Wireless Oximetry

BME 200/300 Design
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Overview

- Pulse Oximetry

- Motivation

- Requirements

- Current Devices & Concepts

- Power

- Wireless

- Hardware

- Next Steps

- Acknowledgements

Pulse Oximeter

- Non invasive medical device

- Measures

  - Oxygen saturation

  - Pulse

Pulse Oximetry

- Different wavelenghs of light absorbed differently by oxygenated hemoglobin
  - Red
  - Infrared (IR)
- Probe has LEDs and photodiode
  - Transmission
  - Reflectance

Pulse Oximetry

- Observing peaks in signal yields pulse

- Blood oxygen saturation
  - Ratio of red signal to infrared
  - Lookup table gives number

Clinical Applications

- Anesthesia

- Post Anesthesia Care Unit

- ICU

- Neonatal

- Transport

- Diagnostic Lab

Motivation

- Children & babies are indiscriminant of cable

    - Will remove probe via cable

- Would allow for a bigger range of motion

- Utilize existing hardware

- Could also be used for adults (i.e. exercise studies)

    - Not main intention

Requirements

- Device should have minimal
  - Cost (under $500.00)
  - Power consumption
  - Size
  - Weight (under 70g)
- Aim: no data loss in ADC/DAC conversions
- Should have self-contained power supply of at least 5 hours
- Must interface with existing hardware

Current Devices & Concepts

Contec

- Asian based company with multiple oximetry devices that display readings directly on the probe
- Some of these products have Bluetooth capabilities that allow the data to be transferred to a computer source

Nonin

- Another popular oximeter manufacturer
- Has similar solutions as Contec but at (~$500 price range)
  - Can connect with many Bluetooth devices
  - Cell phone PDA, laptop etc.
- Model with wrist attachment (Bluetooth) $1500.00

Current Wireless Oximeters

- Neither of these companies have a modular attachment for an existing wired device

Power

Power Needs

- At least 5 hours of continuous running time

- At least 5V

- Minimal weight/size

Traditional Alkaline (AAA)

- Advantages
  - More capacity
  - Inexpensive
- Disadvantage
  - Lower voltage
  - Heavier
  - Disposable

http://www.pizzazz-retail.co.uk/index.php?main_page=popup_image&pID=299

Lithium Ion Rechargable

- Advantages
  - Higher voltage
  - Lightweight
  - Reusable
- Disadvantages
  - Lower capacity
  - Expensive

http://www.batteryspace.com/ProductImages/charger/RCR_comb.jpg

Design matrix

- General information regarding the batteries

Wireless

WiFi

- Advantages
  - High bandwidth
  - ~100 meter range
  - ~50 Mbps transfer rate
  - Computer interfacing
- Disadvantages
  - Power consumption
  - Software required
  - Hardware required (adapter, router, access point)

Bluetooth

- Advantages
  - License free
  - Lowest cost (~$75)
  - "Channel hopping" avoids interference
  - Low power consumption
- Disadvantages
  - ~10 meter range
  - ~1 Mbps data transfer rate
  - Security

Zigbee

- Advantages
  - Lowest power consumption
  - Ad-Hoc network configuration
  - Fast network connection
- Disadvantages
  - New technology
  - ~10 meter range
  - ~250 kbps transfer rate
  - Highest cost (~$250)

