Archives available at journals.mriindia.com

International Journal on Advanced Computer Engineering and Communication Technology

ISSN: 2278-5140

Volume 14 Issue 03s, 2025

Deep Learning Algorithm for Early Pancreatic Cancer Diagnosis

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Peer Review Information

Submission: 05 Nov 2025

Revision: 25 Nov 2025

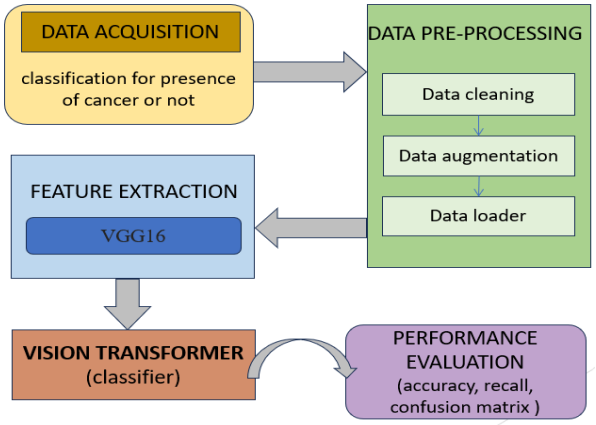
Acceptance: 17 Dec 2025

Keywords

Transfer learning, attention mechanisms, cancer detection, machine learning, deep learning.

Abstract

Pancreatic cancer is usually detected late, making treatment difficult and survival rates low. Early detection using biomarkers is important, but no reliable biomarker has yet reached clinical use due to challenges in sample collection and the highly variable nature of pancreatic tumors. To improve diagnosis, new machine learning and deep learning methods are proposed. The research focuses on segmenting and classifying MRI/CT images and improving classifier performance using medical data. The proposed deep-learning model (HdiGTF-SIRNN) significantly improves accuracy and precision compared to existing methods, and additional techniques (RIDT-GDLBC and DHEGQDRLCS) also show better diagnostic performance.



Introduction

1. Background

A pancreas is the organ positioned within abdomen. It is encircled with organs comprising lesser intestine, liver, and spleen as shown in figure. The pancreas is soft, 6 to 10 extensive, as well as it shaped as plane pear enlarged horizontally across the abdomen. Pancreas generates enzymes which digestion as well as hormones assist to control body procedures of glucose (sugar). It is the significant task for

converting food eaten within fuel to the body's cells.

• Pancreas middle segment is called as neck or body.

• Slim end is termed as tail as well as extends to left side

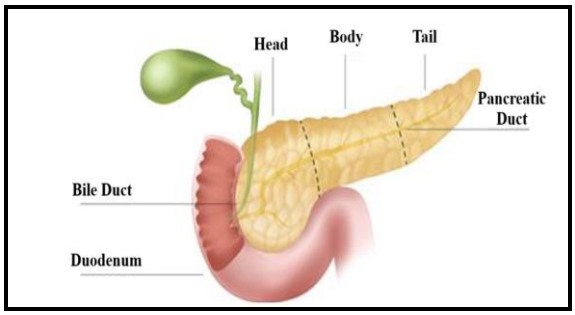


Figure 1 Anatomy of the Pancreas Gland[1]

The pancreas is enveloped by numerous main blood vessels, the better mesenteric artery, higher vein of mesenteric, portal, and celiac, providing blood to pancreas as well as abdominal organs. Almost pancreas (95%) contains exocrine tissue which generates pancreatic enzymes to digestion. Remaining tissue has endocrine cells termed as islets of Langerhans. Clusters of cells similar to grapes as well as create hormones for controlling blood sugar as well as adjust pancreatic secretions.

2. Different Pancreas Conditions:

Diabetes affects the pancreas, which either stops producing insulin (type 1) or cannot release enough insulin (type 2). Several pancreas-related disorders can occur during a person's lifetime, including pancreatitis, precancerous conditions (PanIN, IPMN), and pancreatic cancer.

Pancreatitis is the painful inflammation of the pancreas caused by enzyme buildup. Precursors to pancreatic cancer—such as PanIN, IPMN, and mucinous cystic neoplasms—are linked to risk factors like smoking, genetic syndromes, and chronic pancreatitis. These precancerous lesions progress through different genetic changes, eventually leading to pancreatic ductal adenocarcinoma (PDAC).

