**What is it?**

The Micycle is a self-balancing electric unicycle (SBU). While a regular unicycle is pedal-powered and is kept upright by the skill of the rider, the Micycle is powered by an electric motor and uses a control system to keep itself upright. The rider simply leans forward to accelerate, leans back to brake, and turns by applying pressure on the foot rests.

**Why build it?**

The Micycle has several advantages over regular unicycles and bicycles.
- Great for commuter travel — fits in trains, lifts and office cubicles.
- With a 30 minute learning time, anyone can learn to ride.
- Fun to ride and much cooler than a Segway™.

**How does it stay upright?**

The microcontroller tries to keep the frame angle at zero degrees (akin to keeping the wheel underneath the seat). It follows this basic process:
1. Read the current tilt angle input from the inertial measurement unit (IMU).
2. Calculate the error by comparing the tilt angle to the desired angle.
3. Multiply this difference in angle by a preset value (a gain).
4. Send this as a torque command output to the motor controller.

This process is repeated 300 times every second to form the control loop. The control loop also takes into account the frame angular velocity and acceleration to provide better predictive performance.

**The control loop**

**Specifications**
- **Weight:** 25 kg
- **Max. load:** 100 kg
- **Top speed:** 20 km/hr
- **Battery life:** 1 hr
- **Recharge time:** 2 hr
- **Cost:** $2800

**Safety features**
- Fall detection and automatic shut-off.
- Speed limiting via increased angle bias.
- Auditory warnings on motor saturation.
- Visual low battery warnings.
- Electrical connection fail-safes.

**Future work**
- LED lights for enhanced visibility.
- Migrate to smaller microcontroller.
- Automated weight sensing and performance adjustment.
- Polishing and paint work.
- Implementation of data logging and analysis.

**Components**

- **Microcontroller (hidden)**
  - Performs balancing and auxiliary functions.
  - **Weight:** 0.2 kg
  - **Cost:** $130

- **Unicycle Seat**
  - **Weight:** 0.3 kg
  - **Cost:** $60

- **Frame**
  - **Material:** Aluminium alloy
  - **Weight:** 11 kg
  - **Cost:** $50

- **Battery**
  - **Type:** LiFePO4 — 36 V, 10 A
  - **Weight:** 3.7 kg
  - **Cost:** $440

- **Motor Controller**
  - Regulates the motor current.
  - **Weight:** 0.2 kg
  - **Cost:** $600

- **Hub Motor**
  - Converts electrical current to driving torque.
  - **Weight:** 7 kg
  - **Cost:** $540

- **Tyre and Tube**
  - Traction and impact absorption.
  - **Weight:** 0.3 kg
  - **Cost:** $50

- **Spring**
  - Centres the steering arm.
  - **Weight:** 0.7 kg
  - **Cost:** $100

- **Steering Damper**
  - Reduces steering vibrations.
  - **Weight:** 0.1 kg
  - **Cost:** $50

- **Foot Rests**
  - Rider uses feet to steer.
  - **Weight:** 0.2 kg
  - **Cost:** $20

**Sponsored by:**

Maxon Motor Australia

**Students:** David Caldecott, Andrew Edwards, Matthew Haynes, Miroslav Jerbic, Andrew Kadis and Rhys Madigan. **Supervisor:** Dr. Ben Cazzolato