

— Seminar on —

# JKKNIU Funded Research Projects

FACULTY OF SCIENCE AND ENGINEERING

Fiscal year 2024-25



JATIYA KABI KAZI NAZRUL ISLAM UNIVERSITY

FACULTY OF SCIENCE AND ENGINEERING



JATIYA KABI KAZI NAZRUL ISLAM UNIVERSITY

# Abstracts of JKKNIU Funded Research Projects 2024-25

## Faculty of Science and Engineering

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**Jatiya Kabi Kazi Nazrul Islam University**  
**Trishal-2224, Mymensingh**





I am very happy to announce the annual seminar on research projects conducted by the faculty of Science and Engineering funded by the JKKNIU. A total of 24 projects will be presented in this seminar. Summaries of these researches have been compiled in this volume. This is a new initiative of our faculty. I am beyond happy with the enthusiasm and progress of the researchers' work. I hope that their interest in such research will increase further and other teachers and students will also be encouraged.

**Prof. Dr. A. H. M. Kamal**

Dean, Faculty of Science and Engineering  
Jatiya Kabi Kazi Nazrul Islam University

## **List of Departments:**

Computer Science and Engineering

Electrical and Electronic Engineering

Environmental Science and Engineering

Statistics

### **List of Research Projects (Financial year-2024-2025):**

#### **Department of Computer Science and Engineering**

Sr.	Director	Title	Budget
01	Dr. A. H. M. Kamal Professor Dept. of CSE	Analyzing mental health of University students using machine learning algorithm: JKKNIU as a case study.	3,30,000/-
02	Dr. Tushar Kanti Saha Professor Dept. of CSE	An Efficient Technique for Sleep Stage Classification from ECG Signal.	3,30,000/-
03	Professor Dr. Jannatul Ferdous Dept. of CSE	A Fast and Efficient Technique for Multichannel EEE Signal Classification Using the Frequency Band Selection Method.	3,30,000/-
04	Dr. Uzzal Kumar Prodhan Professor Dept. of CSE	Development of an improved technique for patient data handling.	3,30,000/-
05	Professor Dr. Md. Mijanur Rahman Dept. of CSE	Introducing Hand Gesture Recognition in Human-Machine Interaction System.	3,30,000/-
06	Dr. Habiba Sultana Associate Professor Dept. of CSE	Edge Detection Prediction Error Space Using Deep Learning for data Enhancing data Embedding Scheme.	2,72,000/-
07	Dr. Mahbubun Nahar Assistant Professor Dept. of CSE	Improving the Security of Personal Information to Protect Cybercrimes While Receiving Hospitality Services.	2,72,000/-
08	Dr. Subrata Kumar Das Professor Dept. of CSE	To improve the computer vision for surveillance from visual inputs	2,63,000/-

#### **Department of Electrical and Electronic Engineering**

09	Dr. Md. Ali Asgar Associate Professor Dept. of Electrical and Electronic Engineering	A Comparative Analysis of Different Machine Learning Models for the Detection of Dengue Fever in Bangladesh.	3,00,000/-
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10	Kazi Md. Shahiduzzaman Associate Professor Dept. of Electrical and Electronic	Analysis and Detection of Autism Spectrum Disorder and Attention Deficit Hyperactivity Disorder Using Machine Learning.	3,00,000/-
11	Dr. Md. Mahbubur Rahman Associate Professor Dept. of Electrical and Electronic Engineering	A Study of Dynamic Region-Based Adaptive Histogram Equalization Method for Image Enhancement.	3,00,000/-
12	Bijoy Kumer Karmaker Associate Professor Dept. of Electrical and Electronic Engineering	Brain Tumor Identification and Classification From Mri Imaging Using Machine Learning and Deep Learning.	3,00,000/-
13	Firoz Sarkar Assistant Professor Dept. of Electrical and Electronic Engineering	Study and Development of an Algorithm for Surveillance Systems Using CCTV Cameras.	2,72,000/-

#### **Department of Environmental Science and Engineering**

14	Dr. Ashraf Ali Siddique Professor Dept. of Environmental Science and Engineering	Geochemical and isotopic studies on sources of toxic heavy metal(s) dispersion in the urban storm-surface water and groundwater system in the Mymensingh City Corporation area: Potential impact on environment.	3,30,000/-
15	F.K. Sayematanzia Assistant Professor Dept. of Environmental Science and Engineering	Assessing Textile Dyeing Effluents and its Environmental Concern-A Comparative study on Different Industries in Bhaluka, Mymensingh.	2,72,000/-
16	Md. Nakibul Hasan Khan Assistant Professor Dept. of Environmental Science and Engineering	Assessment of Automobile Waste Generation and Management in Mymensingh City.	2,72,000/-
17	S. Bipulendu Basak Assistant Professor Dept. of Environmental Science and Engineering	An Evaluation of Air Pollution Status of Kamrangirchar, Dhaka: Assessment of Air Particulate Matter, Toxic Trace Element and Heavy Metals Analysis.	2,72,000/-

18	Md. Alim Miah Assistant Professor Dept. of Environmental Science and Engineering	The Impact of Climate Change on Deforestation and Biodiversity Loss in the Sundarbans Mangrove Forest in Bangladesh.	2,72,000/-
19	Md. Habibur Rahman Habib Lecturer Dept. of Environmental Science and Engineering	Correlation Between Sea Surface Temperature and Sea Surface Height in the Bay of Bengal: A Statistical Analysis.	2,48,000/-
20	Ananya Roy Lecturer Dept. of Environmental Science and Engineering	Evaluation of Heat Stress related with LULC changes: A Comparative Study on Dhaka and Mymensingh City.	2,48,000/-
21	Marufa Jahan Tonni Lecturer Dept. of Environmental Science and Engineering	Impact Assessment of Land of Land Use Land Cover Change on Ecosystem Services in the Madhupur Sal Tract.	2,48,000/-
22	Samanta Islam Lecturer Dept. of Environmental Science and Engineering	Evolution of Heavy Metals and Antibiotics Contamination in Commercially Cultured Fish at Trishal Upazila: A Potential Risk to Consumer's Health.	2,48,000/-