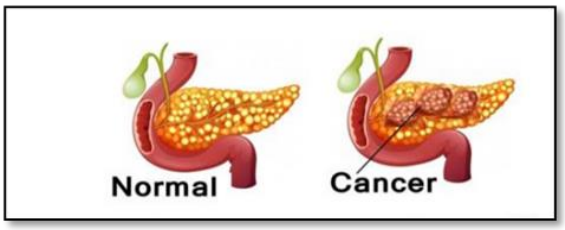


Figure 2 Normal and Abnormal Pancreatic[6]

3. Pancreatic Cancer

Pancreatic cancer is one of the deadliest cancers due to its aggressive nature, fast spread, and poor survival rate. It is linked to factors such as aging, alcohol use, smoking, and diet. Symptoms like abdominal pain, jaundice, diabetes, and weight loss often appear late, making early detection difficult. As cancer cells grow into a tumor, they damage pancreatic function and can spread to other organs through metastasis. India reports a high cancer burden, and pancreatic cancer ranks among the most lethal tumors worldwide. Symptoms of pancreatitis based on various kind. Acute pancreatitis symptoms comprise:

Upper abdominal ache

• Abdominal pain

• Rapid pulse

The pancreatic cancer stages are shown in figure 3

• Stage IA: The cancer is still smaller in the pancreas.

• Stage IB: Cancer has grown in the pancreas.

• Stage IIA: The cancer is making longer beyond the pancreas.

• Stage IIB: Cancer increases in near lymph nodes.

• Stage III: Cancer increases with additional organs in body like the lungs, lymph nodes, and bone

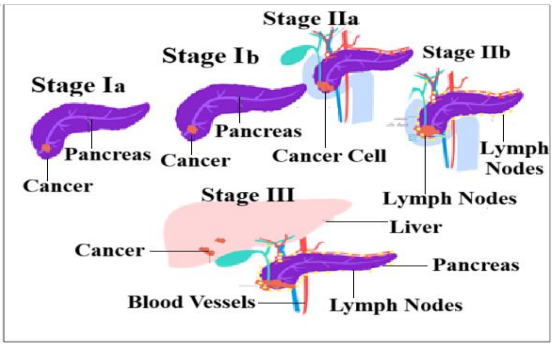


Figure 3 Various stages of pancreatic cancer

4. Computed Tomography

CT is the imaging mechanism which employs the unique X-ray tool for generating exhaustive pictures of the regions from diverse dimensions. The system then combines the entire dimensions to create a body part3-D image. The main intent of a CT scan is to detect the patient's evaluation with suspected pancreatic carcinoma generally involves the dynamic contrast enhanced helical CT attained through fast bolus injection of huge number of iodinated urographic contrast. Pancreatic CT scan image is illustrated from figure 4 Most pancreatic ductal adenocarcinoma (PDAC) is of smaller reduction for improving pancreatic parenchyma within contrast improvement of entire phases in Fig 5.

Figure 4 CT Scan image of pancreatic [11]

Approximately ten percent of pancreatic adenocarcinomas are reducing within CT. As well commonly find the Pancreatic and bile duct dilatation, the atrophy proximal to tumor. Perivascular tumor expansion provides vascular contribution as well as arterial or venous is tumor hallmarks. From pancreatitis, are typically perivascular penetration, while pancreatic carcinoma is used for spongy tissue encasing peripancreatic vessels. As CT is outstanding for identifying unrespectable tumors (>90% accuracy), with multisided helical CT scanners, tumor detection rates enhanced to 90–95%.

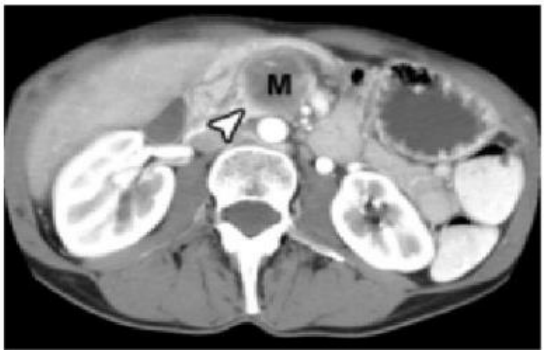


Figure 5 CT image shows pancreatic adenocarcinoma [20]

5. Magnetic Resonance Imaging

MRI employed by producing functional pictures as well as the body's physical processes. MRI as the name suggests strong magnetic as well as radio waves for producing the internal organs. Pancreatic MRI image is portrayed from fig 6. MRI is a very sophisticated technique that generates images by detecting the differences in the rotational axis directions of the protons present in the tissues water molecules.

