A Microcontroller-based, Optically-centric Communication System

for Underwater Applications

A thesis submitted to the

Graduate School\*\*

of the University of Cincinnati

in partial fulfillment of the degree of

Master of Science

in the Department of Electrical Engineering and Computer Science

of the College of Engineering and Applied Science

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July 2017

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Abstract

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* Literature Review
  + EM Attenuation (interaction of light in salt/fresh water
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    - Absorption and scattering (forward and backward) coefficients of clear natural waters
  + Controls (theory and past research on alignment using a QP)
* Theoretical Analysis
  + Comparison of different visible wavelengths viability with regard to absorption and scattering effects found in literature review
  + Calculations/graphs of relative intensity for discrete wavelengths after attenuation and beam divergence
  + Discussion of component selection on above results (photodiode response, laser diode availability/power)
* System Design
  + High level system design and integration with OpenROV
  + MCU
    - PIC32MX selection
    - Description of all modules utilized (like Purva)
  + TX Module
    - Omit any information about laser diode and lens selection
  + RX Module
    - Transimpedance amplifier
    - Pre-ADC filtering
  + Modulation design, framing, and timing
  + Firmware descriptions
    - TX and RX logic and flowcharts
    - State machine diagrams for handshaking
  + Power supply
    - Reverse engineering of OpenROV and its power supplies
    - Analysis of PIC32MX Clicker 2 board’s power supplies
  + Optics board schematic and PCB
* Results
  + Experimental setup(s)
    - Ambient lighting conditions
    - Air/water transmission medium
  + BER as a function of distance
  + Pictures of final system and demo using a filmstrip-like display
* Conclusion and Future Work

Abstract

(<500 words)\*\*

# Acknowledgements

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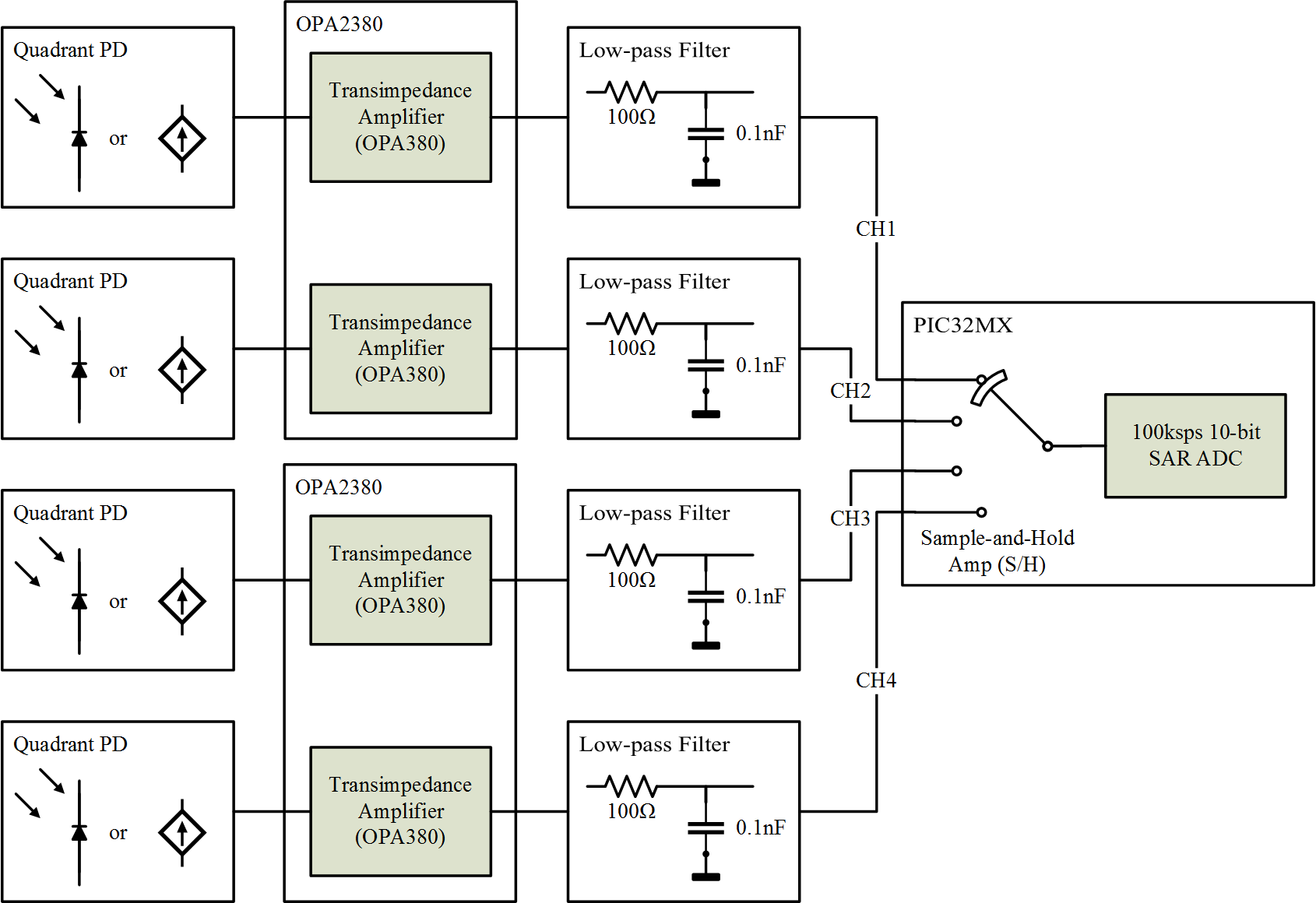
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# List of Abbreviations

|  |  |
| --- | --- |
| ADC | Analog-to-Digital Converter |
|  |  |
|  |  |
|  |  |
| DAC | Digital-to-Analog Converter |
|  |  |
|  |  |
|  |  |
| MCU | Microcontroller Unit |
| PD | Photodiode |
| PWM | Pulse-Width Modulation |
| QP | Quadrant Photodiode |
|  |  |
|  |  |
| SAR | Successive Approximation |
|  |  |
|  |  |
|  |  |

# Introduction

# Importance and Background

## Communication on a water planet

Conversation about the lack of availability of a high-bandwidth communication technique in oceanic environments

## Applications

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Wearable devices

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