FACE RECOGNITION USING OF ORIENTED GRADIENT (HOG) AND SUPPORT VECTOR MACHINE (SVM)

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Introduction

The face recognition using Histogram of Oriented Gradients (HOG) and Support Vector Machine (SVM) involves implementing a system that can automatically identify and recognize faces in images or videos. The process typically begins with preprocessing steps to normalize the images and extract relevant facial features using the HOG algorithm, which captures local texture and shape information. These features are then used to train an SVM classifier, which learns to differentiate between different individuals based on the extracted HOG features. During the training phase, the SVM adjusts its parameters to find the optimal decision boundary that best separates the feature vectors of different individuals. Once the SVM model is trained, it can be deployed to classify new face images andrecognize the individuals present. The project may also involve additional steps such as face detection, data augmentation, and performance evaluation to improve the accuracy and robustness of the face recognition system. Overall, this project combines the power of feature extraction with HOG and the classification capabilities of SVM to create an effective and efficient face recognition solution.

Deep Learning

Deep learning is a branch of machine learning which is based on artificial neural networks.It is capable of learning complex patterns and relationships within data. In deep learning, we don't need to explicitly program everything. It has become increasingly popular in recent years due to the advances in processing power and the availability of large datasets. Because it is based on artificial neural networks (ANNs) also known as deep neural networks (DNNs). These neural networks are inspired by the structure and function of the human brain's biological neurons, and they are designed to learn from large amounts of data.

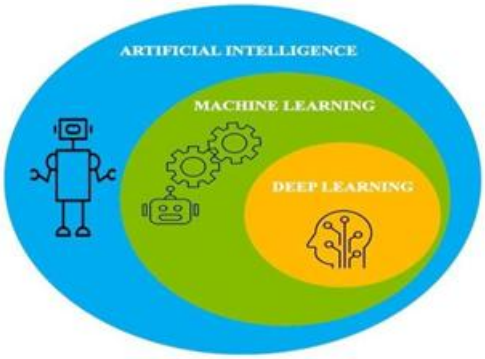

Fig.1. Introduction to Deep Learning

Deep Learning is a subfield of Machine Learning that involves the use of neural networks to model and solve complex problems. Neural networks are modeled after the structure andfunction of the human brain and consist of layers of interconnected nodes that process and transform data.

The key characteristic of Deep Learning is the use of deep neural networks, which have multiple layers of interconnected nodes. These networks can learn complex representations of data by discovering hierarchical patterns and features in the data. Deep Learning algorithms can automatically learn and improve from data without the need for manual feature engineering.

OBJECTIVE

Design a face recognition technology aims to identify unknown persons entering into permits. While Developing face recognition technology we got problem like inaccurate face recognition. We developed this project to address the problem of inaccurate face recognition due to various factors such as poor video quality, weather conditions, personal pose and facial expression, hairstyle,and lighting conditions.

LITERATURE SURVEY

Design for Visitor Authentication Based on Face Recognition Technology Using CCTV

Authors: Hyung-Jin Mun, Min-Hye Lee

Recently, image recognition technology using deep learning has improved significantly and security systems and home services that use biometric information such as fingerprints, iris scans, and face recognition are attracting attention. In particular, user authentication methods that utilize face recognition have been studied at length. This study presents a visitor authentication technology that uses CCTV with a Jetson Nano andwebcam. In the preprocessing phase for face recognition, face data with 7 features that can be identified as a person are collected using CCTV.

Disadvantage: Facial recognition systems can be expensive, involving costs Related to Hardware and Software

IoT based Visitor Identification System

Authors: K. Jayanth; Kamjula Manikanteswar Reddy; B. Harshith;S Sathyalakshmi

The authors discuss the Face recognition is a key element of the sole sense and purpose of security and surveillance in today's environment. Our goal is to see if a Raspberry Pi-based face recognition system can be implemented using traditional face detection. The goal of this work is to use and implement face recognition to the point where it can effectively replace the need for passwords and RFID Cards for access. This research study intends to develop a cost-effective, ergonomic, and simple to use system by utilizing the Raspberry Pi kit, which provides excellent performance and a solely output-based outcome.

Disadvantage: They are prone to risks such as theft, vandalism, and malfunctioning, which need to be considered when setting up the devices.