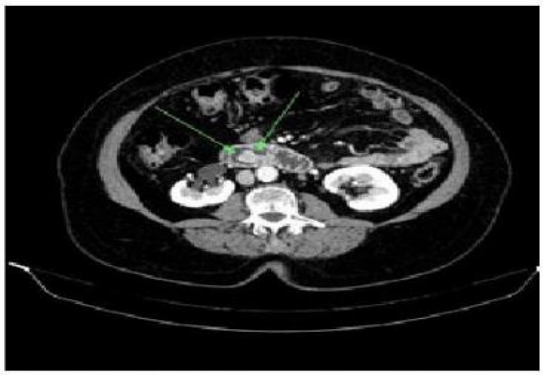


Figure 6 MRI image of pancreatic

On the application of radio waves through a person's body, these protons aligned due to the magnetic field starting to turn out of the equilibrium. The image is produced based on the time every proton takes to align back to its original magnetic field and also on the energy present in each proton through its realignment. Phased-array torso coils, thin slices, as well as active gadolinium-enhanced breath-hold gradient-echo (GRE) were best by MR method. Sequences are supportive to pancreatic carcinoma identification are weighted fat-suppressed as well as gadolinium-improved GRE. The fat suppressed images, pancreas was generally to proteinaceous content of better indication power. The MRI detecting precision rate is superior to contrast-enhanced CT as well as slightly better for the small tumors and metastases detection. The MRI scanners as well as imaging methods are complicated, with higher quality as well as accuracy. Hence, pancreatic disease is founded by MRI. Numerous exact circumstances of MRI have greater in CT, tiny cancers, hypertrophied pancreatic head as well as is attenuating pancreatic cancer. MRI with magnetic resonance cholangiopancreatography is to non-invasively delineates tiny cancer. It is found that MRI scans disparate the CT scans are more sensitive to soft tissues and are also capable of creating a clearer anatomical view of the human organs. As MRI scans do not entail any type of invasive procedures, any type of radiation that is damaging to the body, and its sensitivity for the soft tissues, it has been considered the greatest technique to adopt for the imaging of the pancreatic gland, that employed for the detection of pancreatic cancer.

6. Flow Process of pancreas cancer diagnosis:

The pancreatic cancer CT/MRI image has noise because of patient motion, detector miscalibration, etc., with removing the sound. The noise elimination function is vital to analyze the image in image processing. Different linear

and non-linear denoising techniques are available to eliminate the noise as well as preserve data. Non-linear filters sharpen the edges as well as protect the image data. Depending on this kind of noise present in the image an apt filter is employed to de-noise the image. Figure 7 illustrates the process of pancreas tumors.

