GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3164102
Semester – VI
Subject Name: Machine Vision System

Type of course: Professional Core Course

Prerequisite: Zeal to learn the course

Rationale: Machine vision system is the best part automation field. The concepts of vision system are vitally important to the robotics and automation engineer

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	0	4	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	**Vision System:** Basic Components – Elements of visual perception, Lenses: Pinhole cameras, Gaussian Optics- cameras-computer interfaces.	7
2	**Vision Algorithms:** Fundamental Data Structures: Images, Regions, Sub-pixel Precise Contours – Image Enhancement : Gray value transformations, image smoothing, Fourier Transform – Geometric Transformation - Image segmentation – Segmentation of contours, lines, circles and ellipses – Camera calibration – Stereo Reconstruction.	9
3	**Object Recognition:** Object recognition, Approaches to Object Recognition, Recognition by combination of views – objects with sharp edges, using two views only, using a single view, use of dept values.	9
4	**Applications:** Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking: Following the road, Iconic image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering	7
5	**Robot Vision:** Basic introduction to Robotic operating System (ROS) - Real and Simulated Robots - Introduction to OpenCV, Open NI and PCL, installing and testing ROS camera Drivers, ROS to OpenCV - The cv_bridge Package.	9

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Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**40**	**20**	**20**	**-**	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Rafael C. Gonzalez and Richard E.woods, "Digital Image Processing", Addition - WesleyPublishing Company, New Delhi, 2007.
2. Shimon Ullman, "High-Level Vision: Object recognition and Visual Cognition", A Bradford Book,USA, 2000.
3. R.Patrick Goebel, " ROS by Example: A Do-It-Yourself Guide to Robot Operating System – Volume I", A Pi Robot Production, 2012.
4. Carsten Steger, Markus Ulrich, Christian Wiedemann, "Machine Vision Algorithms and Applications", WILEY-VCH, Weinheim,2008.
5. Damian m Lyons,"Cluster Computing for Robotics and Computer Vision", World Scientific, Singapore, 2011.

Course Outcomes: After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Knowledge or gadgets of vision systems.	15%
CO-2	Ability to understand the image capturing and processing techniques.	25%
CO-3	Ability to apply the vision system in other machines.	20%
CO-4	Knowledge for recognizing the objects.	25%
CO-5	Knowledge in application of vision and image processing in robot operations.	15%

List of Experiments:

1. Understanding of components of vision system.
2. Understanding principles of vision system.
3. Understanding different techniques of Object recognition.

4. Understanding Image processing techniques.
5. Analysis the application of machine vision in industrial application.
6. Understandings of Robot vision – object tracking and image processing software.
7. Understanding clustering techniques for robot vision.
8. Understanding algorithms in vision system.

List of Equipments:

Related simulation software, vision camera, etc.

List of Open Source Software/learning website:

- ROS (Microsoft Robotics Studio, Orocos)