



**Department of Electrical and Computer Engineering
North South University**

Senior Design Project
**Lumbar Spine MRI Segmentation using Deep
Learning**

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Faculty Advisor:
Dr. Mohammad Monirujjaman Khan
Associate Professor
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Spring, 2024

LETTER OF TRANSMITTAL

Nov, 2023

To

Dr. Rajesh Palit

Chairman,

Department of Electrical and Computer Engineering

North South University, Dhaka

Subject: Submission of Capstone Project Report on “Lumbar Spine MRI Segmentation using Deep Learning”

Dear Sir,

With due respect, we would like to submit our **Capstone Project Report on “Lumbar Spine MRI Segmentation using Segmentation”** as a part of our BSc program. This report focuses on improving diagnostic precision by creating an advanced deep learning model for segmenting lumbar spine MRI. This project proved to be extremely beneficial for us, as it provided valuable practical experience and the opportunity to apply theoretical knowledge in real-world scenarios. We made every effort to fulfill all the requirements and dimensions expected in this report to the best of our ability.

We will be highly obliged if you kindly receive this report and provide your valuable judgment. It would be our immense pleasure if you find this report useful and informative to have an apparent perspective on the issue.

Sincerely Yours,

.....
Istiaq Ahmed
ECE Department
North South University, Bangladesh

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Tanvir Ibne Hossain
ECE Department
North South University, Bangladesh

.....
Md. Labib Hasan
ECE Department
North South University, Bangladesh

.....
Md. Zahirul Islam Nahid
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APPROVAL

Istiak Ahmed (ID 1722070042), Tanvir Ibne Hossain (ID 1912205042), Md. Labib Hasan (ID 2011068042) and Md. Zahirul Islam Nahid (ID 2013421642) from Electrical and Computer Engineering Department of North South University, have worked on the Senior Design Project titled “Lumbar Spine MRI Segmentation using Deep Learning” under the supervision of Dr. Mohammad Monirujjaman Khan partial fulfillment of the requirement for the degree of Bachelors of Science in Engineering and has been accepted as satisfactory.

Supervisor’s Signature

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Dr. Mohammad Monirujjaman Khan

Associate Professor

Department of Electrical and Computer Engineering

North South University

Dhaka, Bangladesh.

Chairman’s Signature

.....

Dr. Rajesh Palit

Professor

Department of Electrical and Computer Engineering

North South University

Dhaka, Bangladesh.

DECLARATION

This is to declare that this project is our original work. No part of this work has been submitted elsewhere partially or fully for the award of any other degree or diploma. All project related information will remain confidential and shall not be disclosed without the formal consent of the project supervisor. Relevant previous works presented in this report have been properly acknowledged and cited. The plagiarism policy, as stated by the supervisor, has been maintained.

Students' names & Signatures

1. Istiak Ahmed

2. Tanvir Ibne Hossain

3. Md. Labib Hasan

4. Md. Zahirul Islam Nahid

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ABSTRACT

Lumbar Spine MRI Segmentation using Deep Learning

In this study, an advanced approach to lumbar spine segmentation using deep learning techniques is presented, focusing on addressing key challenges such as class imbalance and data preprocessing. MRI scans of patients with low back pain are meticulously preprocessed to ensure accurate representation of three critical classes: vertebrae, spinal canal, and intervertebral discs (IVDs). By rectifying class inconsistencies, the fidelity of the training data is ensured. The modified U-Net model incorporates innovative architectural enhancements, including an upsample block with leaky ReLU and Glorot uniform initializer, to mitigate common issues such as the dying ReLU problem and improve stability during training. Introducing a custom combined loss function effectively tackles class imbalance, resulting in significant improvements in segmentation accuracy. Evaluation using a comprehensive suite of metrics showcases the superior performance of this approach, outperforming existing methods and advancing the current techniques in lumbar spine segmentation. These findings hold significant advancements for enhanced diagnostic accuracy of lumbar spine MRI and segmentation.