### **Department of Statistics**

23	Abdul Muyeed Assistant Professor Dept. of Statistics	Mediating Roles of Fear of Missing Out (FOMO) and Insomnia on Social Media Addiction among University Students in Bangladesh: A Cross-sectional Survey.	2,72,000/-
24	Md. Merajlul Islam Assistant Professor Dept. of Statistics	Identification of key Candidate Biomarkers for Early Diagnosis, Immune Infiltration, and Therapeutic Drug of Stroke using Integrated Bioinformatics Analysis and Machine Learning.	2,72,000/-

**Project Title: Analyzing mental health of university students using machine learning algorithm: JKKNIU as a case study.**

**Director: Dr. A. H. M. Kamal**, Professor, Dept. of Computer Science and Engineering

*Email: kamal@jkkniu.edu.bd*



**Abstract:** Nowadays, mental health has become an important issue as of physical health. Because mental illness acts as a disturbing agent to people's regular life activities. For this, it impacts on students' behavior, intellectual capacity, emotions, productivity, relationships and confidence level. Especially, the students of tertiary level face that problem randomly. Therefore, early prediction of and assessment to mental disorder level of the university students is important. Focusing on that issue, we develop a model using machine learning algorithms that can determine the state of mental health of university students. Specifying 26 attributes, we conducted a survey, first, to 900 students of various universities. Data was collected both by hard copies from class rooms and google form. We have digitized that survey results as a records in 26 columns file. We, thereafter, figure out the best features by employing both Information Gain and Correlation Repeated Heat map. We encoded all categorical data using level encoder for analyzing by our model. Five different machine learning algorithms, namely Logistic Regression, Support Vector Machine, Random Forest, XGBoost and Adaboost was employed on the processed dataset. In all cases eighty percent of records were used to train the model. The rest were applied for testing the models. Both Adaboost and XGBoost classification algorithm show superiority in achieving highest accuracy, i.e., 100%. The accuracy of Support Vector Machine algorithm is also noticeable, that is 99%. Feature selection by information gain helps in improving the accuracy, indeed. The proposed model would be a very effective application in predicting the mental health condition of university students.

## **Project Title: Introducing hand gesture recognition in human-machine interaction system**

**Director: Dr. Md. Mijanur Rahman**, Professor, Dept. of Computer Science and Engineering

*Email: mijan@jkkniu.edu.bd*



**Executive Summary:** The Industrial Revolution ushered in a new era of automation, with machines taking over many tasks previously performed by humans. However, these early machines were often complex and difficult to operate, requiring specialized training and skill. The need for user-friendly interfaces emerged to bridge the gap between humans and these increasingly sophisticated machines. The advent of computing in the mid-20th century marked a turning point in Human-Machine Interaction (HMI). The field of HMI emerged to study and design these interfaces, aiming to make them intuitive, user-friendly, and effective. In recent years, HMI has evolved to encompass natural user interfaces that allow humans to interact with computers or machines in a more natural and intuitive way, using speech, gestures, facial expressions, and other non-keyboard/mouse interactions. All these human interactions can take place in three basic modes: verbal, non-verbal and physical interactions.

Hand or finger gesture tracking has been utilized in several applications, such as motion capture, human-computer interface, and human behavior analysis. Using a specialized camera, it collects and stores images temporarily before processing the frames and recognizing the predetermined hand motion instructions. In gesture recognition, deep learning-based models can detect patterns in the extracted features from computer vision

and classify them as a particular gesture. This study proposes combining feature extractor and deep learning approaches to employ robust gesture recognition to develop a real-time HMI system. Hence, this study introduces the design and analysis of real-time hand gesture recognition, allowing hand-gesture patterns to be utilized in various applications.

The main objectives of this study are outlined below:

- To present a hand gesture recognition system for real-time human-machine interaction (HMI).
- To perform hand detection and classification using deep neural networks and evaluate the proposed system.
- To interpret hand gesture patterns that will demonstrate AI-powered virtual mouse and keyboard activities in a touchless HMI system.

**Project Title: Introducing hand gesture recognition in human-machine interaction system**

**Director: Dr. Md. Mijanur Rahman**, Professor, Dept. of Computer Science and Engineering

*Email: mijan@jkkniu.edu.bd*



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- To interpret hand gesture patterns that will demonstrate AI-powered virtual mouse and keyboard activities in a touchless HMI system.

## **Project Title: Development of an improved technique for patient data handling**

**Director: Dr. Uzzal Kumar Prodhan**, Professor, Dept. of Computer Science and Engineering

*E-mail: uzzal\_bagerhat@yahoo.com*



**Abstract:** General practitioners and other professionals record healthcare data from various sources and locations. Integrating and exchanging electronic health data from many databases is crucial for providing patients with timely, high-quality care. However, because of the diversity of structural, semantic, and querying syntaxes, exchanging patient data remains a significant challenge. A unified perspective for data exchange is provided by the research project "Development of an improved technique for Patient Data Handling." This research conducted a primary survey on 83 health organizations and found that 42.6% organizations use My SQL, 23.1% use other database, 11.5% use Access database. 42.7% owners of health organization told that patients health records cannot be shared with other health organizations. Survey found that 53.8% organization collect health record through customized software. This research has developed an improved model to handle patient data from diverse database. The architectures of the system functionality are tested using our customized database. The system that has been put in place extracts and combines data from many databases effectively and efficiently. The suggested architecture resolves issues without changing the current systems, facilitating the consolidation and exchange of health data. Users or health professionals could exchange data from dispersed source databases to improve the efficacy of their actions and judgments for patients. The cost of the patients' care would also be decreased by the availability of their prior medical records.

