University of Central Punjab

(Incorporated by Ordinance No. XXIV of 2002 promulgated by Government of the Punjab)

Faculty of Information Technology

PROJECT OFFICE

FORM FOR BS PROJECT IDEA AND GROUP ALLOCATION

	Day			Month			Year			
DATE	2	0	–	0	1	–	2	0	2	3

Project Title: GI Tract Image Segmentation in MR-Linac Cancer Treatment

Brief Description: (Up-to 250 words)

This research project aims to develop a deep learning model that can automatically segment the stomach and intestines on MRI scans to help radiation oncologists deliver high doses of radiation to tumors while avoiding the stomach and intestines.

The project is being supported by the UW-Madison Carbone Cancer Center, which has provided anonymized MRI scans of patients who have undergone radiation therapy. The images in the dataset are in 16-bit grayscale PNG format, and the training annotations are provided as RLE-encoded masks. The competition's test set is entirely unseen, and the goal is to generalize to both partially and wholly unseen cases. The final model will be tested against a non-hidden test set.

The research aims to automate the segmentation process, which is a time-consuming and labor-intensive process that can prolong treatments from 15 minutes a day to an hour a day, which can be difficult for patients to tolerate. A method to segment the stomach and intestines would make treatments much faster and would allow more patients to get more effective treatment.

BS Program:

BSCS ☒

BSSE ☐

Term of Registration:

☐**Fall** _____

☒**Spring** ___**2023**__

Tools to be used:

Python

Image Processing

Deep Learning

Pandas

NumPy

TensorFlow

Sklearn

Project Type:

☒**Research based**

☐**Hardware based/Embedded**

☐**Game based**

☐**Software Development**

☒**Artificial Intelligence (AI)**

☐**Mobile Application**

☐**Web Application**

☐**Robotics**

☐**Database**

☐**Other:** _____

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Extended Abstract: (Up-to 1200 words)

Problem:

Cancer of the gastrointestinal tract is a major health concern worldwide, with an estimated 5 million people diagnosed in 2019 alone. Radiation therapy is a common treatment option for patients with gastrointestinal cancer, but the effectiveness of the treatment relies on the ability to deliver high doses of radiation to the tumor while avoiding the surrounding healthy tissue, such as the stomach and intestines. Currently, radiation oncologists use integrated magnetic resonance imaging (MRI) and linear accelerator systems (MR-Linacs) to visualize the position of the tumor and surrounding tissue on a daily basis. However, this process is time-consuming and labor-intensive, as oncologists must manually outline the position of the stomach and intestines in order to adjust the direction of the x-ray beams. This can prolong treatment from 15 minutes a day to an hour a day, which can be difficult for patients to tolerate.

Related Work:

The use of deep learning techniques for medical image segmentation has gained significant attention in recent years. Deep learning models, such as fully convolutional networks (FCNs) and U-Net, have been widely used in the field of medical image segmentation. These models have been trained on datasets of different modalities, including CT, MRI, and ultrasound images, and have been used to segment various structures such as the liver, prostate, and brain (Kamnitsas et al., 2017; Ronneberger et al., 2015).

Several studies have proposed the use of different architectures of deep learning models for the segmentation of stomach and intestines on MRI scans. For example, U-Net, SegNet, DenseNet, and FCN have been used to segment stomach and intestines on CT and MRI images (Chen et al.,

2018; Isensee et al., 2018; Lee et al., 2019). These studies have shown promising results in terms of accuracy, sensitivity, and specificity.

Recent studies have highlighted the benefits of utilizing pre-trained models and transfer learning for medical image segmentation. For instance, it was shown that fine-tuning pre-trained models can improve the performance of deep learning models for medical image segmentation (Raghu et al., 2019).

The task of stomach and intestines segmentation is challenging due to the shape and texture variability and the presence of other organs that are visually similar. Thus, to tackle this challenge some studies have attempted to use multi-modal data, such as adding an additional MRI sequence that provides complementary information, or by incorporating shape and/or texture priors into the model (Kamnitsas et al., 2017; Lee et al., 2019) Previous research on the use of deep learning for medical image segmentation has focused on a wide range of modalities and structures, with specific attention given to the segmentation of stomach and intestines on MRI scans. Recent studies have shown the benefits of utilizing pre-trained models, transfer learning, and incorporating multiple modalities and shape/texture priors to improve performance in this challenging task.

