Cypress Semiconductor: Arduino “Friendly” PSoC Shield

Proposal Presentation

ECE 480 Design Team 1
Cecilia Acosta
Brett Donlon
Matt Durak
Aaron Thompson
Nathan Ward

Faculty Facilitator
Dr. Robert McGough

Sponsor
Cypress Semiconductor
Patrick Kane
Outline

• Goals
• Background
• Hardware and Software Component
• Diagrams
• Applications
• Project Management
• Questions
Goals

• **Expand Cypress Market base**
  o Interface PSoC5 with Arduino Ethernet Shield
  o Design a PCB to interface PSoC5 to all Arduino Shields.
  o Demonstrate capabilities by creating a mini web server and interfacing with other hardware.
Background

- **PSoC:**
  - Programmable System on Chip, also called a mixed system array.
  - Contains a CPU and programmable hardware.
  - Has sub systems on a single chip. The systems and the connections between them are configured to achieve a system on chip.
  - Used to build embedded systems.
Background

• **Arduino:**
  - Open-source physical computing platform based on a simple microcontroller board.
  - Includes a software development.
  - Can be connected to one or more daughterboards, known as shields.
  - Until recently Arduino was a hardware platform for hobbyists and students, but now it has been endorsed by Google as an Android Development Platform.
Hardware

- **PSoC 5: CY8CKIT-014 FirstTouch Starter Kit**
  - ARM Cortex M3 processor
  - Serial Wire Debugging, Accelerometer, Thermistor, Proximity Sensing, CapSense® touch-sensing, 12-pin wireless module header, 28 general purpose I/O pins (GPIOs)

http://www.cypress.com/?rID=43674
Hardware

- **Arduino Ethernet Shield:**
  - Standard RJ-45 connection
  - Wiznet W5100 ethernet chip
    - Implements IP stack including TCP/UDP
  - MicroSD card slot
  - SPI bus shared by Ethernet and MicroSD

- **Motor Control Shield:**
  - Controls DC motors
  - Will be used to demonstrate design’s compatibility with other Arduino shields
Hardware

- **PCB**: Printed Circuit Board
  - Used to support and connect electronic components.
  - These boards are widely used in electronics.
  - They are inexpensive and very reliable.
  - In our case the PCB will connect the PSoC 5 to the Arduino Shields.
Software

- PSoC Creator
  - Development environment
  - Schematic design of hardware components
  - IDE for C, generates C API’s for components
Software

- Arduino libraries
  - Used by Arduino and Arduino Shields
    - Atmega328 with 32KB of flash for the standard board
  - Written in C++
Component Diagram

SOFTWARE

PSoc Creator

Personal Computer

Program

HARDWARE

PSoc

Custom PCB

Ethernet Shield

HARDWARE

LED

Motor

Resistor

Capacitor
FAST Diagram
Applications

- Turning an LED on and off over the internet.
- Reading a message on a webpage and then sending the message to the SD card.
- Writing a message from the SD card to a website.
- Integration with social media; Sending messages or data retrieved by the PSoC to Twitter
Feasibility Matrix

<table>
<thead>
<tr>
<th>Engineering Criteria</th>
<th>Possible Hardware Solutions</th>
<th>Possible Software Solutions</th>
<th>Possible Software Demos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S1</td>
<td>S2</td>
<td>S3</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Totals</td>
<td>45</td>
<td>51</td>
<td>55</td>
</tr>
<tr>
<td>Normalized Totals</td>
<td></td>
<td>2.55</td>
<td>3.055556</td>
</tr>
</tbody>
</table>

9 = Best, 1 = Worst

**Hardware Component**
- Connect PSoC to shield via protoshield S1: This setup has already been completed
- Connect PSoC to shield via a custom PCB (stacked) without enclosure S2: Involves creation of a PCB similar to the protoshield
- Connect PSoC to shield via a custom PCB (stacked) with enclosure S3: Stacked design may prove difficult to mount due to irregular structure
- Connect PSoC to shield via a custom PCB (side by side) with enclosure S4: Placing the PSoC and shield side by side may be easier to mount

**Software Component**
- Create ethernet and SD software from scratch S5: Allows for custom design, but involves more coding
- Port ethernet and SD software from Arduino libraries S6: Involves research and debugging of pre-made code, but platform independent code can be reused easily
- Include demos from Arduino S7: Demo code available and fairly platform-independent
- Include custom demos S8: Requires more research, may yield more impressive results
### Risk Analysis

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Description</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and fabrication of PCB extends beyond delivery date</td>
<td>Major, Low Likelihood</td>
<td>Low (5)</td>
</tr>
<tr>
<td>Difficulty porting Arduino libraries to PSoC Creator Environment</td>
<td>Serious, Low Likelihood</td>
<td>Moderate (8)</td>
</tr>
<tr>
<td>Server application demo development issues</td>
<td>Serious, Low Likelihood</td>
<td>Moderate (8)</td>
</tr>
</tbody>
</table>