**Project Title: An efficient approach to sleep stage classification from ECG signal**

**Director: Dr. Tushar Kanti Saha**, Professor, Dept. of Computer Science and Engineering

*Email: tusharcsebd@gmail.com*



**Abstract:** Sleep is a fundamental physiological activity of human beings. Several parts of our body remain less active or take a rest during sleep. A good sleep is essential for everyone to become active throughout the day. There are many sleep disorders in people, such as insomnia, sleep apnea, narcolepsy, restless legs syndrome, parasomnias, and circadian rhythm disorders. Moreover, early detection of sleep-related disorders may help many people from several diseases. These disorders can be detected by correctly classifying sleep stages in people. Therefore, this work considers the problem of designing an efficient approach for sleep stage classification. Additionally, polysomnography (PSG) data is a valuable source of the ECG signal, which can be utilized for sleep stage classification. From the ECG signal, we determine heart-rate variability (HRV). Usually, there are six sleep stages in a human: wake, REM, NREM1, NREM2, NREM3, and NREM4. These sleep stages can be obtained from the HRV of the ECG signal. Therefore, we used the SHHS Visit-2 dataset, which was collected from 3,295 participants of the same age. From this data, we took only 23 participants' data (male:13 and female:10) for our experiment. Next, we extract the ECG signal from each PSG file. Each ECG signal is divided into 30-second epochs according to the annotation provided in the dataset. To address our problem using the dataset, we propose a system for sleep stage classification using machine learning and feature engineering. In the system, we first divide each

30-second epoch of the ECG signal into 3 parts, 10 seconds each, to reduce noise and artifacts. From each epoch, we detect the RR interval that indicates the length of a ventricular cardiac cycle found between two RR waves. Here, we extract the HRV features from the RR intervals in terms of three domains: time, frequency, and geometric domain. Thus, we have our dataset with 23 features and six classes. However, we found a class imbalance problem in the dataset. Then we apply data balancing techniques (SMOTEENN and ADASYN separately) to the dataset. Moreover, we reduce about 60% features from our dataset using the PCA algorithm. Finally, our proposed model applies the tree-based machine learning algorithms (random forest, XGB, and extra trees) to the dataset. Then, we obtain 99.24% accuracy for sleep stage classification using the extra trees classifier, which surpasses the existing results of sleep stage classification.

**Project Title: To improve the computer vision for surveillance from visual inputs**

**Director: Dr. Subrata Kumar Das,** Professor, Dept. of Computer Science and Engineering

*Email: sdas\_ce@yahoo.com*



**Abstract:** Estimating head pose features contributes significantly to improving the accuracy of individual recognition. To do that, analyzing facial appearances from different angles - front, side, and tilted views - is essential to achieve robust and reliable identification key points. This work offers a real-time facial system that employs 2D video or still visual input, capable of identifying individuals by extracting features across a broader range of head poses. Leveraging deep learning methods, the system generates highly discriminative face embeddings for identification tasks by combining triplet loss with the architecture of the NN4-Small2 convolutional neural network. A landmark-driven geometric approach is applied based on key features of the nose tip, chin, and outer corners of the eyes. Along with the assessment of the head posture, the movement of pitch and yaw angles is measured from the chosen facial markers. The proposed technique accurately estimates up to  $75^\circ$  of yaw and  $45^\circ$  of pitch, demonstrating high precision and reliable performance across a wide range of illumination conditions and head orientations. The recognition technique of head pose in more orientations enhances the system's applicability in various fields, including virtual reality, human-computer interaction, driver monitoring, surveillance, and fraud detection in an examination hall. With a lightweight model and an achieved speed of 37 FPS, the solution emphasizes both accuracy and efficiency, making it well-suited for real-time deployment on ordinary hardware.

**Project Title: Edge detection in prediction error space using deep learning for enhancing data embedding scheme.**

**Director: Dr. Habiba Sultana**, Associate Professor, Dept. of Computer Science and Engineering

*Email: srity.cse@gmail.com*



**Abstract:** Edge is an important feature of an image. Edge detection is a fundamental image processing tools for identifying the most significant edges within an image. Their existing many traditional edge detection methods such as Sobel, Prewitts, Roberts, Canny etc.. Recently machine learning approaches are more popular for detecting edge in an image than traditional methods. So far in this proposed work, we used machine learning techniques for identifying edge in predicted error space of an image. We used various classifiers such as Support Vector Machine, Decision Tree, Random Forest, K-Nearest Neighbour for detecting edge. We select Random Forest classifier for highest accuracy. Then we implant secret bits in edge and non- edge pixels using Least Significant Bits Substitution embedding techniques. For evaluating the proposed method, we used various performance parameters such as PSNR, SSIM, Entropy, Correlation and Accuracy. The experimental results show that our proposed method performs better than existing methods.

**Project Title: Improving the security of personal information to protect cybercrimes while receiving hospitality services**

**Director: Dr. Mahbubun Nahar**, Assistant Professor, Dept. of Computer Science and Engineering

*Email: mahbubacse@jkkniu.edu.bd*



**Abstract:** The hospitality sector has always been a popular target for online fraudsters. To protect the leakage or unauthorized use of information in the hospitality management system in a hotel or motel, information security is very important. Cyber criminals have recently attacked the hotel industry throughout the world. The bulk of attacks in the sector are driven by financial motivations, with the goal of stealing data that may be sold or utilized to generate revenue. Although credit card information is the main goal, fraudsters also try to obtain private visitor data in order to perpetrate fraud and use it as leverage to demand ransom. It has a significant impact on hospitality-related businesses. The goal of this research is to enhance the security of traveler's or visitor's information given in the hotel by applying a local binary pattern (LBP) code and the XOR operation. To do this we take the visitor's photograph and then transform it into a binary value. Further, we convert this binary into a DNA sequence, which is used as the cover DNA strand. Before implantation the cover DNA strand and information are encrypted using the complementary rule. The encryption method of this system improves the security of confidential information. An XOR procedure is used to implant secret bits. The XOR process additionally makes use of a Local Binary Pattern (LBP) coding. The resilience of the technique has been enhanced by each of these policies. The likelihood of system compromise is minimal. Unauthorized access will be more challenging as a result. With no stego expansion, the technique offers a larger embedding capacity of 2 bpns. Stated

differently, the embedding capacity is 8 times the image size; however, the current technique displays it as equal to the image size. The method functions equally well on standalone devices and cyber-physical systems (CPS) (like the cloud) and can handle any kind of message, including text, images, binary, and so forth. The system is the guard against information leaks. In the hotel sector, information technology directors and chief information officers (CIOs) can use this system for enhancing electronic information security protocols. Improve the security of travelers or guests to prevent information leaks and cyber-crimes while they are enjoying hospitality services. Other industries that require security, including banking, can use the suggested algorithm with modest adjustments to stop hacking, even if they are not in the hospitality sector.

