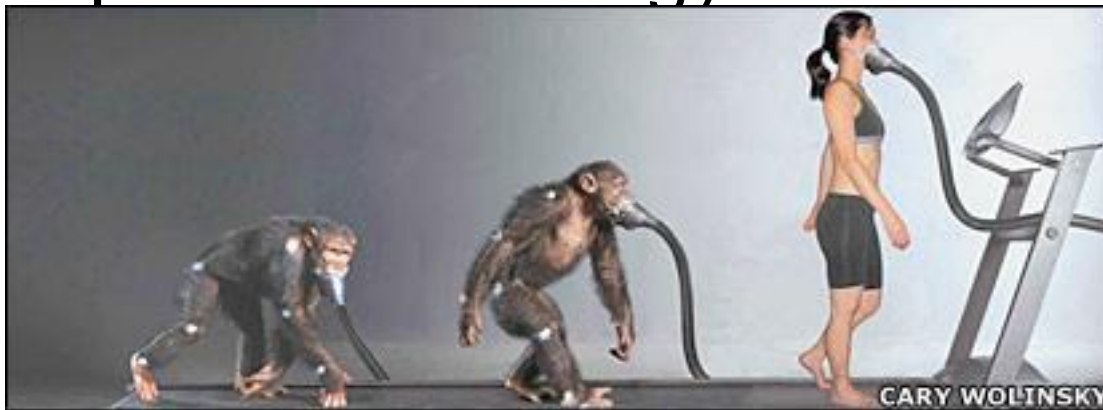Cameras, Force Plates

Energy Used for Walking

Need oxygen masks

cameras, force plates

Use a robot   Darwin

- model walking

- reduces overheads
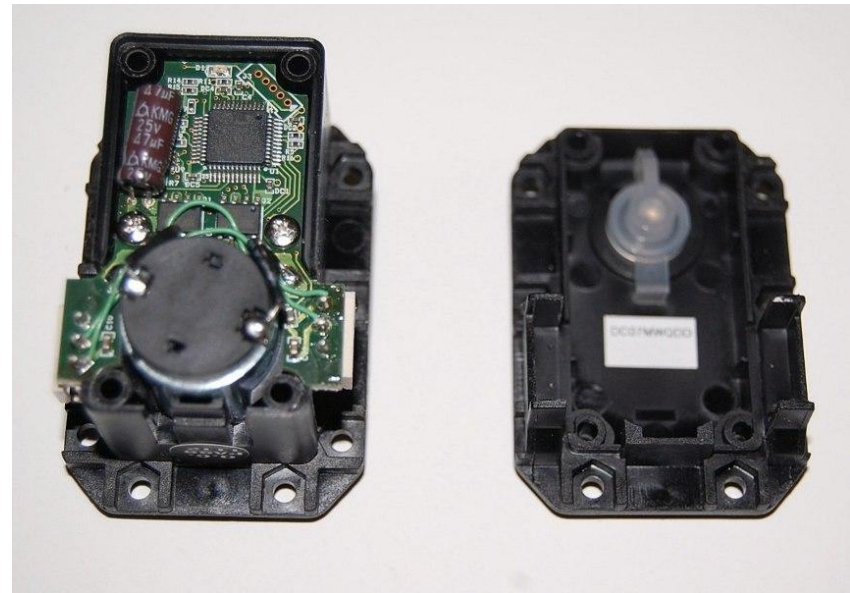
- convenient to measure
  power and energy

Servo

Darwin the robot has 20 servos for movement.

Energy Consumption

Measure from each servo/motor

- voltage

- current

- time

Get Power, Energy

Pre-made Sensors

ACS712 Breakout

- made Darwin release smoke
- promising because it uses
  hall effect to measure current
  in either direction