Intelligent Face Recognition Based Multi-Location Linked IoT Based Car Parking System

Authors: Vankadhara Rajyalakshmi; Kuruva Lakshmanna

Many nations are adopting smart city applications, which boost residential satisfaction with their living conditions and reduce pollution by better-using people's time and resources. Multi-Location parking garages are standard in smart cities because they allow for better access control and space allocation to avoid traffic and delay in complex business areas. The Internet of Things (IoT) has the potential to link billionsof devices and services worldwide, at any time, and for a wide range of uses. Smart parking is currently one of the most talked-about subjects in IoT research.

Disadvantage: Issues with sensor reliability, parking information accuracy.

Real-Time Biometric System for Security and Surveillance Using FaceRecognition

Authors: A Jaiswal, S Tarar

The proposed approach integrates two powerful techniques: sparse nonnegative matrix factorization (NMF) and convolutional neural networks (CNNs). Firstly, the motor imagery data is decomposed into sparse nonnegative components using NMF, effectively extracting meaningful features while reducing dimensionality. This decomposition enhances computational efficiency and facilitates feature extraction

The integration of sparse NMF and CNNs aims to leverage the strengths of both techniques. This hybrid approach offers advantages including improved classification performance, enhanced interpretability of features, and increased robustness to noise and variability in the data.

Disadvantage: False positives, Scanner Compatibility, High Expensive.

Authentication Using Face Recognition System into Examination HallAuthors: SM Basha, P Rajesh, PS Tej, NS Kumar, K Surendra

Human identification is a procedure to distinguish an individual dependent on at least one of kind highlights of that individual. Numerous wide assortments of individual confirmation method are accessible in the business and law upholding field. The most widely recognized individual check technique is Password identification number (PIN) or secret phrase framework. In any case, these strategies are helpless against phony, robbery,and slips by in the client's memory.

Disadvantage: The face identification system for attendance with real-time processing of videos has a very poor accuracy rate and a low level of stability.

Real Time Attendance System Using Face Recognition TechniqueAuthors: Mayank Srivastava, Amit Kumar, Aditya Dixit

Attendance is a mandatory part of every class in colleges. Often, there is a minimum attendance requirement for courses taken by students. The simplest methods of taking attendance include roll-call or manually signing on a document. These methods are tedious and waste time and do not take advantage of technology in any way. Attendance will have to be manually entered from the attendance sheet into the database. Further, proxy attendance is easy, wherein a student gives attendance to another student, either by forging his signature or calling out his name during roll-call. A current solution to make attendance easier, and gaining popularity, is biometric attendance.

Disadvantage: Huge storage requirements, Potential Privacy Issues, vulnerable detection.

Seamless Personnel Authentication using Facial Recognition and Identity-Based Identification on Mobile Devices

Authors: Jun-Ren Tan, Wai-Kit Chin, Ji-Jian Chin and Vik-Tor Goh

Security systems for buildings are no longer an uncommon thing in daily life with increasingly complex access control systems to achieve secured building security system. Achieving a hassle-free yet secure access control systems has been always a challenge for organizations especially for those managing large buildings. In this project, we develop a prototype that utilizes a combination of biometric and cryptography based security schemesto grant access control on personnel going in and out of a building. Our development achieves two-factor authentication in one single step which provides users a seamless experience for authentication. The identity-based identification (IBI) scheme that is based on number-theoretic cryptography is implemented on mobile devices to allow the identification scheme to run in the background.

Disadvantage: There is a risk of the technology being misused for unauthorized surveillance, and tracking individuals without their knowledge or consent.

EXISTING SYSTEM

User authentication is the process of verifying the identity of a user before granting accessto a system or service. It typically involves the user providing some form of credentials, such as a username and password, biometric data like fingerprints or facial recognition, orcryptographic keys. These credentials are compared against stored information in a database or directory to confirm the user's identity. The authentication process aims to ensure that only authorized users are granted access to sensitive information or resources, thus safeguarding against unauthorized access and potential security breaches. Strong authentication methods often involve multi-factor authentication, which combines two or more different types of credentials to enhance security. Overall, user authentication plays a critical role in protecting digital assets and maintaining the integrity of systems and data.