## **Project Title: Brain tumor identification and classification from MRI imaging using machine learning and deep learning**

**Director: Bijoy Kumer Karmaker**, Associate Professor, Dept. of Electrical and Electronic Engineering

*Email: [bijoy\\_ice@jkkniu.edu.bd](mailto:bijoy_ice@jkkniu.edu.bd)*



**Abstract:** Precise identification of brain tumors is essential for effective clinical diagnosis and treatment planning. However, tumor detection poses significant challenges due to the considerable diversity in tumor appearances, which often vary in terms of shape, size, and texture. Among numerous medical imaging techniques, Magnetic Resonance Imaging (MRI) is widely utilized for brain tumor detection because of its ability to produce high-resolution images of soft tissues. Despite its effectiveness, manual interpretation of MRI scans is both labor-intensive and time-consuming, requiring expert radiological knowledge. To overcome these limitations, there is a growing demand for automated systems capable of detecting and classifying brain tumors accurately and efficiently.

In this research, we proposed an automated model that leverages machine learning and deep learning techniques to classify and segment brain tumors from 2D MRI images. The model is trained and evaluated on a dataset containing 7,023 T1 and T2-weighted contrast-enhanced MRI images. We employ and compare several classification algorithms: K-Nearest Neighbors (KNN), Support Vector Machine (SVM), Random Forest, and a pre-trained ResNet-50 convolutional neural network. Out of these models, ResNet-50 achieved the highest classification accuracy of 94%.

Furthermore, we develop a hybrid segmentation model by combining the Random Forest classifier with the U-Net deep learning architecture, which enhances tumor region localization in the MRI images. This hybrid approach enables both precise classification and accurate segmentation of brain tumors.

The proposed system offers a promising tool for assisting medical professionals in diagnosing brain tumors with greater speed and accuracy. By reducing dependency on manual image analysis, the model could significantly accelerate the diagnostic workflow, thereby facilitating timely intervention and treatment planning for patients with brain tumors.

## **Project Title: A comparative study on prediction of dengue fever in Bangladesh using various machine learning algorithms**

**Director: Dr. Md. Ali Asgar**, Associate Professor, Dept. of Electrical and Electronic Engineering

*Email: asgar\_eee@jkkniu.edu.bd*



**Abstract:** Dengue fever is a mosquito-borne viral infection that causes a significant public health threat worldwide. Early detection and prediction of dengue outbreaks can assist ineffective disease management and resource allocation. Here, performance evaluation of various machine learning models for detecting dengue disease has been carried out in real dataset that was obtained in two districts of Bangladesh such as Tangail and Mymensingh districts. The models considered here include traditional algorithms such as: K-Nearest Neighbors (KNN), Decision Trees, LogitBoost, Naive Bayes, Logistic Regression, Support Vector Machine (SVM), and Artificial Neural Networks (ANN). The dataset used in this research comprises historical dengue-related data, including climate variables, mosquito population information, and previous outbreak occurrences. Feature engineering approaches are utilized for the extraction of related information from the dataset, and preprocessing methods are implemented to handle missing values and outliers. The machine learning models are trained and validated using temporal cross-validation to ensure robust performance across different time periods. Evaluation metrics such as accuracy, precision, recall, and F1-score are used for the assessment of model predictive capabilities. In binary prediction, test results showed that decision tree model outperformed others with an accuracy of 89% followed by f1-score, precision, sensitivity, specificity, FPR, NPR of 83%, 84%, 63%, 92%, 7%, 92%, respectively and SVM model with an accuracy of 84% followed by f1-score, precision, sensitivity, specificity, FPR, NPR of 73%, 68%, 80%, 86%, 13%, 92%. In multi-class classification, the decision tree algorithm achieved the highest accuracy of 98% followed by K-nearest neighbors (KNN)(96%), and support vector machine (SVM) (94.1%).

**Project Title: Analysis and detection of autism spectrum disorder and attention deficit hyperactivity disorder using machine learning algorithm**

**Director: Kazi Md. Shahiduzzaman**, Associate Professor, Dept. of Electrical and Electronic Engineering

*Email: kazi\_eee05@yahoo.com*



**Abstract:** Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD) are the most common neurodevelopmental disorders in children and adults. Despite the burgeoning application of machine learning (ML) and deep learning (DL) in healthcare, a comprehensive and systematic understanding of their specific utility, effective algorithms, and optimal data modalities for the analysis and detection of ASD and ADHD remains fragmented. This review aims to provide a clearer roadmap for future research and clinical translation in the field of ML/DL for ASD/ADHD detection. The framework strategically integrates data derived from Electroencephalography (EEG) signals and clinical text/questionnaires, leveraging their distinct yet complementary information content to construct robust and interpretable diagnostic models. The evaluation of the proposed framework is based on a qualitative and quantitative analysis of the extracted data. Finally, the validated and interpreted models would yield the Diagnostic Output (DOU) for Autism and ADHD. Using the developed synthetic dataset, we achieved an 82% accuracy in classifying four types of neurodiversity. Among the tested models, Random Forest demonstrated the highest performance. This finding is significant as it highlights the potential of synthetic data in addressing the challenges of limited real-world data for neurodiversity classification. The strong performance of the Random Forest model suggests its suitability for this task, warranting further investigation and refinement for potential clinical applications. Rigorous validation, as emphasized in the experimental setup, ensures the reliability and generalizability of these results.

**Project Title: A study of dynamic region-based adaptive histogram equalization method for image enhancement.**

**Director: Dr. Md. Mahbubur Rahman**, Associate Professor, Dept. of Electrical and Electronic Engineering

*Email: mahbubur@jkkniu.edu.bd*



**Abstract:** Currently, the digital image processing has become increasingly popular due to its uses in various fields, including medical diagnostics, satellite imaging, underwater imaging, CCTV footage, drones, and remote sensing and monitoring. It improves the contrast and quality of the images because the original image may not have had sufficient contrast, making it appear blurry and of poor quality. The histogram equalization (HE) is one of the most popular techniques for enhancing global contrast of images. Nevertheless, HE often leads to over-enhancement of certain areas and loss of details, especially in areas with uniform intensities. An adaptive technique such as Adaptive Histogram Equalization (AHE) uses contextual intensity information to process the image locally. It enhances contrast in localized areas, but it also tends to amplify noise in relatively homogeneous areas. The Contrast Limited Adaptive Histogram Equalization (CLAHE) effectively mitigates these issues by adjusting image contrast locally to avoid over-amplification of noise. However, its performance highly depends on the choice of parameters — namely the clip limit and tile grid size. Hence, the traditional image enhancement methods often fail to deliver the desired enhancements. To address this issue, we propose a dynamic region-based adaptive histogram equalization method that adjusts CLAHE parameters dynamically at a local level by extracting features from the image. This improves the visual quality of the image, enabling more accurate and efficient utilization in various applications.