INA219 Breakout

- measured servo's current
- limitation: just ONE direction
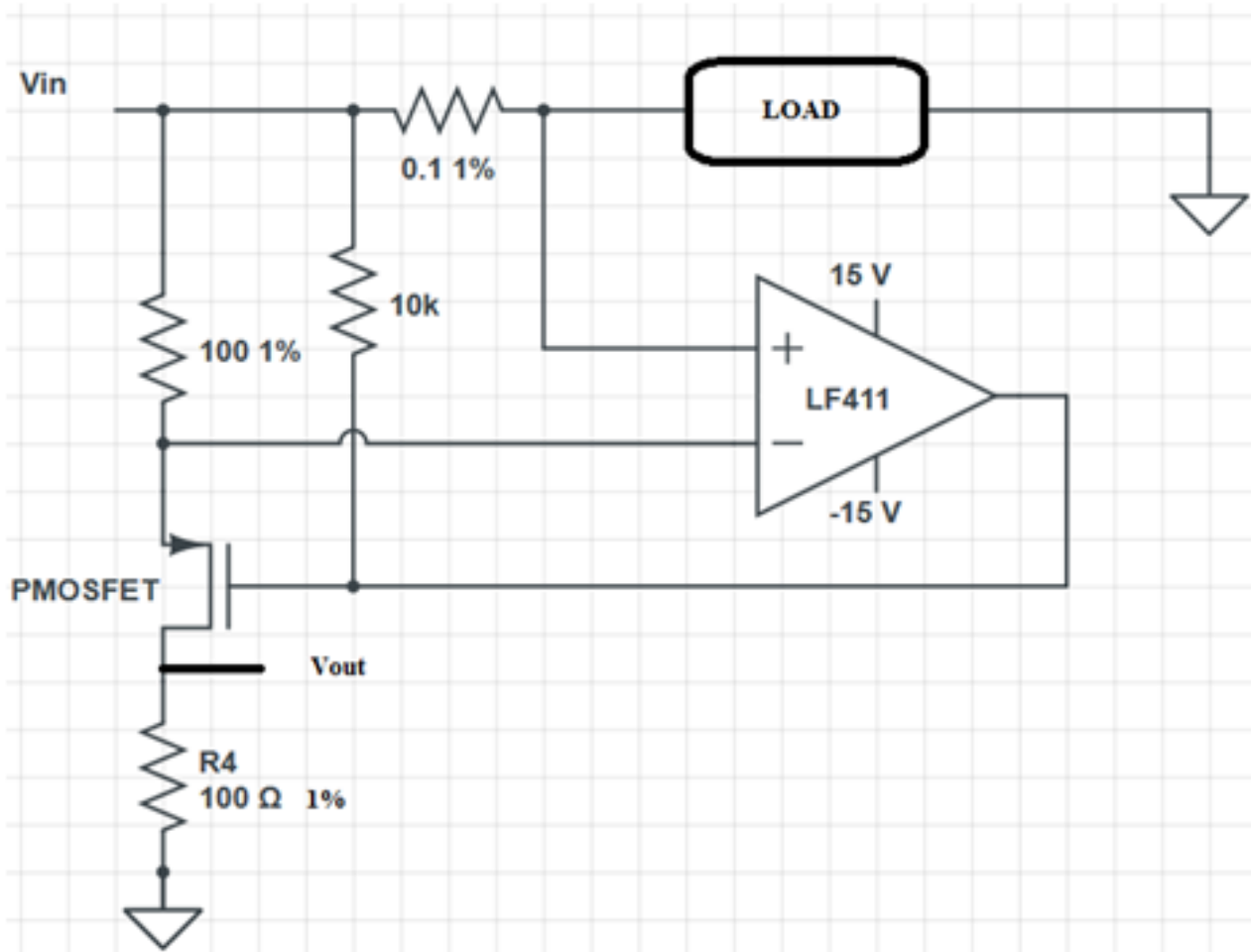- max # of 4