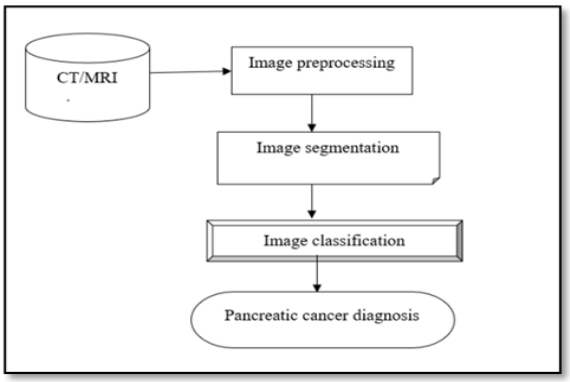


Figure 7 Flow Process of pancreas cancer diagnosis

Review Of Literature

1. Introduction

Image processing scheme developed for detecting the object integrates segmentation, classification, as well as data grouping are employed using various number of fields. In order to categorize different specific objects within the image, the object detection is used. The object recognition techniques are used for identifying as well as tracking object movement. Several image segmentation approaches are obtainable in image processing and deciding upon the apt classifiers for the selected image segmentation becomes increasingly significant when it comes to medical applications such as cancer detection. Listed below is some of the work performed in the past relating to cancer diagnosis and related medical applications. N. Al-Shaheri F et al., introduced a Blood biomarker to diagnosis as well as pancreatic cancer identification. It was a vital feature to enhance dismal condition makes probable. Also, advanced growth to clinical utilization for enhancing biomarker for providing various clinical intents as well as diagnostic accuracies need to be performed. Frederike Dijk et al.,[10] developed an unsupervised group recognition in PDAC correlates better similarity among described classification. The enhancement of pancreatic cancer lethal rate was fair due to the competent biomarkers require for screening and premature detection tumors. Behrouz Alizadeh Savareh, [7] introduced a robust diagnostic model by means of the ML methods to find out the pancreatic cancer by miRNA biomarkers. The obtained outcomes provide the index with clinically-chosen miRNAs as biomarkers to discover the pancreatic cancer as well as showed ranking miRNAs through feature selection techniques. With this, top discerning miRNAs to identify pancreatic cancer was confirmed to be acquired. Abu Z. M. Dayem Ullah,[1] reviewed an analysis of temporality of clinical factors related with pancreatic cancer.

2. Research Gap

The following research gaps have been recognized from the extensive literature survey conducted. • Difference between the significant versus the insignificant cancers is at a standstill a challenge. The pancreas conditions at type 1diabetes and type 2diabetes. Type 2 diabetes and cancer are more general in adult people. Type 1 diabetes lead to an augmented risk of developing cancer of the cervix and the stomach cancer. Offering a clear differentiation between the two conditions is vital in providing timely and apt treatment to the patient. There is no work carried out in this direction.

•Till day many works have been employed towards developing prediction performance rate of the cancer but no work has been carried out to classify the image into different each growing stages of pancreas cancer.

• Most of the work performs in this area only address about the development in the prediction accuracy using only the deep learning and convolutional network methods with diverse classifiers but does not notify which among the two methods are improved in terms of performance. In the deep learning model is handling fewer samples for pancreatic cancer detection.

3. Motivation of this work

Cancer arises from unknown DNA mutations and is increasing due to pollution, stress, lifestyle changes, and family history. India reports about 1.9 million cases and 8.5 lakh deaths each year, making early detection crucial. However, most cancers show no early symptoms, and current screening methods like biopsies, CT scans, and MRIs are slow and require high expertise. Machine learning and image processing can improve early cancer detection by analyzing medical images quickly and accurately. This potential motivates research in using ML-based techniques for cancer diagnosis.

Table 1: Summary of Methods, Classifiers and Performance Metrics based on various studies

Sr. No.	Classifiers/ Methods	Results
1	.Pre-trained CNN classifier. SVM classifier, random forest (RF) Classifier.	Accuracy-93 % Specificity-81.24%
2	TB detection classifiers. base classifiers.	Accuracy-89.77 % Sensitivity-90.91% Specificity-88.64%
3	Probabilistic Neural Network (PNN), Neural Network Classifier, Ensemble Learning -Support Vector Machine (EL-SVM) as classifier.	Accuracy-90 %
4	Naïve Bayes Classifier.	Accuracy-88.60 % Sensitivity-79.10%
5	Dynamic base-classifier meta-classifier ANN classifier Naïve Bayes classifier, Random Forest, K* instance-based classifier.	Accuracy-99.45 %

From ICMR, India registers around 1.9 million cancers, as well as close up to 8.5 lakh people from cancer related problems with every year. Ratio of the registered cases and the number of deaths per year is in fact alarming. Also understand the detail that, cancers are curable if detected at a starting stage. But, in most cases, people do not illustrate any early symptoms. Even regular health checkups provide very lesser assist in detecting the presence of cancers in extremely early stages as the patient screening with the existing technologies namely biopsies, CT scans, MRI, etc., needs a really high expertise and time. The certain machine learning with image processing techniques presented for previously existing screening systems greatly develops the possibility of detecting cancer with highest accuracy. ML is the discipline of AI which associates problem of obtaining knowledge from a set of samples with the common concepts for sketching the conclusion. In recent years ML is manifested to significant task within the biomedical region by providing enormous applications. ML essentially works by searching for the given set of data during an n-dimensional space. Image 16 processing on the other hand is confirmed to be extremely useful in detecting cancer presence in its initial stages. It essentially works by executing certain functions on the image in an effort to extract some useful facts. As time and accuracy is the significant task of cancers, ML and image processing techniques offer very promising outcomes in a very lesser time. This acts as a point of motivation in order to perform this research work. processing on the other hand is confirmed to be extremely useful in detecting cancer presence in its initial stages. It essentially works by executing certain functions on the image in an effort to extract some useful facts. As time and accuracy is the significant task of cancers, ML and image processing techniques offer very promising outcomes in a very lesser time. This acts as a point of motivation in order to perform this research work.