**Project Title: Study and development of an algorithm for surveillance systems using CCTV**

**Director: Firoz Sarkar**, Assistant Professor, Dept. of Electrical and Electronic Engineering

*Email: fsarkar07@yahoo.com*



**Abstract:** For the smart campus in the modern world of rapid technological development and growing security threats, the development of intelligent video surveillance systems stands out as a crucial invention. These systems, which are essential to the protection of all the stakeholders at the campus spheres, use automated, sophisticated analytics to improve awareness of circumstances and operational effectiveness without requiring continual human supervision. With a focus on the architecture of the system and the thoughtful selection of technology, this paper focuses on the creation of an intelligent video surveillance system designed especially for smart campus. By means of thorough investigation, this paper assesses cutting-edge models for real-time object identification tasks, recognizing the complex trade-off between accuracy and performance that is necessary for implementing such algorithms. A thorough analysis of different models is part of the suggested methodology, which leads to the creation of a reliable system architecture for easy deployment. Experimental findings indicate how effective the system is in real-world situations like facial recognition, border management, and occupancy monitoring. By demonstrating the creation and deployment of an advanced intelligent video surveillance system and emphasizing its potential to improve campus security and operational efficiency, this study advances the field.

**Project Title: Geochemical and isotopic studies on sources of toxic heavy metal(s) dispersion in the urban storm-surface water and groundwater system in the Mymensingh city corporation area: Potential impact on environment**

**Director: Dr. Ashraf Ali Seddique**, Professor, Dept. of Environmental Science and Engineering

*Email: ashraf.ali@jkkniu.edu.bd*



**Abstract:** The study area, a major financial and educational hub in north-central Bangladesh, is experiencing water quality challenges owing to rapid urbanization, industrialization, and population growth. These developments have led to increased untreated discharges; including tannery waste, municipal sewage, urban storm water runoff, and agricultural effluents, into the Old Brahmaputra River and its adjacent recharge zones. These zones serve as geochemical and hydraulic boundaries for underlying aquifers, posing a severe threat to groundwater quality. This study investigated toxic heavy metal contamination dynamics in urban groundwater systems by integrating hydrogeochemical assessments, multivariate statistics, spatial mapping, and multiple water quality indices, including the WQI, HMPI and MI. Twenty-three groundwater samples from shallow (<50 m), moderate (50–100 m), and deep (>100 m) tubewells, along with 12 urban storm-water pond samples (2–3m deep), were collected during the pre-monsoon season (2024), shortly after a 19 mm rainfall event. Physicochemical parameters, major ions, selected toxic heavy metals (As, Fe, Mn, Ni, Pb, Cr, Cd, Cu, Zn, Li, Mo), and stable isotopes ( $\delta^{18}\text{O}$  and  $\delta^2\text{H}$ ) were analyzed using field probes and ICP-MS. The results revealed that all pond water

samples exceeded the WHO (2011) limit for Pb (0.63–0.83 mg/L), while 75%, 50%, 34%, 33%, and 33% exceeded Fe (0.10–4.59 mg/L), Ni (0.005–0.047 mg/L), Mn (0.10–1.73 mg/L), Cr (up to 0.112 mg/L), and Zn (up to 5.74 mg/L) limits, respectively. Cd was detected in one sample (0.080 mg/L), exceeding both the WHO and CCME (2007) guidelines. In groundwater, Fe (0.21–2.27 mg/L) and Mn (0.03–1.25 mg/L) exceeded WHO (2011) limits in 52% and 74% of wells, respectively. Isotopic signatures ( $\delta^{18}\text{O}$ : -3.53‰ to -5.81‰;  $\delta^2\text{H}$ : -18.99‰ to -35.58‰) confirmed meteoric origin and local recharge in aquifer systems, supported by alignment along with both the GMWL and LMWL. Multivariate analysis and mineral saturation indices indicated mixed geogenic and anthropogenic contamination sources, with undersaturation of carbonate/sulfate phases, which enhanced metal mobility. Spatial analysis of water quality indices identified pollution hotspots in the northern and eastern parts of the study area, linked to industrial effluents, landfill leachate, urban storm water, and agricultural runoff. This study emphasizes the need for integrated mitigation strategies to safeguard groundwater resources and environment.

**Project Title: Assessment of automobile waste generation and management in Mymensingh city**

**Director: Md. Nakibul Hasan Khan**, Assistant Professor, Dept. of Environmental Science and Engineering

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**Abstract:** Numbers of automobiles in the Mymensingh city has been increasing with convenient mobility demands. Hence hazardous vehicle wastes are creating notable threats to the city-dwellers and the surrounding environment. The purpose of the study was to investigate the automobile waste generation scenario and existing automobile waste management practices in the city. Primary data were collected via field observations, questionnaires survey, and interviews, and secondary data were collected from reviewing of documents and reports of different offices. Total 48 automobile workshops, garages, servicing-centers were visited for quantitative and qualitative survey analysis. The last 5 (five) fiscal-year recorded data shows that there are around 33,904 various types of automobiles running in the city, of which ~17596 are battery-powered autorickshaws/bikes. From this automobile sector, wastes including combustible, highly hazardous, corrosive- battery as well as metal-scrap, lube-oils, tires/rubber, foam/textile and plastic wastes were discovered. Only in a single month a maximum of 11,77tons waste-battery (~71%) were derived from them whereas 330tons, 92.91tons, 54tons, 7tons and 3tons of tire, metal-scrap, lubricant-oil, foam/textile and plastic wastes were produced respectively in the city. On the other perspective, maximum production of metal-scrap (~75,640kg/month), waste-lube-oils (22,750 liter/month) were produced from the

3-wheeler, 2-wheeler and plastic-wastes (4,100kg/month) were produced from 3-wheeler vehicles accordingly. But sustainable management statements like rusting-protective, separated or sealed, container collection and storage (lube-oils) practices were not well-associated with the existing management practices. Rather flammable, toxic, etc. waste-transportations were not properly documented and not done via designated vehicles. In the city, waste recycling and treatment activities were found totally absent except one battery recycling plant. Every waste has negative effects on both the environment and human health. In Mymensingh city proper plan and infrastructure for automobile waste management is required for environmental sustainability.

