A

COURSE FILE

ON

"COMPUTER VISION"

IV B-Tech II Semester (R22)

Academic Year 2023-24

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CMR ENGINEERING COLLEGE

KANDLAKOYA (V), MEDCHAL (M), R.R.DIST.

CMR ENGINEERING COLLEGE

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(Approved by AICTE - New Delhi. Affiliated to JNTUH and Accredited by NAAC & NBA)

COURSE INSTRUCTOR NAME: **Mr. Y. SHYAM SUNDAR** **ACADEMIC YEAR: 2023-24**
SUBJECT NAME: **COMPUTER VISION**
EMAIL-ID:-**shyamsundar.y@cmrec.ac.in** CLASS ROOM NO: B-212
CONTACT NO: 8309830267
SEM START DATE AND END DATE: **04-12-2023 T0 27-03-2024**

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HOD

1. DEPARTMENT VISION & MISSION

Vision:

To produce globally competent and industry ready graduates in Computer Science & Engineering by imparting quality education with a know-how of cutting edge technology and holistic personality.

Mission:

M1. To offer high quality education in Computer Science & Engineering in order to build core competence for the students by laying solid foundation in Applied Mathematics, and program framework with a focus on concept building.
M2. The department promotes excellence in teaching, research, and collaborative activities to prepare students for professional career or higher studies.
M3. Creating intellectual environment for developing logical skills and problem solving strategies, thus to develop, able and proficient computer engineer to compete in the current global scenario.

2. LIST OF PEOs AND POs

2.1 Program Educational Objectives (PEO):

PEO 1: Excel in professional career and higher education by acquiring knowledge of mathematical computing and engineering principles.
PEO 2: To provide an intellectual environment for analyzing and designing computing systems for technical needs.
PEO 3: Exhibit professionalism to adapt current trends using lifelong learning with legal and ethical responsibilities.
PEO 4: To produce responsible graduates with effective communication skills and multidisciplinary practices to serve society and preserve the environment.

2.2 .Program Outcomes (PO):

Engineering Graduates will be able to satisfy these NBA graduate attributes:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, 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 and design 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 the information to provide valid conclusions
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering 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 assess societal, 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 need for sustainable development
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in 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 write effective reports and design documentation, make effective presentations, and give and receive clear 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 and leader 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 engage in independent and life-long learning in the broadest context of technological change