Proposed Methodology:

The proposed methodology for this competition is to use a CNN-based model to segment the stomach and intestines in MRI scans. The dataset used for the competition includes anonymized MRI scans of patients treated at the UW-Madison Carbone Cancer Center, with training annotations provided as RLE-encoded masks.

To train the CNN, a combination of image data augmentation and transfer learning techniques will be used. Image data augmentation will

be used to increase the diversity of the training dataset, while transfer learning will be used to leverage pre-trained models to improve the performance of the CNN.

The model will be evaluated using metrics such as dice coefficient, Jaccard index, and Hausdorff distance.

Expected Results:

It is expected that the proposed CNN-based model will be able to accurately segment the stomach and intestines in MRI scans. By automating the segmentation process, the proposed model will help to reduce the time and labor required for radiation oncologists to adjust the direction of the x-ray beams, thus allowing for more efficient and effective treatment for patients with gastrointestinal cancer.

Conclusion:

This research aims to develop a deep learning model that can accurately segment the stomach and intestines in MRI scans of cancer patients. By automating the segmentation process, the proposed model has the potential to improve the efficiency and effectiveness of radiation therapy for patients with gastrointestinal cancer. The use of CNNs and image data augmentation techniques is expected to lead to improved performance compared to previous methods. The final model will be evaluated using metrics such as dice coefficient, Jaccard index, and Hausdorff distance. The results of this competition will be useful not only for the research community but also for the medical community, as it will help to improve the treatment of patients with gastrointestinal cancer.

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Particulars of the students:

Sr. #	Registration# eg.**L1F00BSCS0101**	Name in Full Use Block Letters	Email Only UCP Email	Contact #	CGPA	Signatures
1	L1S20BSCS0005	Mohsin Iqbal	L1S20BSCS0005@ucp.edu.pk	03054239006	3.75	
2	L1S20BSCS0010	Umer Ahmed	L1S20BSCS0010@ucp.edu.pk	03228447079	3.47	
3	L1S20BSCS0059	Aiza Ihsan	L1S20BSCS0059@ucp.edu.pk	03497728744	3.57	
4	L1S20BSCS0029	Wajahat Manzoor	L1S20BSCS0029@ucp.edu.pk	03433338338	2.32	

Name and Signatures of the advisor: _____

For Project Office use only

Remarks:	Signatures and Date
Group No	_____ **Manager Projects**

UNDERTAKING FOR UNDERGRADUATE FINAL YEAR PROJECTS

Acceptance of Project Idea

Students will be required to defend their idea before the scrutiny committee (SC) which has the authority to accept or reject the project idea. The decision taken by the SC will be final and cannot be challenged.

Similarly, in phase wise evaluations, the marks awarded by the evaluators will be considered final. No excuses on their skill, relevancy, competency or biasedness will be acceptable as an absolve.

Issuance of hardware

Due to the prevailing COVID 19 pandemic situation, it may not be possible to acquire any kind of specific hardware. This situation is due to the import/export problems faced by all countries and it can't be predicted when the situation will improve. Therefore, it is highly recommended that only the hardware which is readily available in Lahore (Hall Road) may be requested for the projects. Furthermore, if the hardware is not available, the HOD may recommend change in the project scope.

The Project Office will facilitate the requestor only in initiating the procurement process. However, Project Office bears no liability if the hardware is not procured timely as it beyond its purview. It shall be sole responsibility of the project advisor or the group itself to arrange the required hardware for the project if predominantly essential. Furthermore, the problem(s) of procurement of necessary hardware will not be considered admissible plea to revise the awarded grades.

A group/advisor is bound to collect procured hardware within two days on intimation from the project office and return within a week of grade notification.

Supervisory Meetings

A group is required to hold at least two meetings per month and maintain meeting minutes. Missing two consecutive meetings without any notice may lead to withdrawal of the project.

I, Mr. /Ms. /Dr. _____, solemnly declare that I have read and understood the above mentioned instructions and shall abide by these in both letter and spirit.

Project Title: _____

_____
Advisor‘s Name & Signature

_____
Date:

Student 1: Name: Registration#	Student 2: Name: Registration#	Student 3: Name: Registration#	Student 4: Name: Registration#
_____ Signature	_____ Signature	_____ Signature	_____ Signature