**Project Title: An evaluation of air pollution status of Kamrangirchar, Dhaka: Assessment of air particulate matter, toxic trace elements and heavy metals analysis**

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**Abstract:** Dhaka, the capital of Bangladesh, ranks among the top 3% most polluted cities globally, with worsening air quality endangering public health and environmental sustainability. This study focuses on Kamrangirchar, a densely populated southwestern sub-region, where numerous unregulated industries- battery recycling, plastic manufacturing, and metal workshops operate with little environmental oversight, contributing significantly to ambient air pollution. The study pointed to assess the spatial distribution and interactions of major air pollutants, including PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub>, CO, O<sub>3</sub>, NH<sub>3</sub>, and Pb, through data collected from 50 systematically selected sampling sites covering residential, commercial, and industrial zones. Analytical procedures, including data processing, spatial mapping, and visualization, were carried out using Microsoft Excel, ArcGIS 10.8, and Python. The Air Quality Index (AQI) was computed to evaluate the ambient air quality status across the study area. Findings indicate that approximately 60% of the sampled locations recorded AQI values categorized as “very unhealthy” or “hazardous”, ranging between 142 and 332. Concentrations of PM<sub>2.5</sub>, PM<sub>10</sub>, and Pb frequently exceeded the permissible limits set by the Department of Environment (DoE), particularly in proximity to informal industrial sites. The highest concentration of Pb (12.36 µg/m<sup>3</sup>) was observed adjacent to an informal battery recycling facility. Correlation analysis revealed a strong inverse relationship between ozone (O<sub>3</sub>) and pollutants such as

NO<sub>2</sub> and PM<sub>10</sub>, which is attributed to the decomposition of ozone in the presence of elevated NO<sub>x</sub> concentrations. Conversely, pollutants primarily associated with combustion processes- namely CO, Pb, PM, SO<sub>2</sub>, and NO<sub>2</sub> demonstrated significant positive correlations, suggesting a shared anthropogenic origin. Principal Component Analysis (PCA) indicated that approximately 74.3% of the total variance in air pollution could be explained by a few key sources, predominantly emissions of PM, NO<sub>2</sub>, SO<sub>2</sub>, CO, and Pb. O<sub>3</sub> emerged as an independent factor, likely inhibited by high NO<sub>2</sub> levels in the atmosphere. The study underscores the critical implications of unregulated industrial activity in exacerbating air pollution and highlights the potential health hazards associated with chronic exposure to airborne heavy metals such as lead, which is known to be toxic and carcinogenic. These findings reinforce the necessity for implementing science-based regulatory frameworks and policy interventions to control emissions, protect environmental quality, and safeguard public health in urban industrial zones.

**Project Title: Assessing textile dyeing effluents and its environmental concern –a comparative study on different industries in Bhaluka, Mymensingh**

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**Abstract:** The research work was conducted to analyze the wastewater discharge practices of textile and dyeing industries in Bhaluka, Mymensingh, Bangladesh, focusing on physicochemical and bacteriological quality of water. Due to inadequate wastewater management, toxic industrial effluents are contaminating local water sources, leading to water pollution, soil degradation, ecological damage, and health hazards. Field and laboratory analyses measured key parameters, including pH, dissolved oxygen (DO), electrical conductivity (EC), total dissolved solids (TDS), temperature, salinity, biological oxygen demand (BOD), chemical oxygen demand (COD), heavy metals (chromium, arsenic, copper, cadmium), and bacterial contamination. Results showed that pH values ranged from 6.25 to 7.02, within the WHO and Bangladesh standard (6.5–8.5). DO levels (6.98 to 8.75 mg/L) were above Bangladesh standards, within the WHO range (4.5–8 mg/L). However, EC levels (1980 to 2103  $\mu\text{S}/\text{cm}$ ) and TDS levels (1013 to 1069 mg/L) exceeded recommended limits of 1000  $\mu\text{S}/\text{cm}$  and 600 mg/L, respectively, indicating a high concentration of dissolved substances. Water temperature ranged from 34.72°C to 36.86°C, above the optimal 20–30°C range, which can interfere with treatment processes. Salinity ranged from 1.01 to 1.06. Heavy metals were a significant concern. Chromium levels reached up to 0.81 mg/L, exceeding the WHO maximum of 0.05 mg/L. Arsenic

ranged from 0.033 to 0.354 mg/L, surpassing the WHO limit (0.01 mg/L) and the Bangladesh limit (0.2 mg/L). Copper levels (0.813–1.784 mg/L) were above Bangladesh's 1 mg/L limit but within the WHO's 2 mg/L standard. Cadmium levels (0.033–0.354 mg/L) were also high, far exceeding both WHO (0.001 mg/L) and Bangladesh (0.01 mg/L) limits. Coliform and fecal coliform counts indicated severe bacterial contamination, with sample 9 notably exceeding the WHO standard of 0 CFU/100 mL. These findings call for stricter regulatory enforcement, improved treatment infrastructure, and public education initiatives to mitigate the environmental and health risks in the region.

