**NIRMA UNIVERSITY**

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| **Institute:** | Institute of Technology |
| **Name of Programme:** | BTech CSE |
| **Course Code:** | 4CS211DE25 |
| **Course Title:** | Surveillance and Analytics |
| **Course Type:** | Disciplinary Minor- Elective |
| **Year of Introduction:** | 2025-26 |

| L | T | Practical Component | | | | C |
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**Course Learning Outcomes (CLO):**

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

1. illustrate types of surveillance systems and their components and summarize objectives of analysing surveillance data (BL2)
2. identify key surveillance system components and analytical pipeline, applying preprocessing techniques to enhance video analysis (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 tasks. (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 Analysing 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 | 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 | 08 |
| 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. | Title | Hours |
|---|---|---|
| 1 | Reading and Writing Video Data | 02 |
| 2 | Key Frame Detection in a Video | 04 |
| 3 | Edge Detection in a Video | 02 |
| 4 | Object Detection | 04 |
| 5 | Real-Time Object Detection | 02 |
| 6 | Object Tracking in a Video | 02 |
| 6 | Human Activity Recognition from an image | 02 |
| 7 | Human Activity Recognition from a video | 02 |
| 8 | Person Tracking | 02 |
| 9 | Person Identification | 02 |
| 10 | Human Behavior Analysis in a Video | 06 |