Resistive Touchscreen

- Investigate a resistive touchscreen
  - Something that actually was used for a long time!
- Use voltage as a signal to determine position of touch
  - How?
**Resistive Touchscreen**

- Physical touch results in physical contact between top and bottom layers
- Voltage dividers allow us to compute touch location

EX: Nokia N900, Nokia N97 Mini, LG Optimus, LG GW620, Nintendo DS™
Tools for today:

● Launchpad - measuring device & providing power
● Voltage dividers
  ○ How we will detect location
● Falstad
  ○ Circuit simulation, has virtual Power Supplies and Multimeters
Touchscreen Theory (Note 13/14)

- What’s the voltage at the top?
- What’s the voltage at the bottom?
- Voltage at u2?
Touchscreen Theory (Note 13/14)

- What’s the voltage at the top?
  \( V_s \)

- What’s the voltage at the bottom?
  0

- Voltage at \( u_2 \)?
  Voltage Divider!
**Touchscreen Theory (Note 13/14)**

- **Voltage divider:**

  \[ u_2 = V_s \times \frac{kR_1}{kR_1 + R_1} \]

  \[ u_2 = V_s \times \frac{R_1(k)}{R_1(k + 1)} \]

  \[ u_2 = V_s \times \frac{k}{k + 1} \]

  Independent of the value of R!
Building it up

- What are the voltages at $u_2$ and $u_3$?

\[ u_2 = V_s \frac{k}{k + 1} \]
\[ u_3 = V_s \frac{k}{k + 1} \]

- What’s the voltage difference?

The Rs cancel out! All the matters is the proportion between the top and bottom resistors.
In fact, $u_3$ and $u_2$ are at the SAME VOLTAGE.
Building it up

- We know that $u_2 - u_3 = 0$
- **How much current goes through $R_3$?**

\[ u_2 = V_s \times \frac{k}{k + 1} \]
\[ u_3 = V_s \times \frac{k}{k + 1} \]
Building it up

- Add one more resistor divider...
- We get our touchscreen!
Poll time!

What is the voltage at u4?
- 0V
- Same as u2
- None of the above

How much current is flowing through Rh2?
- 0A
- Non-zero current
Poll time!

What is the voltage at u4?
- 0V
- Same as u2
- None of the above

How much current is flowing through Rh2?
- 0A
- Non-zero current
Building it up

- But how do we measure the voltage?
- Our finger can press down on a point, but we need the voltage measurement!
Building it up

- We can add another (ungrounded) mesh!
- If we connect the mesh at the point we touch, we get the voltage!
- Why specifically a mesh? We’ll see in a bit.
Resistive Touchscreen - 2 Layers

Bottom Layer: Resistive Layer
Resistive Touchscreen - 2 Layers

Top Layer:
Flexible Resistive Layer
What’s the difference?

- Nothing
  - The ink is a bunch of resistors
    - The resistor values don’t matter because we showed only the proportions matter for this circuit
  - Their circuit diagrams are the same
- One is flexible so we can actually move it to make contact
- We use two so that we can measure with one and apply voltage to the other without changing our circuit
Computing a Location

- Measure some voltages, compute location based on value
- Can you find any two horizontal locations that would output the same voltage?
- What about vertical?
Computing a Location

- We can only determine vertical position.
- What about the other orientation? What if we turned it sideways?
Computing a Location

- Let’s turn it sideways
  - Apply voltage so we power the horizontal direction
  - Find “vertical” location in horizontal orientation
- This gives horizontal location
Computing a Location

- If we take two readings, one in each dimension can uniquely determine our location in 2D
- More on this in the lab notebook
Taking the Limit

- 9 touch points is kinda... meh
- How do we get more?
Taking the Limit

- Add more resistors!
Taking the Limit

● But what if I don’t want to increase the size of the circuit?
  ○ Add more, but make the resistors smaller!

● What happens as the resistors approach infinitely small sizes?
  ○ Isn’t that just a resistive sheet?
  ○ This is how all resistive touchscreens work
  ○ Review lecture note_12, note_13, note_14
Simulating Touchscreens

- Falstad simulator (http://tinyurl.com/y8pms37j)
  - Will be used in this lab to simulate resistive dividers in upper and bottom plates
Pointers

● If you do NOT have pre-stripped breadboarding wires:
  ○ Strip wires using wire cutter (if you have one)
  ○ Use male-male jumper wires (recommended option, if you do not have a wire cutter)
  ○ Strip wires using scissors/kitchen knife (at your own risk)

● Watch instructional videos in the notebook if you are doing option 2 or 3

● If none of these options work, you can still get checked off!