**Project Title: The impact of climate change on deforestation and biodiversity loss in the Sundarbans mangrove forest in Bangladesh**

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**Abstract:** This study investigates the multifaceted impacts of climate change on deforestation and biodiversity loss in the Sundarbans mangrove forest of Bangladesh, focusing on deforestation trends, biodiversity dynamics, socio-environmental drivers, and water quality parameters. Using multi-temporal satellite imagery (Landsat 7, Landsat 8, and MODIS) from 2000 to 2023, combined with GIS and remote sensing techniques, the study assesses land cover changes, revealing a fluctuating vegetation pattern with a net decline of 5.76% between 2010 and 2020. Salinity intrusion has progressively expanded inland, with projections indicating up to 40% of the Sundarbans may be affected by salinity by 2100. Biodiversity assessments, derived from secondary data and field surveys, indicate alarming species declines, including a reduction in Royal Bengal tiger numbers from 450 to 400 and significant losses across wildlife, fish, aquatic biodiversity, alongside overall reductions in plant, bird, and reptile populations between 2013 and 2023. Socio-economic surveys and stakeholder interviews highlight cyclonic events (80%), salinity intrusion (14%), and sea-level rise (4%) as the primary drivers of deforestation, with limited community awareness about climate adaptation policies. Water quality monitoring, through field sampling at ten locations, identified fluctuations in physicochemical parameters, including increased electrical conductivity, variable pH (6.6-7.2), declining

dissolved oxygen, and notable variances in sodium, chloride, and bicarbonate concentrations, indicating deteriorating water conditions under climatic stress. The findings collectively underscore that climate change is accelerating ecological degradation in the Sundarbans, necessitating urgent integrated management strategies focusing on reforestation, climate adaptation, biodiversity conservation, and sustainable resource management to safeguard this critical ecosystem.

**Project Title: Correlation between sea surface temperature and sea surface height in the Bay of Bengal: A statistical analysis**

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**Abstract:** This study investigates the long-term relationship between sea surface temperature (SST) and sea surface height (SSH) in the Bay of Bengal, using historical data from the Asia-Pacific Data Research Center (1871–2010). Statistical methods such as the Mann-Kendall test and Sen’s slope estimator were employed to detect and quantify trends. The results reveal strong and statistically significant increasing trends in both SST and SSH over the 140-year period. Kendall’s tau values of 0.783 for SST and 0.821 for SSH indicate strong monotonic trends, while extremely low p-values ( $< 2.2 \times 10^{-16}$ ) confirm the reliability of these trends. Sen’s slope estimates suggest a steady rise of  $0.00581^{\circ}\text{C}$  per year in SST and  $0.000706 \text{ m/year}$  ( $0.706 \text{ mm/year}$ ) in SSH. These findings are further supported by high Z-values (13.715 for SST and 14.392 for SSH), reinforcing the statistical significance of the observed changes. The Pearson correlation matrix also shows strong positive relationships among time, SST, and SSH, with correlation coefficients of 0.6967 (SST vs. time), 0.8774 (SSH vs. time), and 0.679 (SST vs. SSH), all with p-values  $< 2.2 \times 10^{-16}$ . The study concludes that the Bay of Bengal is experiencing significant warming and sea level rise, primarily driven by climatic processes such as thermal expansion and ocean-atmosphere interactions. The strong SST–SSH linkage highlights the influence of ocean warming on vertical sea level changes. These findings underscore the importance of continuous ocean monitoring and contribute valuable insights into the ocean’s response to long-term climate variability. The study also supports regional climate modeling and informs coastal management strategies in this climate-sensitive region.

**Project Title: Impact assessment of land use land cover change on ecosystem services in the Madhupur Sal Tract, Bangladesh**

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**Abstract:** Land cover changes driven by rapid urbanization have significantly impacted Bangladesh's local ecosystem services. The Madhupur Sal Tract is the country's last remaining patch of natural forest, which is ecologically invaluable. So, estimating ecosystem service values (ESV) resulting from the changes in land use and land cover (LULC) is essential for the policy-making stages. Satellite image processing platforms, like remote sensing and GIS, were used to analyze the LULC changes from 2001 to 2025. The investigation showed a sharp decline in natural forests, agricultural land, and grassland from 28.2% to 10.3%, 60% to 49% and 11% to 7% respectively, during the study period. On the other hand, the urban area doubled during these 25 years. The findings signified a drastic shift from agriculture/forest to plantation and settlement. ESV was estimated using the Global Ecosystem Services Value Coefficient along with the LULC change analysis. The use of Global datasets for the ESV Coefficient has reduced the cost of actual monetary valuation. From 2001 to 2025, approximately 1.254 billion BDT (10.3 million USD) of ecosystem services value was lost due to reduced forest cover, agricultural land, and grassland. Individual value of ecosystem service functions such as nutrient cycling, climate regulation, production of raw materials, soil formation, and erosion control have also been changed that ultimately influenced the loss of total ESV. So, it can be recommended that the policy maker should take some immediate decision to protect the remaining forest and should **promote mixed agroforestry** over monoculture to reduce the ecosystem degradation and biodiversity loss.

**Project Title: Evaluation of heavy metals and antibiotics contamination in commercially cultured fish at Trishal upazila: A potential risk to consumer's health**

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**Abstract:** This study explored heavy metal and antibiotic contamination in commercially cultured fish from Trishal Upazila, Bangladesh, with implications for consumer health. Three large-scale fish farms were selected from Mathbari, Dhanikhola, and Sakhua—regions known for intensive aquaculture. Representative samples of Pangas (Pangasiushypophthalmus), Rui (Labeorohita), and Tilapia (Oreochromis niloticus) were analyzed for eight heavy metals (As, Pb, Cd, Cr, Ni, Cu, Zn, Hg) and tetracycline residues. The mean concentrations of Arsenic (1.13 ppm), Lead (0.64 ppm), Chromium (3.49 ppm), and Nickel (1.05 ppm) exceeded WHO/FAO permissible limits. Tilapia exhibited the highest accumulation of Arsenic and Mercury. Non-carcinogenic risk assessment using the Target Hazard Quotient (THQ) and Hazard Index (HI) indicated elevated health risks ( $HI > 1$ ) in most samples, with Mercury being the predominant contributor. Carcinogenic risk (CR) values for Arsenic, Lead, and Cadmium exceeded USEPA thresholds in several samples, particularly for children. Tetracycline residues were detected in all fish, though levels remained below the Codex Maximum Residue Limit (MRL) of 100  $\mu\text{g}/\text{kg}$ . However, the consistent detection suggests systemic antibiotic use in local aquaculture practices, potentially contributing to antimicrobial resistance (AMR). These findings highlight an urgent need for regulatory oversight, targeted monitoring, and sustainable farming practices to mitigate contamination and safeguard public health.