Infrared

- Advantages
  - Low power consumption
  - No software
  - Ad-Hoc network configuration
- Disadvantages
  - Range (requires line of sight)
  - Low level of security
  - ~20 kbps transfer rate
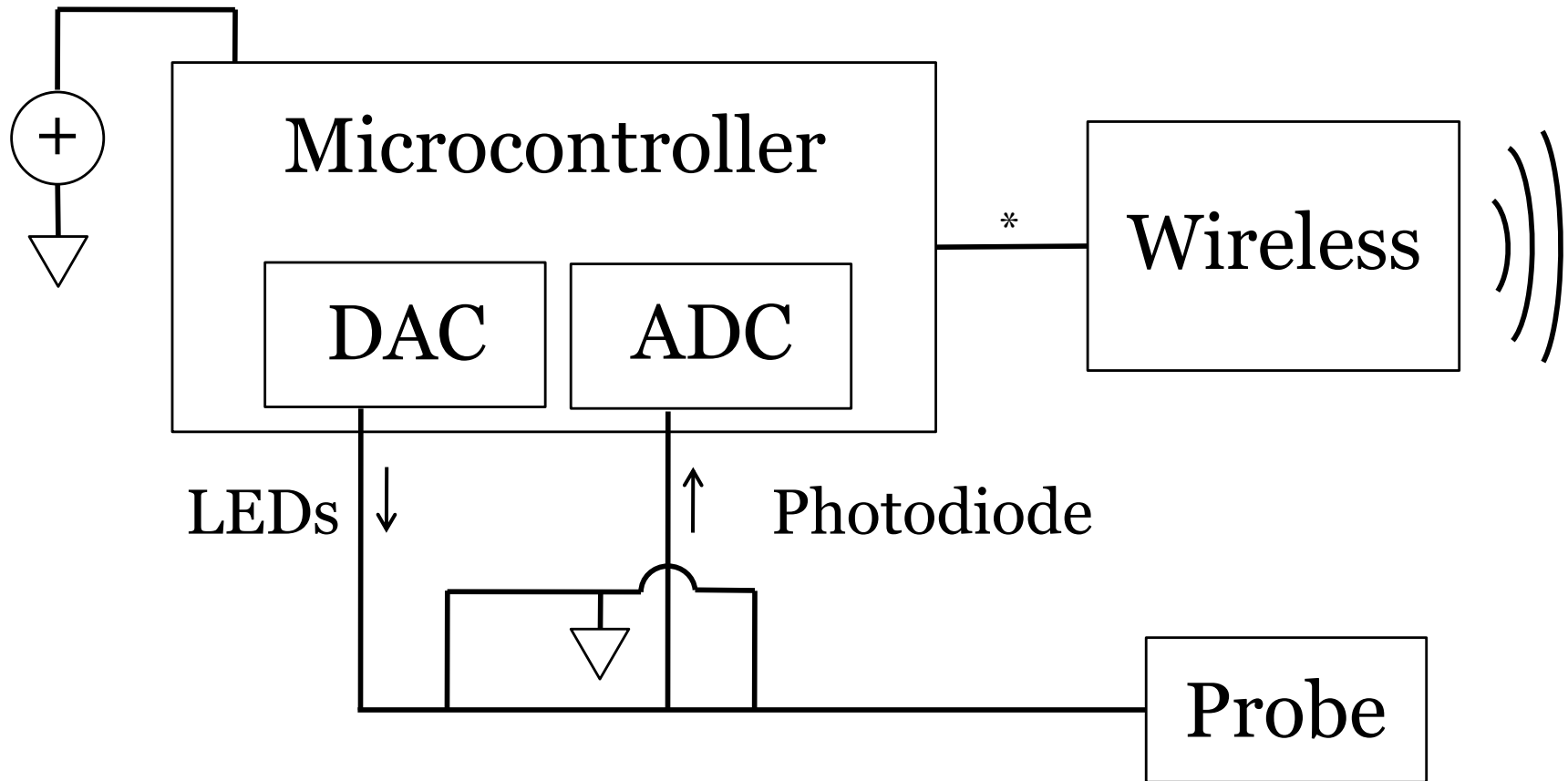 - Interference from ambient light