PROPOSED SYSTEM

The different Deep Learning models that are consider for Face Recognition are Histogram of Oriented Gradient(HOG), Landmark Estimation Algorithm(LEA), Support Vector Machine(SVM).

Histogram of Oriented Gradients (HOG) is a feature extraction technique used primarily in computer vision for object detection and recognition tasks. It works by analyzing the distribution of gradients, or intensity gradients, in localized regions of an image. Essentially, HOG divides the image into small cells and computes the gradient orientationand magnitude within each cell. It then groups these gradient information into histograms,capturing the dominant gradient directions within each block of cells.

SYSTEM ARCHITECTURE

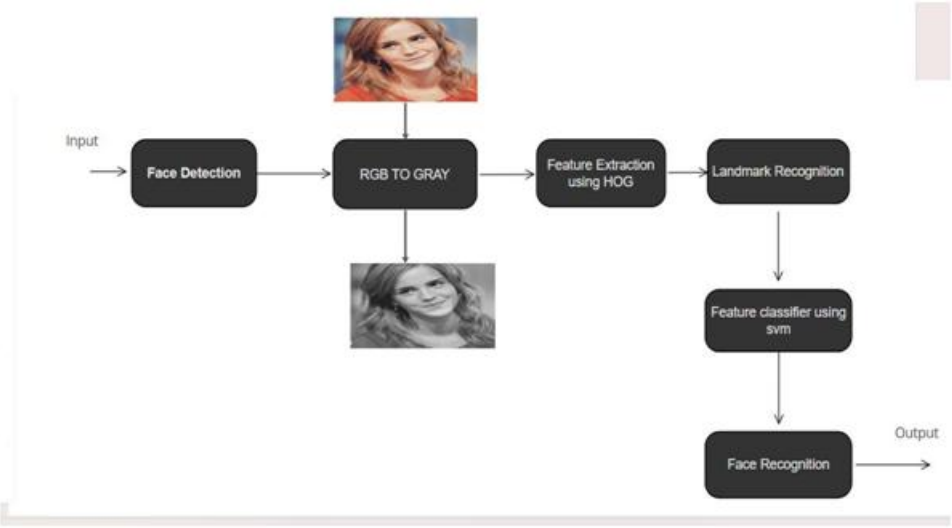

Fig.1. Architecture of Proposed System

The proposed system for face recognition using Histogram of Oriented (HOG) and Support Vector Machine(SVM) aims to address the challenges associated with inaccurate face recognition due to some factors such as poor video quality, weather conditions, personal pose and facial expressions. The Face Recognition consists of two Alogorithms i.e., Histogram of Oriented Gradient(HOG) and Support Vector Machine(SVM) .

Histogram of Oriented Gradient(HOG): The Histogram of Oriented Gradients (HOG) is a feature descriptor that captures the local gradient information in an image. It divides theimage into small spatial regions called cells and computes histograms of gradient orientations within each cell. These histograms are then normalized to enhance the robustness of the descriptor against changes in illumination and contrast. HOG has been widely used in object detection and recognition due to its ability to represent the local shapeand texture information effectively.

Support Vector Machine (SVM) is a popular classification algorithm used to distinguish between different individuals based on their facial features. SVM learns to classify face images by finding the optimal decision boundary that separates the feature vectors extracted from the images of different individuals. These feature vectors are often derived from techniques like Histogram of Oriented Gradients (HOG), which capture the distinctive characteristics of faces while reducing dimensionality.By training on a dataset containing labeled face images, SVM can accurately classify new face images, enabling applications such as biometric authentication, surveillance, and access control systems.

ADVANTAGES OF PROPOSED SYSTEM

This System has High “Accuracy” when compare to user Authentication.

HOG features have relatively low “dimensionality” compared to raw pixel data.

Face “landmark estimation” algorithms provide crucial spatial information aboutfacial features such as eyes, nose, and mouth.

These algorithms can be seamlessly “integrated” into larger systems.

High Accurate face recognition in a wide range of practical scenarios.

SYSTEM STUDY

The system study of a project on face recognition using Histogram of Oriented Gradients (HOG) and Support Vector Machine (SVM) involves understanding the requirements, scope,and feasibility of implementing such a system. It includes analyzing the existing methods and technologies related to face recognition, as well as identifying the specific goals and objectives of the project. During this phase, factors such as data collection, preprocessing techniques, feature extraction with HOG, training and testing of SVM classifier, integration with user interfaces or other systems, and performance evaluation are considered.

