

# Contents

<b>Introduction</b>	<b>1</b>
<b>1 Background and State of the Art</b>	<b>3</b>
1.1 Vehicular Networks	3
1.1.1 Architecture of Vehicular Ad-hoc Networks (VANets)	4
1.1.2 Standards for VANets	5
1.1.3 Need for New Alternative and Hybrid Schemes for VANets	5
1.2 Visible Light Communications applied to VANets	6
1.2.1 Vehicular Optical Wireless Channel Modeling	6
<b>2 Materials and Methods</b>	<b>10</b>
2.1 Software Defined Radios	10
2.1.1 Ettus Research (National Instruments) - Universal Software Radio Peripheral (USRP)	11
2.1.2 GNU Radio SDR Programming Software	11
2.2 VLC Channel Elements	12
2.2.1 Signal Combining Circuit for LED	12
2.2.2 Thorlabs PDA36A Photodetector (PD)	13
2.3 Vehicle Control and Automation Communication Technologies	14
2.3.1 Control Area Network Bus (CAN Bus) Interfaces	14
2.4 Arduino Nano: Open Source Microcontroller and Serial Interface	15
<b>3 Implementation</b>	<b>17</b>
3.1 CAN Module Implementation	18
3.2 VLC Link Implementation	20
3.2.1 SDRs Hardware and Software Configuration	20
3.2.2 Signal Combining Circuit Implementation	22
<b>Conclusion</b>	<b>22</b>
<b>Bibliography</b>	<b>28</b>
<b>Appendix A: List of Publications</b>	<b>29</b>
<b>Appendix B: Codes</b>	<b>30</b>