

Contents

Table of Contents

Declaration by the Candidate	I
Certificate of Supervisor	II
Thesis Approval Form	III
Declaration by Research Scholar.....	V
Acknowledgment.....	VI
List of Figures.....	X
List of Tables	XI
ABSTRACT.....	XIII
Chapter 1	1
Introduction.....	1
1.1 Digital Image processing.....	1
1.2 Remote Sensing	1
1.3 Satellite Sensor:.....	3
1.3.1 Passive Sensors Satellites:	3
1.3.2 Active Sensors Satellite:	4
1.4 IRS (Indian Remote Sensing):	4
1.5 Remote Sensing Images	7
1.5.1 Multispectral image.....	7
1.5.2 Hyper spectral image.....	8
1.6 False Color Composite (FCC).....	8
1.7 Deep Learning.....	9
1.8 Contribution of the research work toward the problem domain	11
1.9 Objectives of the Research.....	11
1.10 Organization of the Thesis	12
References:	13
Chapter 2	16
Literature Review.....	16
2.1 Introduction	16
References:	31
Chapter 3	38
Methodology	38

3.1	Introduction	38
3.2	Land use land cover classification model.....	39
3.2.1	Data Acquisition	40
3.2.2	Preprocessing.....	41
3.2.2.1	FCC creation	41
3.2.2.2	Pre-processing of FCC:.....	42
3.2.2.3	Creation of Mask	43
3.2.2.4	Dataset.....	45
3.2.3	Identification and classification	45
3.2.3.1	Models	45
3.2.3.1.1	U-Net :	45
3.2.3.1.2	Deeplabv3+.....	48
3.2.3.1.3	Tiramisu	49
3.2.3.2	Training Sample Selection	51
3.2.3.3	Training Configuration	51
3.2.3.4	Algorithm steps	52
3.2.3.5	Final classified image.....	52
3.3	Research Methodology.....	53
References:	54
Chapter 4.....	56
Result and Conclusion.....	56
Conclusion	75
Bibliography	77
Appendix A.....	80
Plagiarism Report	80
Appendix B.....	81
Publications	81
Summary	153

List of Figures

Figure No. Name of the Figure	Pg. No.
Figure 1.1: LISS – III Multispectral image	8
Figure 1.2: False Color Composite (FCC) image	9
Figure 3.1: Land use and land cover Mapping & Classification Model	40
Figure 3.2 : GPCs Collection	41
Figure 3.3: FCC Creation	42
Figure 3.4: FCC (1024 X 1024) (256 x 256)	43
Figure 3.5: Basic concept of ML	44
Figure 3.6: Ground Truth Mask	44
Figure 3.7: U-net Architecture	46
Figure 3.8: Deeplabv3+ model. [ref: https://arxiv.org/abs/1802.02611]	49
Figure 3.9: Tiramisu Architecture [Ref https://towardsdatascience.com/review-fc-densenet-one-hundred-layer-tiramisu-semantic-segmentation-22ee3be434d5]	50
Figure 3.10 Research Methodology	53
Figure 4.1: Training logs U-Net, Dataset - 1	56
Figure 4.2: Result Predicted by the Model	56-57
Figure 4.3: Training logs U-Net, RMSprop, Dataset -1	58
Figure 4.4: Result Predicted by the Model	58
Figure 4.5: Training logs	59
Figure 4.6: Result Predicted by the Model	59
Figure 4.7: Training logs Deeplabv3+, Dataset – 1	60
Figure 4.8: Result Predicted by the Model	60
Figure 4.9: Training logs DeepLabv3+, Dataset -2	61
Figure 4.10: Result Predicted by the Model	61
Figure 4.11. Training logs U-Net, Dataset -2	62
Figure 4.12: Result Predicted by the Model	62-63
Figure 4.13: Training logs Deeplabv3+, Dataset -2	63
Figure 4.14: Result Predicted by the Model	63-64
Figure 4.15: Training logs Tiramisu, Dataset – 1	64
Figure 4.16: Result Predicted by the Model	64-65
Figure 4.17: Training Logs Tiramisu – Dataset-2	65
Figure 4.18: Result predicted by the model	66
Figure 4.19: Result Predicted by the model	66-67
Figure 4.20: Dataset-wise accuracy	68
Figure 4.21: Classification of land use land cover with different classifiers	69 – 71
Figure 4.22: Model-wise accuracy with dataset -1	72
Figure 4.23: Model-wise accuracy with dataset – 2	72
Figure 4.24: Model-wise accuracy with dataset – 3	73
Figure 4.25: U-Net Accuracy on all dataset	74
Figure 4.26: Deeplabv3+Accuracy on all dataset	74
Figure 4.27: Tiramisu Accuracy on all dataset	75

List of Tables

Table No.	Name of Table	Pg. No.
Table 3.1	Hyperparameters and other configurations used for training the model	51
Table 4.1	Experiment result	67
Table 4.2	Experiment result for dataset - 1	71
Table 4.3	Experiment result for dataset - 2	72
Table 4.4	Experiment result for dataset - 3	73
Table 4.5	Experiment result for all dataset using U-Net	73
Table 4.6	Experiment result for all dataset using DeeplabV3+	74
Table 4.7	Experiment result for all dataset using Tiramisu	74

List of Acronym

CNN	Convolutional Neural Network
FCN	Fully Convolutional Network
DTC	Decision Tree Classifier
ROI	Region Of Interest
SVM	Support Vector Machine
DL	Deep Learning
ReLU	Rectified Linear Unit
ADAM	Adaptive Moment Estimation
RMSProp	Root Mean Squared Propagation
GCP	Ground Control Point
GPS	Global Positioning System
FCC	False Color Composite
MLC	Maximum Likelihood Classifier
EM	Electromagnetic Spectrum
RS	Remote sensing (RS)
IRS	Indian Remote Sensing
ISRO	Indian Space Research Organization
LISS	Linear Imaging Self Scanner