4.Problem Statement

Pancreatic cancer is the cruel kinds of cancer as well as predicted to be extremely underprivileged within associations. Pancreas borderline has tricky in differentiate over anatomies within CT/MRI scans, as difficult ocular form as well as vague curves. The significant health research is accessible on cancer forecast, that have different appearances as well as concerning on varied body elements. Cancer is forecasted to be not correctable, that cannot be preserved capably. At present, machine learning as well as neural networks optimistic outcomes to pancreatic image segmentation. • Identification of the greatest preprocessing strategy: Performing preprocess is very necessary, especially, when there is a need to lessen the resources needed for removing redundant data without mislay upon decisive as well as most important data. It greatly facilitates lessening of redundant information, which in turn minimizes the data dimensionality to be taken into consideration. As in our study we deal with clinical images, the data gathered from the images will also be very enormous. So it becomes even more necessary to discover the best possible preprocessing approach, which is practically missing in the existing systems. • Using an accurate classification approach: The medical image remains the vital issue for the image recognition. An accurate classification algorithm aids in classifying the image into dissimilar classes, which in turn helps the doctors in diagnosing the disease healthier. Even now doctors mostly make employ their professional experience to categorize medical images, which is tiring, prone to errors, and also consumes time. Identifying the best classification approach for the chosen

preprocessing technique still remains an open issue. • Obtain higher accuracy rates: when it comes to the recognition of diseases like cancers, the accuracy with which this condition is detected still remains insufficient even with so much advancement in present-day medical technology. Still there exists high false positive as well as false negative rates, to the patient may have, to undergo either over diagnosis or under diagnosis, both of which are unsafe for the patient. The existing systems have still not yielded acceptable results with respect to the accuracy with which the condition is diagnosed.

5. Research Objectives

The proposed work is used for evolving potential method for diagnosing pancreatic cancer at the very beginning stage with the highest accuracy. The following research objectives are given below: • To augment the pancreatic cancer detection accuracy, Schutz index regressive segmentation and Log-Linear analysis are used in Hadoop distributed Guided Trilateral Filter based Schutz Indexive Recurrent Neural Network (HdiGTF-SIRNN). • To increase early disease diagnosis by improved precision and recall, guided trilateral filter based preprocessing is executed. • To improve the pancreatic cancer classifier performance, Rand Indexive Decision Tree with Gradient Descent Logit Boost Classifier (RIDT-GDLBC) method is proposed. • To enhance the pancreatic cancer diagnosis accuracy, Distributed Hybrid Elitism gene Quadratic Discriminant Reinforced Learning Classifier System (DHEGQDRLCS) is introduced.

Research Methodology

1. An Efficient Novel approach with Multiclass Label Classification through Machine Learning Models for Pancreatic Cancer:

CNN were the methodological models employed for propagating classes of data. Besides, the neural networks were worked on perception of multicast as well as back propagation, that was mainly employed to segmentation, categorization as well as associated information. A variation among conventional as well as gathered alternates of reconsideration of connected characteristics. The novel construction called Hadoop distributed Convolutional Neural Network (HdiCNN) was designed to find the object in images. A image cannot protect associations among channels as well as reliability of luminaries. According to classification of CNN, HdiCNN find out recolored image as depicted in figure 1.8 A process of image classification for pancreatic cancer detection using HdiCNN is shown in figure 8. The HdiCNN comprises convolutional layer, pooling layer as well as fully 46 connected layer. First, number of pancreatic tumor images was used as input. Then, the input data was forwarded to the convolutional layer.

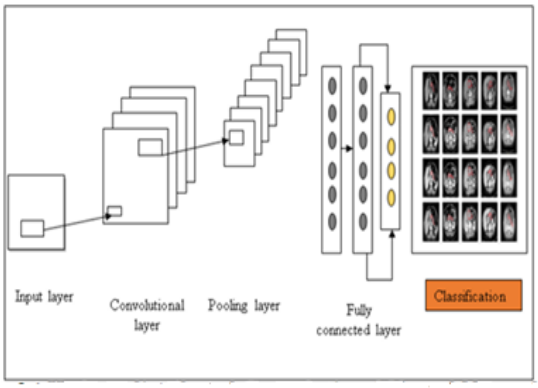


Figure 8 Hadoop distributed Convolutional Neural Network for image classification [20]

The major principle of convolutional layer was to carry out a filter for input image to make feature map which extract features existed within input image. After that, pooling was employed to diminish the dimensions of the feature map.