Home-made Sensors

Differential Amplifier

- a simple design

- The output is supposed to be

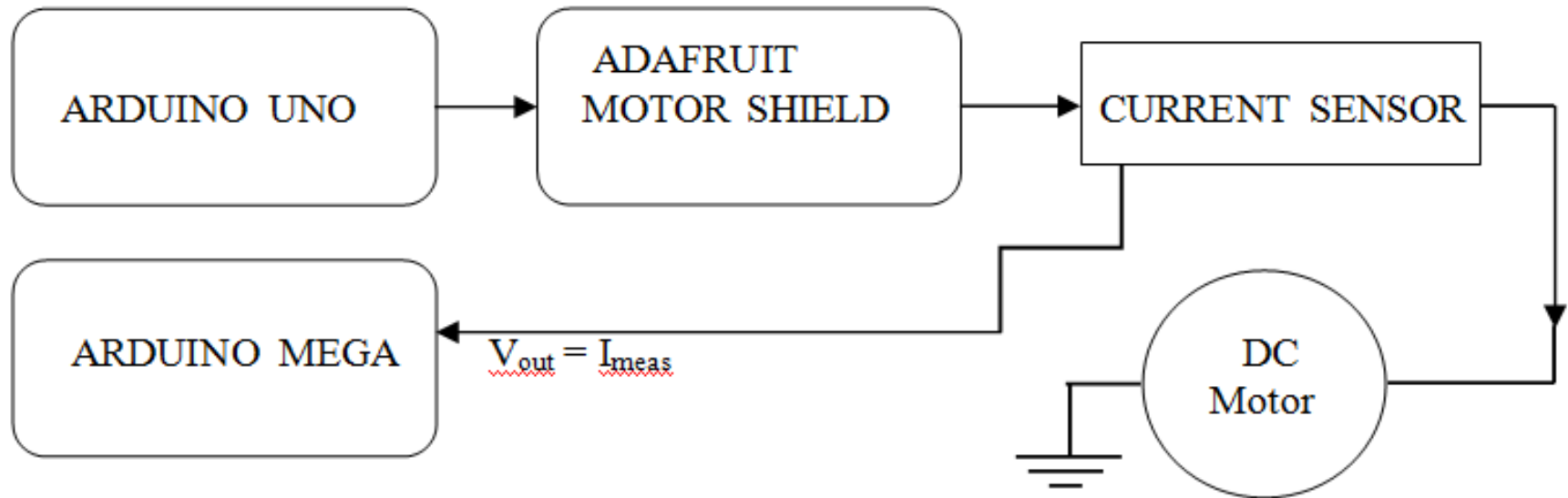 equal to current, but data showed

  otherwise

Current Monitor Circuit

- a little more complex

- The output is consistent with ammeter

  reading

Current Monitor Circuit
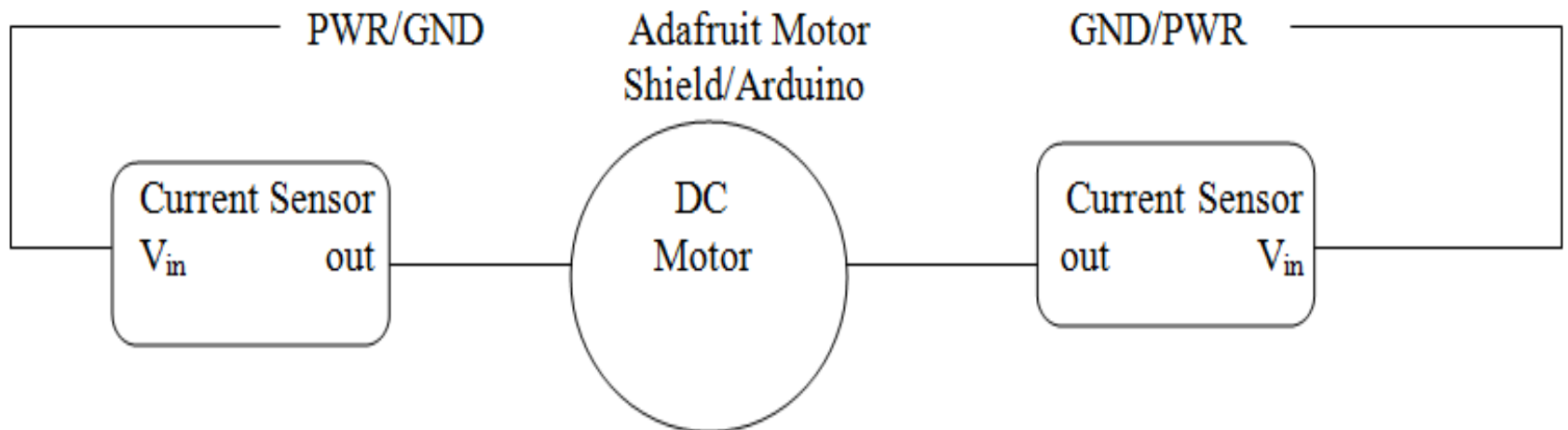
A Setup for testing Current Sensors

Measuring Current Direction

- Use ACS712

- Use 2 INA219

PWR/GND   Adafruit Motor   GND/PWR
Shield/Arduino

Current Sensor

V_{in} out

DC
Motor

Current Sensor

out V_{in}

Future Experiments

- Further characterization of current monitor circuits

   - some of the 411 op amps are defective
   - good thing that it is easy to swap them out

- Test ACS712 on a servo's DC motor

- Test two INA219 for current & its direction

Summary

- Home-made circuits are easy to fix and great for tinkering, but may not always be reliable.

- Pre-made current sensors, especially ACS712, seems promising

- The detailed data will help in gait analysis, which can help design fitness exercises or better training for increased power.

Conclusion

- Home-made circuits are back-up plans in
 case commercial ones fail to work.

- Commercially available current sensors,
 like ACS712 or INA219, can be tested on
 the testing setup.

- Gait Analysis on a robot can benefit
 ordinary people and serious athletes