**Project Title: Evaluation of heat stress related with LULC changes: A comparative study on Dhaka and Mymensingh city, Bangladesh**

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**Abstract:** Dhaka, the capital city and Mymensingh, prominent divisional city, are the fastest-growing cities in Bangladesh, notably alter the land use and land cover to support rapid urban expansion over the last 30 years (1994 to 2024). Satellite image analysis unveils the substantial increase of buildup area in Dhaka (24.36%) and Mymensingh (25.26%) within these period accompanied by significant decline in vegetation, bare land and water-body resulting heat stress particularly during pre-monsoon period. The thermal stress has been measured by means Discomfort Index (DI) and Humidity Index or Humidex (HD) using pre-monsoon and post monsoon temperature and humidity data of 1994 and 2024. But during pre-monsoon in 1994, most of the people of Dhaka's 12.01% area felt discomfort which sharply rose to 91.21% in 2024 including 0.26% area with the state of medical emergency according to discomfort index. Humidexresult show that only 12.1% area residence felt great discomfort in 1994 that jumped to 44.94% in 2024 and the heat stress become dangerous to very dangerous for 53.66% area. Conversely, the thermal stress in Mymensingh is quite moderate still in 1994, 79.69% of areas people don't feel any discomfort which drop to 26.9% in 2024 resulting from DI. Similarly, comfort state has dropped from 90.76% to 42.48% areas according to HD but no state of danger has been recorded in the 30 years. Sen's slope analysis also verifies the urban heat island effect

characterized by significant warming ( $+0.04\text{ }^{\circ}\text{C}/\text{year}$ ) and drying ( $-0.18\%/ \text{year}$ ) trend in Dhaka , while Mymensingh exhibits a gentle trend (temperature:  $+0.02\text{ }^{\circ}\text{C}/\text{year}$ , humidity:  $+0.03\%/ \text{year}$ ). This study reveals that the risk of extreme heat stress in Dhaka required quick urban heat adaptation solution and proactive mitigation for Mymensingh.

**Project Title: Mediating roles of fear of missing out (FOMO) on the relationship between social media addiction and insomnia among university students in Bangladesh: A cross-sectional survey**

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**Abstract:**

**Background:** The increasing prevalence of social media has transformed the psychological and behavioral patterns of university students, raising concerns about its association with mental health issues such as social media addiction (SMA), fear of missing out (FoMO), and insomnia. But the underlying psychological mechanisms and cultural dynamics of these issues remain under explored in Bangladesh. This study investigates whether FoMO mediates the relationship between SMA and the severity of insomnia among Bangladeshi university students, employing a theoretically grounded and context-specific analysis.

**Methods:** A cross-sectional survey was conducted with 427 university students selected through multistage random sampling from 12 public and private universities in Bangladesh. The study employed validated tools, including the Bergen Social Media Addiction Scale (BSMAS), the Fear of Missing Out (FoMO) Scale, and the Insomnia Severity Index (ISI). Descriptive statistics, correlation analyses, and mediation modeling were performed using PROCESS Macro (Model 4). The Sobel test was applied to confirm the significance of the mediation effect.

**Findings:** Social media addiction (SMA) exhibited a significant positive correlation with the FoMO and insomnia severity . Additionally, FoMO was significantly correlated with

insomnia . Mediation analysis revealed that FoMO partially mediated the relationship between SMA and insomnia, with an indirect effect of, accounting for 17.4% of the total effect. The Sobel test further validated this mediating role . Notably, 11.5% of respondents met the criteria for social media addiction, while 54.3% reported symptoms of insomnia. Moreover, female students experienced significantly higher levels of insomnia compared to their male counterparts .

**Conclusion:** This study identifies FoMO as a key psychological factor that connects excessive social media use to sleep disturbances among university students. By addressing FoMO in interventions, it may be possible to mitigate the negative effects of digital overexposure on sleep health.

**Originality:** This study is the first empirical research conducted in Bangladesh to apply a structured mediation model connecting SMA, FoMO, and insomnia. It contributes to the global digital mental health literature and offers practical insights for culturally relevant interventions and policy-making in developing countries.

**Project Title: Identification of key candidate biomarkers for early diagnosis, immune infiltration, and therapeutic drug of stroke using integrated bioinformatics analysis and machine learning**

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**Abstract:**

**Background and objective:** Stroke remain one of the leading causes of death and long-term disability globally. Timely and accurate diagnosis, understanding immune responses, and identifying effective therapeutics are critical for improving patient outcomes. Although substantial research has been conducted in this field, reliable and clinically applicable biomarkers for the early detection and targeted treatment of stroke are still lacking, highlighting the urgent need for novel diagnostic and therapeutic approaches. This study aims to identify key candidate biomarkers associated with stroke, immune cell infiltration, and potential therapeutic targets using integrated bioinformatics approaches and machine learning (ML) techniques.

**Materials and Methods:** Gene expression profiles were obtained from GEO datasets. DEGs between stroke and control samples were identified using the LIMMA. WGCNA was applied to detect gene modules associated with stroke. LASSO, Boruta, and SVM-RFE were used to determine core genes, and a PPI network was constructed using STRING and visualized in Cytoscape to uncover hub genes. A stacking ensemble model was developed to validate potential diagnostic biomarkers using AUC values. Immune cell infiltration analysis was conducted using CIBERSORT to characterize the immune

infiltration patterns in stroke. Finally, **DGIdb** was utilized to identify potential drug-gene interactions, enabling the selection of key candidate drugs that may target the identified stroke-related biomarkers for therapeutic intervention.

**Results:** A total of 1,595 DEGs were identified between stroke and normal tissues, including 55 upregulated and 541 downregulated genes. ML algorithms identified *PPP6C*, *ATRX*, *DNAJA2*, *GK3*, *BCL2A1*, *EIF4E3*, *GAB2*, *STK17B*, *CD55*, *ATP11B*, and *CYRIB* as core genes. PPI analysis revealed *BCL2A1*, *STK17B*, *FAM49B*, *PPP6C*, *EIF4E3*, and *DNAJA2* as hub genes. Among them, *DNAJA2* demonstrated strong diagnostic potential (AUC > 0.80). DGIdb analysis identified *Vorinostat*, *ATRA*, and *Bleomycin* as potential candidate drugs targeting the *DNAJA2* gene.

**Conclusion:** This integrative analysis identified novel biomarkers for early stroke diagnosis, provided insights into immune-related mechanisms, and proposed candidate drugs. These findings may contribute to developing personalized treatment strategies for stroke patients.