Then the results were forwarded to the FC layer. A process of FC layer was to connect output of previous layer. Designed network comprised many FC layers where the last layer was associated to the output layer. In that layer, the classification of pancreatic tumor image was made using activation function. Lastly, the output layer provided the classification results into normal or diseased.

Applications

1. Modified algorithm will help to increase in Performance accuracy.
2. It is more easily and corrected cancer disease diagnosis.

Conclusion

Pancreatic cancer is difficult to detect early because the pancreas is deep inside the body and shows no external symptoms. It has one of the lowest five-year survival rates worldwide, making early detection crucial. Traditional machine learning methods like SVM and logistic regression fail to accurately classify or segment medical images. This study proposes a three-step deep learning approach using a Hadoop-based recurrent neural network (HdiGTF-SIRNN) to segment MRI/CT images and improve diagnosis. The method achieves strong results with about 86% accuracy, precision, and recall.

References

Abu Z. M. Dayem Ullah, Konstantinos Stasinos, Claude Chelala & Hemant M. Kocher, "Temporality of clinical factors associated with pancreatic cancer: a case-control study using linked electronic health records", BMC Cancer, 2021, vol 21, pp 1-13.

Andika, L.A.; Pratiwi, H.; Sulistijowati Handajani, S "Convolutional neural network modeling for classification pulmonary tuberculosis disease", J. Phys. Conf. Ser. 2020, pp 1-6.

Ardila, D., Kiraly, A. P., Bharadwaj, S., Choi, B., Reicher, D. P., & Shetty,"End-to-end lung cancer screening with three-dimensional deep learning on low-dose chest computed tomography", Nature Medicine, 2019, vol 25.

Arshiya S. Ansari , Abu Sarwar Zamani , Mohammad Sajid Mohammadi , Meenakshi , Mahyudin Ritonga , Syed Sohail Ahmed. Ashley N. Krepline, Jennifer L. Geurts, Idayat Akinola, Kathleen K. Christians, Callisia N. Clarke, George, Paul S. Ritch, Abdul H. Khan, William A. Hall, Beth A. Erickson, Mike O. Griffin, Douglas B. Evans & Susan Tsai, "Detection of germline variants using expanded multigene panels in patients with localized pancreatic cancer", HPB, 2020,pp 1-8.

Sunkara, S. P. (2025). *Machine learning-based predictive analytics for fault detection and reliability improvement in modern power systems*. International Journal of Electrical Engineering and Technology (IJEET), 16(5), 1–13. https://doi.org/10.34218/IJEET_16_05_001

Sunkara, S. P. (2025). *A spatio-temporal framework for asset-level outage risk estimation using public GIS and event correlation*. International Journal of Computer Engineering and Technology (IJCET), 16(1), 4211–4227. https://doi.org/10.34218/IJCET_16_01_286

Ayan,E.;Ünver,H.M., "Diagnosis of Pneumonia from Chest XRay Images using Deep Learning",Sci. Meet. Electr. Electron. Biomed. Eng. Comput. Sci., 2019, pp 1 5.

Behrouz Alizadeh Savareh, Hamid Asadzadeh Aghdaie, Ali Behmanesh, Azadeh, Bashiri, Amir Sadeghi, Mohammadreza Zali, Roshanak Shams, "A machine learning approach 145 identified a diagnostic model for pancreatic cancer through using circulating microRNA signatures", Pancreatology, 2020, vol 20 (6).

Chouhan, V.; Singh, S.K.; Khamparia, A.; Gupta, D.; Albuquerque, V.H.C.D., "A Novel Transfer Learning Based Approach for Pneumonia Detection in Chest X-ray Images", Appl. Sci., 2020, vol 10, pp 1-17.

Hazarika, I., Khalfan, J., Ahmed, M., Yousif, A., & Hussain, J. (2024). Role of fintech as an enabler to fulfill HR requirements and attain sustainability. *Springer.* https://doi.org/10.1007/978-3-031-62106-2_5

Hazarika, I., Youdan, A., Daypuyart, G. T., Gonzales, A., Bautista, J., Ramos, J., Yadav, R. K., & Ying, Z. (2025). *Internal communication's role in employee well-being (SDG 3) and productivity (SDG 8)*. Lex Localis: Journal of Local Self-Government, 23(S6), 7599.