#### Risk Legend

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Low (Green)</th>
<th>Moderate (Yellow)</th>
<th>High (Red)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near Certainty</td>
<td>≤ 5</td>
<td>≥ 5, ≤ 12</td>
<td>≥ 12</td>
</tr>
<tr>
<td>Highly Likely</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likely</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Likelihood</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extremely Improbable</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Task Description

- **Design and fabrication of PCB**
  - Description: Extends beyond delivery date
  - Likelihood: Low
  - Impact: Low
  - Risk: Low (5)

- **Difficulty porting Arduino libraries**
  - Description: To PSoC Creator Environment
  - Likelihood: Low
  - Impact: Moderate
  - Risk: Moderate (8)

- **Server application demo development issues**
  - Description: Serious
  - Likelihood: Low
  - Impact: Moderate
  - Risk: Moderate (8)
# Gantt Chart

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
<th>Predecessors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Compatibility</td>
<td>52 days</td>
<td>Mon 9/12/11</td>
<td>Tue 11/2/11</td>
<td></td>
</tr>
<tr>
<td>Layout Planning</td>
<td>6 days</td>
<td>Mon 9/12/11</td>
<td>Mon 9/19/11</td>
<td></td>
</tr>
<tr>
<td>Bread Board Connect</td>
<td>5 days</td>
<td>Mon 9/19/11</td>
<td>Fri 9/23/11</td>
<td>2</td>
</tr>
<tr>
<td>Soldering to Proto Box</td>
<td>2 days</td>
<td>Fri 9/23/11</td>
<td>Mon 9/26/11</td>
<td>3</td>
</tr>
<tr>
<td>PSoC Pin Programming</td>
<td>5 days</td>
<td>Tue 9/27/11</td>
<td>Mon 10/3/11</td>
<td>4</td>
</tr>
<tr>
<td>PCB Design</td>
<td>16 days</td>
<td>Tue 10/4/11</td>
<td>Tue 10/25/11</td>
<td>5</td>
</tr>
<tr>
<td>PCB Development</td>
<td>20 days</td>
<td>Wed 10/26/11</td>
<td>Tue 11/22/11</td>
<td>6</td>
</tr>
<tr>
<td>LED Test</td>
<td>4 days</td>
<td>Fri 10/7/11</td>
<td>Wed 1/11/11</td>
<td>5</td>
</tr>
<tr>
<td>Web Server Development</td>
<td>27 days</td>
<td>Mon 10/3/11</td>
<td>Tue 11/3/11</td>
<td></td>
</tr>
<tr>
<td>Port Arduino to PSoC</td>
<td>6 days</td>
<td>Mon 10/1/11</td>
<td>Mon 10/10/11</td>
<td>10</td>
</tr>
<tr>
<td>Ethernet Firmware</td>
<td>6 days</td>
<td>Tue 10/11/11</td>
<td>Tue 10/18/11</td>
<td>10</td>
</tr>
<tr>
<td>Server Application Dev</td>
<td>15 days</td>
<td>Wed 10/19/11</td>
<td>Tue 11/8/11</td>
<td>11</td>
</tr>
<tr>
<td>SD Card Firmware</td>
<td>6 days</td>
<td>Tue 10/11/11</td>
<td>Tue 10/18/11</td>
<td>10</td>
</tr>
<tr>
<td>SD Card Write Demo</td>
<td>15 days</td>
<td>Wed 10/19/11</td>
<td>Tue 11/8/11</td>
<td>13</td>
</tr>
</tbody>
</table>
# Project Management

<table>
<thead>
<tr>
<th>Team Member</th>
<th>Technical Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaron</td>
<td>PSoC Creator Pin Configuration and Design</td>
</tr>
<tr>
<td>Matt and Nate</td>
<td>Porting Arduino Ethernet code, SD Card code</td>
</tr>
<tr>
<td>Brett</td>
<td>Power consumption analysis and Soldering</td>
</tr>
<tr>
<td>Brett and Cecilia</td>
<td>PCB Design, Packaging, Pin Configuration and design</td>
</tr>
</tbody>
</table>
### Budget

- $500 allocated
- Proposed design solution will stay well under the allocated funds
- Cypress provided Team 1 with two PSoC First Touch kits

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arduino Ethernet Shield</td>
<td>$46.72</td>
</tr>
<tr>
<td>Sparkfun Arduino ProtoShield Kit</td>
<td>$20.51</td>
</tr>
<tr>
<td>PCB Fabrication (approximation)</td>
<td>$70.00</td>
</tr>
<tr>
<td>Arduino Motor Shield</td>
<td>$19.25</td>
</tr>
<tr>
<td>Additional Hardware (Headers, etc.)</td>
<td>$5.00</td>
</tr>
<tr>
<td>Packaging (Approx.)</td>
<td>$30.00</td>
</tr>
</tbody>
</table>

**TOTAL: $191.48**