NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	MTech CSE (Cyber Security)
Course Code:	6CS466ME25
Course Title:	Surveillance and Analytics
Course Type:	Department Elective-III
Year of Introduction:	2025-26

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Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

1. illustrate types of surveillance systems, their components and summarize objectives of analyzing surveillance data (BL2)
2. identify important components of a surveillance system and its analytical pipeline and apply various preprocessing techniques on a video (BL3)
3. assess different analytics tasks on surveillance data and adapt existing techniques and models for them (BL5)
4. create intelligent models using machine learning and deep learning for different surveillance task. (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction:** Types of Surveillance and Surveillance Systems, Various Surveillance Sensors and type of the data they collect, Need, Importance and Applications of Surveillance, Objectives of Analyzing Surveillance Data	03
Unit-II	**Scalar Surveillance Systems:** Surveillance based on images, Public Health Surveillance, Home Security, monitored and unmonitored security systems, IoT based analytics, speech analytics, border patrolling surveillance mechanisms	06
Unit-II	**Components of Video Analytics:** Understanding Video and its Components, Need for Video Surveillance and its Analytics, Video Analysis Pipeline, Video Preprocessing Techniques, Edge Detection in Video, Key Frame Extraction Techniques, PCA, FLD, SIFT	08
Unit-III	**Foreground Extraction from a Video:** Background Estimation, Averaging, Gaussian Mixture Model, Optical Flow, Image Segmentation, Region Growing, Region Splitting, Morphological Operations, Tracking in a Multiple Camera Environment, Deep Learning Techniques for Foreground Extraction from a Video	10
Unit-IV	**Classification in Video:** Spatiotemporal Convolutional Neural Networks, ConvLSTM, 3D CNN, Attention Mechanisms, Visual Transformers, Fuzzy Classification	8
Unit-V	**Surveillance for Security:** Abandoned Object Detection, Human Behavioural Analysis, Human, Action Recognition, Perimeter Security, Crowd Analysis and Prediction of Crowd Congestion, Person Re-Identification.	10

Self-Study:
The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

1. Graeme A. Jones, Nikos Paragios, Carlo S. Regazzoni, Video-Based Surveillance Systems: Computer Vision and Distributed Processing, Kluwer Academic Publisher
2. Nilanjan Dey, Amira Ashour and Suvojit Acharjee, Applied Video Processing in Surveillance and Monitoring Systems, IGI Global
3. Zhihao Chen, Ye Yang, Jingyu Xue, Liping Ye, Feng Guo, The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite, CreateSpace Independent Publishing Platform
4. E. R. Davies and Matthew Turk, Advanced Methods and Deep Learning in Computer Vision, Elsevier
5. Umberto Michelucci, Advanced Applied Deep Learning: Convolutional Neural Networks and Object Detection, Apress.

Suggested List of Experiments:

Sr. No.	Name of Experiments/Exercises	Hours
1	Reading and Writing Video Data	02
2	Key Frame Detection in a Video	02
3	Edge Detection in a Video	02
4	Real -time Object Detection and Tracking in a Video	06
5	Human Activity Recognition in a Video	06
6	Person Re-Identification	06
7	Human Behavior Analysis in a Video.	06