GUJARAT TECHNOLOGICAL UNIVERSITY

SUBJECT: MACHINE VISION SYSTEM

SUBJECT CODE: 2164102

B.E. 6th Semester

Type of course: Professional Core Course

Prerequisite: Robotic Sensor, Vision System, Automated Scanning/Tracking system

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						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Vision System:** Basic Components – Elements of visual perception, Lenses: Pinhole cameras, Gaussian Optics- cameras-computer interfaces.	9	20%
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	20%
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	20%
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.	9	20%

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	20%

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:

1. Knowledge or gadgets of vision systems
2. Ability to understand the image capturing and processing techniques
3. Ability to apply the vision system in other machines
4. Knowledge for recognizing the objects
5. Knowledge in application of vision and image processing in robot operations

List of Tutorial:

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.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.