Design Matrix

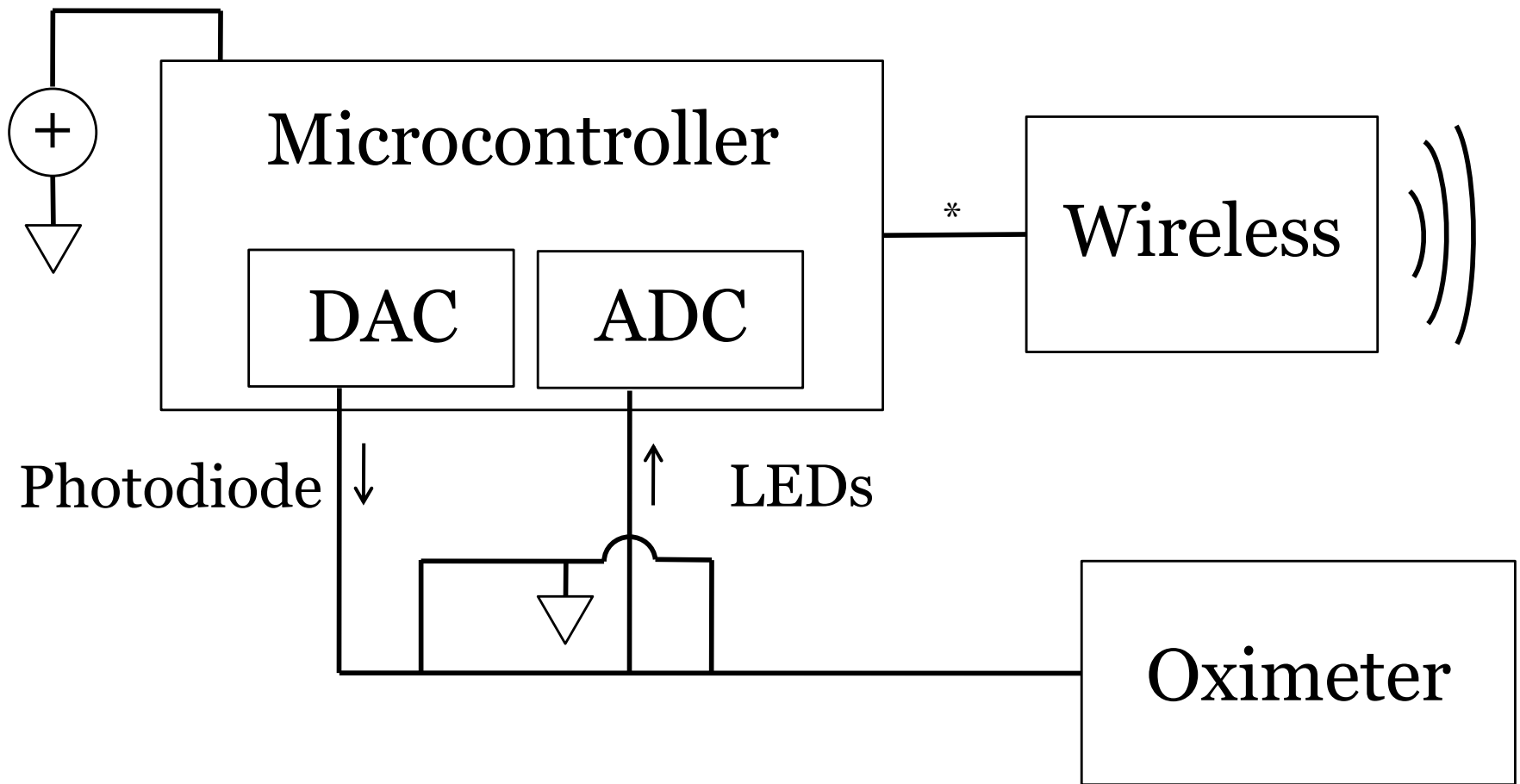|	Bluetooth	WiFi	Zigbee	Infrared
Power Consumption (25)	20	10	25	20
Size (15)	15	5	15	10
Programming Feasibility (35)	30	35	25	25
Bit Rate (5)	4	5	3	3
Cost (20)	20	10	10	5
Total (100)	**89**	**65**	**78**	**63**

Hardware

Schematic - Probe

* Method of data transfer dependent on wireless method and chip chosen

Schematic - Oximeter

Photodiode ↓

↑ LEDs

Microcontroller

DAC

ADC

Wireless

Oximeter

* Method of data transfer dependent on wireless method and chip chosen

Considerations

- Microcontroller
  - Should have both ADC and DAC of sufficient resolution
  - Will need to power probe
  - Should allow for In-Circuit Serial Programming (ICSP)
  - Given schematics does not include all necessary components

Considerations

- Wireless
  - Both need to be paired
  - Bidirectional communication necessary
- Power
  - Oximeter dongle – powered by oximeter?
  - Probe dongle – will need "external" power source

Next Steps

- Continue testing on pulse oximeter

- Begin testing Bluetooth chips

- Pick microcontroller to fit needs

- Prototype

Acknowledgements

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References

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Questions