FLY-ROD ACCESSORY PACK
PRESENTED AS A HONORS PROGRAM SENIOR PROJECT

A Senior Design Project by Rob Streeter and Kurtis Buck
Overview

- General Project Description
- Sub-system Highlights
- Total Cost Breakdown
- Q / A
General Description

- Heated guides
- Fish metrics
- Air temperature
- Intuitive display
Design Specifications

- Heated guides
- Temperature sensing (within ±1 °F)
  - Range is different from original specs, now 0-110° F
- Fish weight (within 0.25 lbs)
- Fish length (within 0.5 inches)
- Low battery indicator (105% minimum required voltage; 12.8 Volts)
  - The last four are displayed on an LED display
    - Temperature displays in 5° increments
Sub-system Highlights - Power

- 3 regulated voltage levels
  - +5 V DC (7805 regulator)
  - +12 V DC (7812)
  - -12 V DC (7912)

- Voltage provided by four 9V batteries, center tapped to provide positive and negative voltage levels.

- Design taken from datasheets for the regulators
Sub-system Highlights – Power Circuit Schematic

-12 Volt Regulator (7912)

+12 Volt Regulator (7812)

+5 Volt Regulator (7805)
Sub-system Highlights – Heated Guides

- Many Attempts
  - Frostex Heat Tape
  - Minco
  - Transistors
    - 2SD313
    - 2N5682
    - 2N3617

- Found the 2SD313 to be the best choice
Sub-system Highlights – Heated Guides
Circuit Schematic and Testing

- Initial testing of 2SD313
  - 10 minutes ON, 52°F temperature gain
  - Used 30V and 1A during this period
  - $P_D = 6.94 \text{ W}$, $P_{D\text{max}} = 22.97 \text{ W}$

- All measurements have shown to be well within safe ranges given in data sheets
Sub-system Highlights – Heated Guides Experiment
Sub-system Highlight - Microcontroller

- ATtiny861 chip
  - Upgrade from the ATtiny261 we originally used
  - Power-efficient
  - Small (20 pin DIP package)
  - Included all necessary features
    - 8kB Flash memory
    - 6 channel, 8-bit ADC
    - Numerous general I/O pins
Sub-system Highlights — Fish Metrics

- Length with a Celesco SP1-25 String-Potentiometer
  - Most expensive component
  - Very easy interface to controller

- Weight with a Omega LCL-010 Load Cell (Strain Gauge)
  - More complicated interface circuit — used a template interface discussed in EE 4390
Sub-system Highlights – Fish Metrics

Circuit Schematics (String Pot)

- Image taken from datasheets
- Voltage divider design
Sub-system Highlights – Fish Metrics
Circuit Schematics (Load Cell)

AD620 Instrumentation Amp
OP177 Operational Amp
Voltage Divider for biasing

LoadC

+12V
GND

To μCtrl ADC Channel
Sub-system Highlights – LED Display

- 2 rain-gauge style displays
  - Increases the range of values for display
  - Avoids cold-weather issues with LCD displays
  - Easy to visualize, digitally controlled circuit

- Low-voltage indicator light
  - Transistor switch controlled
Sub-system Highlights – LED Display Circuit Schematic

- **+5 V**
- **μCtrl Control Line**
- **μCtrl Data Lines**
- **GND**
- **μCtrl Control Line**
- **2-to-4 Line Decoder (74139)**
- **4-to-16 Line Decoder (74154)**
- **2N3904 Transistor**
- **Connector to LED board**
Sub-system Highlights – LED Display

Circuit Schematic (page 2)

- Low battery Voltage Indicator LED
- Secondary, 4 LED Display
- Connector to main board
- Primary, 10 LED Display

LED board pictured measures 5.5” x 1.5”
Entire System Circuit Schematic
(Except LED Board)

- Power Supply Circuitry
- ATtiny861
- LED Display Circuitry
- Load Cell Circuitry
## Design Specifics – Part Costs

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontrollers</td>
<td>4 @ $3.00 each = $12.00</td>
</tr>
<tr>
<td>Heating Element(s)</td>
<td>3 different possibilities totaling $11.88</td>
</tr>
<tr>
<td>String Potentiometer</td>
<td>2 @ $138.00 each = $278.00</td>
</tr>
<tr>
<td>Load Cell + mounting hardware</td>
<td>$85.00</td>
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<tr>
<td>Batteries</td>
<td>$16.88</td>
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<tr>
<td>Other Components (provided by the ECE Department shop)</td>
<td>~$45.00</td>
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<tr>
<td>Total project cost (minus fly rod and shipping)</td>
<td>$448.76</td>
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$310.76 with only one string-pot
Major Issues

- Heating Elements
  - Tried several options before finding one that had potential
  - Cost-limited by one company (minimum order price of $250.00)
Major Issues

- Moving to a PCB from the breadboard
  - Design was fully-functional on a breadboard
  - Mistakes in PCB design
    - More difficult to fix than on a breadboard
  - More difficult to test than a breadboard circuit
Future Work

- Streamline guide heating
- Data storage
- Eliminate external wiring between hip-pack and rod
- Weather-proof the hip-pack

- Separate heat from fish metrics for two separate products
Acknowledgements

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Questions?