Deepesh Agarwal, Obdulia Covarrubias-Zambrano, Stefan H. Bossmann, And Balasubramaniam Natarajan, "Early Detection of Pancreatic Cancers Using Liquid Biopsies and Hierarchical Decision Structure", Oncology, 2022, vol 10, pp 1-8.

Sharma, B. (2025). *Ethical and AI concerns in data privacy: A charismatic dilemma*. International Journal of Multidisciplinary Research and Development, 12(7), 18–32.

Sharma, B. (2023). *Impact of artificial intelligence on the legal industry: Advantages, challenges, and ethical implications*. BioGecko, 12(2), 3363–3374.

Frederike Dijk, Veronique L. Veenstra, Eline C. Soer, Mark P.G. Dings, Helene Damhofer, Marco Marzano, Anne Steins, Cynthia Waasdorp, Olivier R. Busch, MarcG. Besselink, Johanna A. "Unsupervised class discovery in pancreatic ductal adenocarcinoma reveals cell-intrinsic mesenchymal features and high concordance between existing classification systems", 2020, Scientific Reports, pp 1-12.

Gao, X.W.; James-reynolds, C.; Currie, E.Analysis of tuberculosis severity levels from CT pulmonary images based on enhanced residual deep learning architecture .Neurocomputing, 2019, vol 392, pp 233–244.

Glicksberg B S, Miotto R, Johnson K W, Shameer K, Li L, Chen R, Dudley J T"Automated disease cohort selection using word embeddings from Electronic Health Records", Pac Symp Bio computional, 2018, vol 23.

Gordienko,Y., Gang,P., Hui,J., Zeng.W, Kochura,Y.,Alienin,O.,Rokovyi,O.,Stirenko,S., "Deep Learning with Lung Segmentation and Bone Shadow Exclusion Techniques for Chest X-Ray Analysis of Lung Cancer", Adv.Intell.Syst.Comput. 2019.

Gozes,O., Frid,M., Greenspan, H.,Patrick,D, "Rapid AI Development Cycle for the Coronavirs (COVID-19) Pandemic: Initial Results for Automated Detection & Patient Monitoring using Deep Learning CT Image Analysis" Article arXiv 2020, pp 1-22.

Matsubayashi. H, Ishiwatari H, Sasaki K, Uesaka K, and Ono H, "Detecting early pancreatic cancer: Current problems and future prospects," Gut Liver, 2020, vol 14(1), pp 30- 36.

Haotian Wu, Suwen Ou, Hongli Zhang, Rui Huang, Shan Yu, Ming Zhao and Sheng Tai, "Advances in biomarkers and techniques for pancreatic cancer diagnosis", Cancer Cell International,2022, pp 1-12.

Heo, S.J., Kim, Y., Yun, S., Lim, S.S., Kim, J., Nam, C.M., Park, "Deep Learning Algorithms with Demographic Information Help to Detect Tuberculosis in Chest Radiographs in Annual Workers' Health Examination Data", Int. J. Environ. Res. Public Health, 2019, vol 16, pp 1-9.

Hwang, E.J., Park, S., Jin, K.N., Kim, J.I., Choi, S.Y, Lee, J.H., Goo, "Development and Validation of a Deep Learning—based Automatic Detection Algorithm for Active Pulmonary Tuberculosis on Chest Radiographs". Clin. Infect. Dis., vol 69, 2019.

Ilario Giovanni Rapposelli, Valentina Zampiga, Ilaria Cangini, Valentina Arcangeli, Mila Ravegnani, Martina Valgiusti, Sara Pini, Stefano Tamberi, Giulia Bartolini, Alessandro Passardi, Giovanni Martinelli, Daniele Calistri, Giovanni Luca Frassineti, Fabio Falcini and Rita Danesi, "Comprehensive analysis of DNA damage repair genes reveals pathogenic 147 variants beyond BRCA and suggests the need for extensive genetic testing in pancreatic cancer", BMC Cancer, 2021, pp 1-10.

Saltz J, Gupta R, Hou L, Kurc T, "Spatial organization and molecular correlation of tumor-infiltrating lymphocytes using deep learning on pathology images", Cell Rep., 2018, vol 23 (1).