Support Vector Machine(SVM)

The Support Vector Machines (SVM) are a class of supervised learning algorithms that excel in classification tasks. SVMs work by finding the optimal hyperplane that separates different classes in a high-dimensional feature space. By maximizing the margin between the classes, SVMs achieve good generalization performance and can handle non-linear decision boundariesthrough the use of kernel functions. SVMs have been successfully applied in various domains, including face recognition, where they offer robustness against noise and outliers.

DATA PREPARATIONData Input:

Face image database
Live face image capture (e.g., camera)

Preprocessing:

Face detection (e.g., Viola-Jones algorithm)
Face alignment (e.g., affine transformation)
Face resizing (e.g., to 128x128 pixels)
Grayscale conversion
Histogram equalization

HOG Feature Extraction:

Divide face image into small cells (e.g., 8x8 pixels)
Calculate gradient orientation and magnitude for each cell
Create a histogram of oriented gradients for each cell
Concatenate histograms from all cells to form a feature vector

Feature Vector Normalization:

Normalize feature vectors to have the same length

SVM Training:

Split dataset into training and testing sets
Train SVM classifier using training set
Use HOG feature vectors as inputs and corresponding labels (e.g., person ID) as outputs

SVM Classification:

Use trained SVM classifier to classify new face images
Extract HOG features from new image and input them into SVM classifier
Classifier outputs a label (e.g., person ID) indicating the recognized face

Recognition Output:

Display recognized face image and corresponding label (e.g., person name)DATA PREPA

Sample Dateset

The dataset should be large enough to capture the variability present in real-world scenarios and should cover a wide range of demographics, including gender, age, ethnicity, and facial characteristics. Additionally, the dataset may include multiple images per individual to account for variations in appearance across different

images.

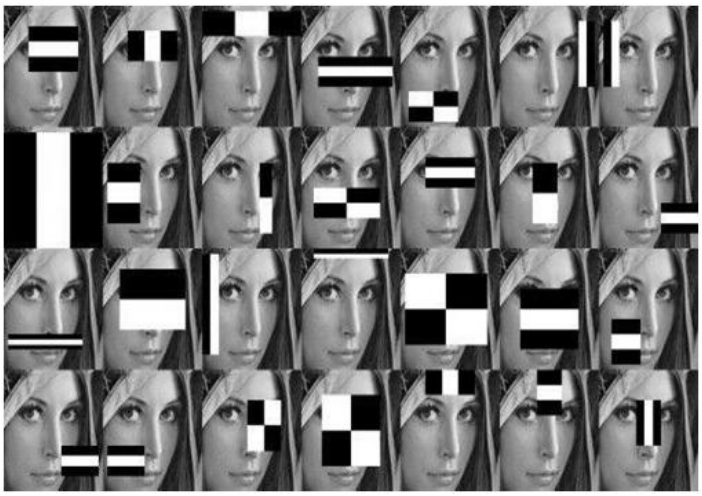

Fig.2. Collection of face recognition images

Work Flow of HOG

The workflow of HOG involves several key steps. Initially, the project begins with preprocessing the face images to enhance their quality and standardize their appearance, often converting them to grayscale to simplify processing. Next, HOG calculates the gradients, representing the intensity changes, within localized regions of the images. These gradients are then quantized into orientation histograms within small cells, capturing the dominant directions of edges and texture.

