

## TABLE OF CONTENTS

<b>Chapter No.</b>	<b>Title</b>	<b>Page No.</b>
	<b>List of Tables</b>	xi
	<b>List of Figures</b>	xiii
	<b>List of Abbreviations</b>	xvii
	<b>Abstract</b>	xx
<b>1</b>	<b>INTRODUCTION</b>	
1.1	Endoscopy	1
1.2	Artefacts	5
	1.2.1 Saturation	6
	1.2.2 Specular Reflections	6
	1.2.3 Blur	7
	1.2.4 Contrast	8
	1.2.5 Instrument	9
	1.2.6 Bubbles	9
	1.2.7 Blood	10
	1.2.8 Miscellaneous Artefacts	11
1.3	Artificial Intelligence	12
	1.3.1 Popular Object Detection Algorithms	13
	1.3.2 Image Segmentation	15
	1.3.3 Classification of Segmentation Algorithms	16
1.4	Artificial Intelligence in the Field of Endoscopy	18
1.5	Motivation of the Research	19
1.6	Objectives of the Research	20
1.7	Contribution of the Thesis	20

<b>Chapter No.</b>	<b>Title</b>	<b>Page No.</b>
1.8	Organization of the Report	21
<b>2</b>	<b>LITERATURE REVIEW</b>	
2.1	Introduction	23
2.2	Methodology of Review for Artefact Detection	23
2.3	History of Object Detectors	24
	2.3.1 Single Stage Object Detectors in Endoscopic Artefact Detection	24
	2.3.2 Two Stage Object Detectors in Endoscopic Artefact Detection	27
	2.3.3 Multi Stage Object Detectors in Endoscopic Artefact Detection	29
	2.3.4 Anchor Free Detectors	31
2.4	Methodology of Review for Artefact Segmentation	32
2.5	History of Segmentation Algorithm	32
2.6	Segmentation Model for Single Artefact Segmentation	33
2.7	Segmentation Model for Multiple Artefact Segmentation	34
2.8	Research Gaps Identified	38
2.9	Chapter Summary	38
<b>3</b>	<b>DATASET</b>	
3.1	Importance of the Dataset	40
3.2	Public Dataset	40
	3.2.1 EAD2019	41
	3.2.2 EAD2020	44
3.3	Curation of the Custom Dataset	46
	3.3.1 Annotation Protocols	47
	3.3.2 Annotation Software and Procedure	49
3.4	Partitioning of Dataset	51

<b>Chapter No.</b>	<b>Title</b>	<b>Page No.</b>
3.5	Data Augmentation for Artefact Detection	52
3.6	Run Time Data Augmentation Techniques for Artefact Detection	55
3.7	System Configuration	57
3.8	Statement of Ethics	57
3.9	Chapter Summary	57
<b>4</b>	<b>ENDOSCOPIC ARTEFACT DETECTOR</b>	
4.1	Introduction	58
4.2	Methodology	59
4.3	Proposed Ensemble Method for Endoscopic Artefact Detection	59
	4.3.1 YOLOv3 for Endoscopic Artefact Detection	60
	4.3.2 YOLOv4 for Endoscopic Artefact Detection	64
	4.3.3 Faster R-CNN for Endoscopic Artefact Detection	68
	4.3.4 Ensemble Model	70
4.4	Performance Metrics and Simulation Results	73
	4.4.1 Test Dataset	73
	4.4.2 Performance Metrics	73
	4.4.3 Simulation Results	75
4.5	Chapter Summary	84
<b>5</b>	<b>ENDOSCOPIC ARTEFACT SEGMENTATION</b>	
5.1	Introduction	85
5.2	Simulation Setup	85
	5.2.1 Dataset	85
	5.2.2 Data Augmentation	86
	5.2.3 System Configuration and Programming	87

<b>Chapter No.</b>	<b>Title</b>	<b>Page No.</b>
5.3	Traditional Algorithms for Artefact Segmentation	87
5.4	CNN Architecture	88
	5.4.1 Convolutional Layer	89
	5.4.2 Pooling Layer	90
	5.4.3 Fully Connected layer	91
5.5	CNN Based Image Segmentation Algorithm Under Study	91
5.6	Performance Metrics and Simulation Results	93
	5.6.1 Test Set for Artefact Segmentation	93
	5.6.2 Performance Metrics to Evaluate Traditional and DL Algorithms Under Study	93
	5.6.3 Simulation Results of Traditional and DL based Algorithms Under Study	94
5.7	Artefact Segmentation Models for Ensemble	103
	5.7.1 U-Net and Link-Net for Ensemble	104
	5.7.2 Training of U-Net and Link-Net for Artefact Segmentation	107
	5.7.3 Ensemble model for Artefact Segmentation	108
	5.7.4 Performance Metrics	110
	5.7.5 Simulation Results of Proposed DL Based Ensemble Segmentation Model	110
5.8	Chapter Summary	112
<b>6</b>	<b>ARTEFACT RESTORATION AND POLYP CLASSIFICATION</b>	
6.1	Introduction	114
6.2	Dataset	116
6.3	Artefact Segmentation	116

<b>Chapter No.</b>	<b>Title</b>	<b>Page No.</b>
6.4	Image Restoration	116
6.5	Polyp Classification	119
	6.5.1 Image Pre-Processing	119
	6.5.2 CNN Architecture	120
	6.5.3 Training	123
6.6	Performance Metrics and Simulation Results to Evaluate Polyp Classifier	124
	6.6.1 Test Set for Polyp Classification	124
	6.6.2 Performance Metrics	124
	6.6.3 Simulation Results	124
6.7	Chapter Summary	126
<b>7</b>	<b>CONCLUSION AND FUTURE DIRECTION</b>	
	<b>REFERENCES</b>	
	<b>LIST OF PUBLICATIONS</b>	
	<b>PLAGIARISM REPORT</b>	