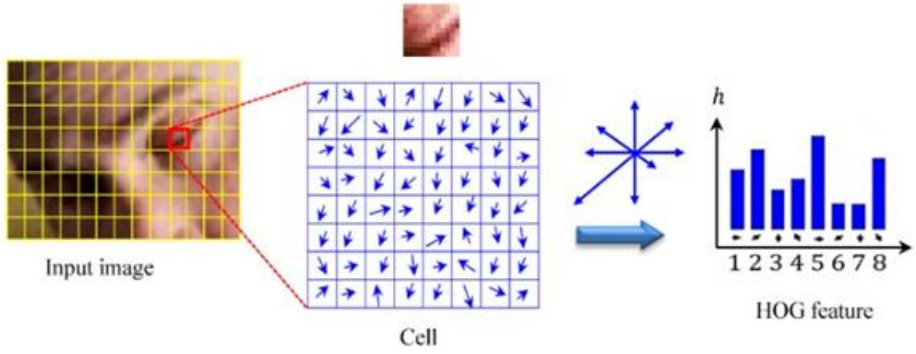

Fig.3. Work Flow of HOG

EVALUATION CRITERIA

Evaluating face recognition using HOG and SVM involves a few key criteria. Some important ones include accuracy, precision, recall, and F1 score. Accuracy measures the overall correctness of the model's predictions, while precision measures the proportion of correctly identified faces out of all the faces predicted. Recall measures the proportion of correctly identified faces out of all the actual faces. The F1 score combines precision and recall into a single metric. These criteria help assess the performance and effectiveness of the face recognition system.

RESULTS

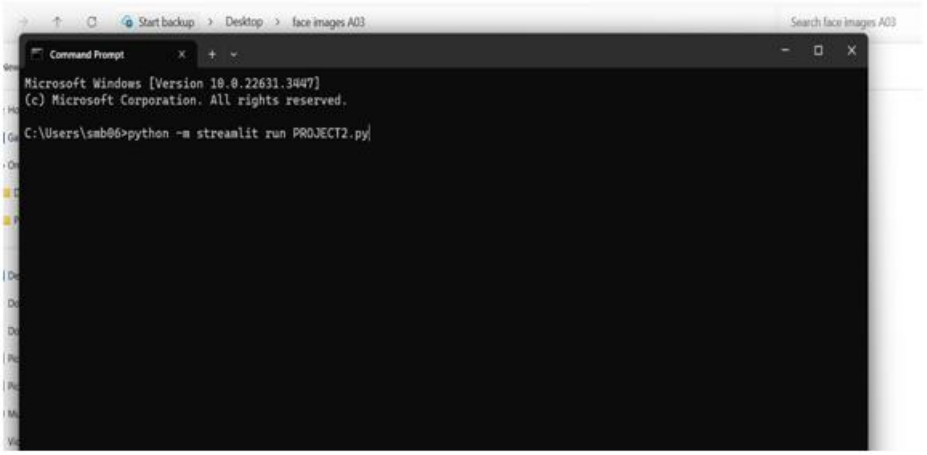

Fig.4. Command image

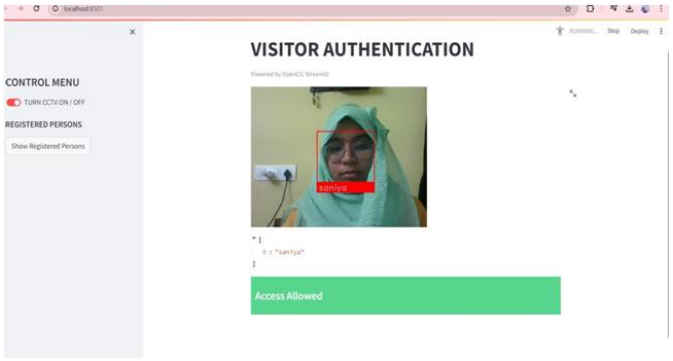

Fig.5. Sample Face image

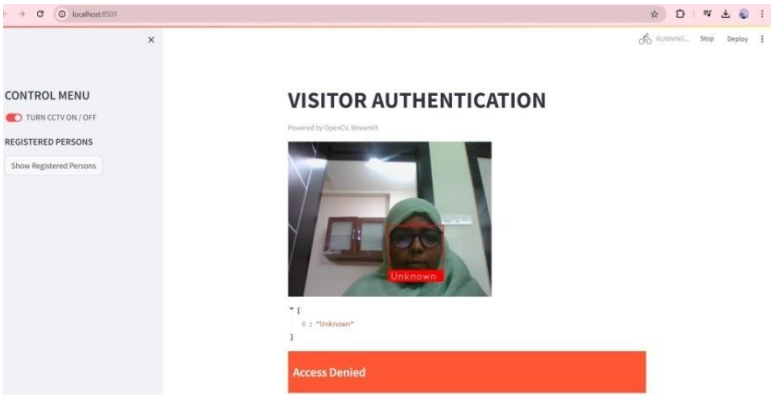

Fig.6. Sample Face image

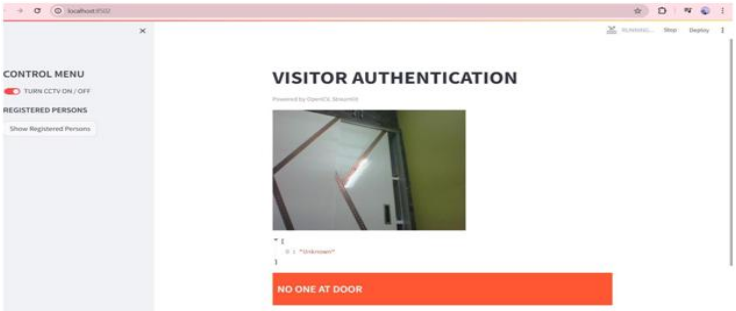

Fig.7. Sample Face image

Conclusion

The face recognition with Histogram of Oriented Gradients (HOG) and Support Vector Machines (SVM) has proven to be a highly effective approach for face recognition tasks. HOG's ability to extract robust and discriminative features from face images, coupled with SVM's powerful classification capabilities, enables accurate identification of individuals even in varying lighting conditions and pose. The HOG+SVM framework has demonstrated excellent performance in face recognition benchmarks, outperforming other state-of-the-art methods. Its robustness, efficiency, and accuracy make it a suitable solution for various applications, including security, surveillance, and identity verification systems. Overall, the HOG+SVM approach has contributed significantly to the advancement of face recognition technology, paving the way for further innovations in this field.

FUTURE SCOPE

The future scope on face recognition using Histogram of Oriented Gradients (HOG) and Support Vector Machine (SVM) holds promising opportunities for further enhancement and application, which have shown remarkable performance in image recognition tasks. HOG features and SVM classification, the system could achieve even higher accuracy and robustness in recognizing faces across diverse conditions. Additionally, there's scope for optimizing the computational efficiency of the algorithms to enable real-time face recognition on resource-constrained devices, such as smartphones and embedded systems. Moreover, exploring applications beyond traditional face recognition, such as emotion detection, age estimation, and facial attribute analysis, could expand the project's utility in various domains, including security, healthcare, and human-computer interaction. Overall, the future scope of the project involves leveraging emerging technologies and exploring new application areas to further advance the capabilities and impact of face recognition using HOG and SVM

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PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics,natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems anddesign system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of theinformation to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and needfor sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities andnorms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leaderin diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and writeeffective reports and design documentation, make effective presentations, and give and receiveclear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member andleader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engagein independent and life-long learning in the broadest context of technological change.

Institute Vision , Mission Statements

Vision: To emerge as a centre of technical excellence, transforming the engineering aspirantsinto dynamic and socially responsible technocrats.

IM1: Implementing effective strategies for imparting quality education in a conducive academicambience to upgrade the intellectual and professional dimensions of the learner's personality IM2: Facilitating skill development and research to fulfill societal needs
IM3: Inculcating moral principles, environmental consciousness and social responsibility amongStudents
IM4: Grooming the students to handle the career challenges successfully

Department of CSE

Vision

To evolve as a leading computer science and engineering center producing competenttechnocrats to meet the demands of ever-changing industry and society

Mission

Impart quality education through innovative teaching learning processes
Motivate the learners to upgrade technical expertise by promoting learner centricactivities.
Inculcate values and interpersonal skills in the learners towards overall development.
Upgrade knowledge in cutting edge technologies keeping pace with industrial standardsthrough collaborations.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Apply the expertise in adaptive algorithms to develop quality software applications.
PSO 2: Demonstrate the capabilities in basic and advanced technologies towards gettingemployed or to become an entrepreneur

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of B.Tech in Computer Science and Engineering Programme shall be able to
PEO 1: Outperform in professional career or higher learning by upgrading skillsin Computer Science and Engineering stream.
PEO 2: Provide computing solutions for complex problems to meet industry demands andsocietal needs.
PEO 3: Offer ethical, socially sensitive solutions as professionals and as entrepreneurs inComputer Science and other engineering disciplines.
PEO 4: Leverage new computing technologies by engaging themselves in perpetual learning.