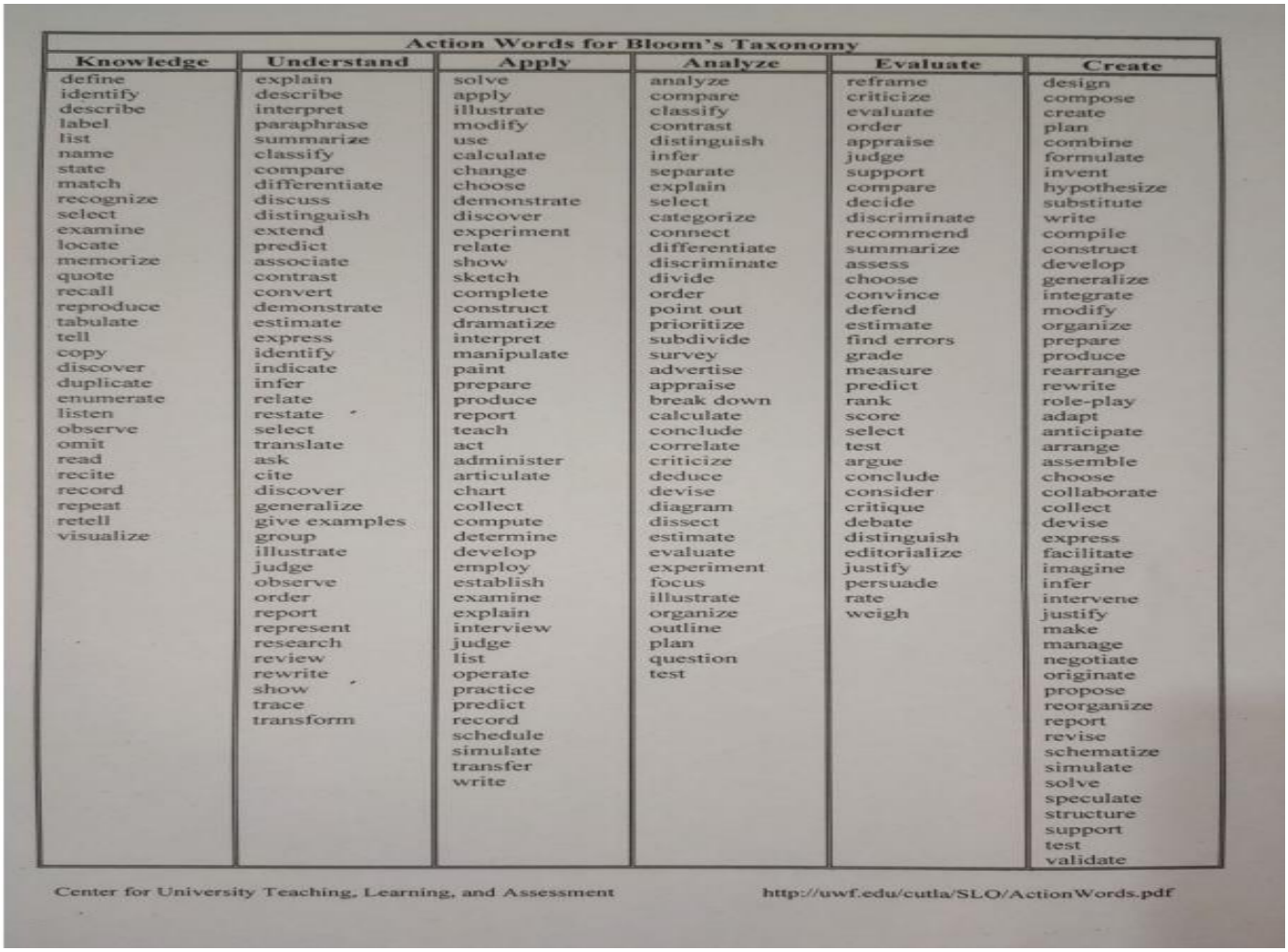
2.3 Program Specific Outcomes (PSOs):

PSO1: Professional Skills and Foundations of Software development: Ability to analyze, design and develop applications by adopting the dynamic nature of Software developments.
PSO2: Applications of Computing and Research Ability: Ability to use knowledge in cutting edge technologies in identifying research gaps and to render solutions with innovative ideas.

3. COURSE OUTCOMES

1. List of course outcomes with BTL

CO1	To Implement fundamental image processing techniques required for computer vision. **(UNDERSTAND)**
CO2	To Perform Shapes and Regions analysis. **(CREATING)**
CO3	Apply Hough Transform for line, circle, and ellipse detections **(ANALYZING)**
CO4	Apply 3D vision and motion techniques. **(APPLY)**
CO5	Develop applications using computer vision techniques **(IMPLEMENTATION)**



Action Words for Bloom's Taxonomy

Knowledge	Understand	Apply	Analyze	Evaluate	Create
define	explain	solve	analyze	reframe	design
identify	describe	apply	compare	criticize	compose
describe	interpret	illustrate	classify	evaluate	create
label	paraphrase	modify	contrast	order	plan
list	summarize	use	distinguish	appraise	combine
name	classify	calculate	infer	judge	formulate
state	compare	change	separate	support	invent
match	differentiate	choose	explain	compare	hypothesize
recognize	discuss	demonstrate	select	decide	substitute
select	distinguish	discover	categorize	discriminate	write
examine	extend	experiment	connect	recommend	compile
locate	predict	relate	differentiate	summarize	construct
memorize	associate	show	discriminate	assess	develop
quote	contrast	sketch	divide	choose	generalize
recall	convert	complete	order	convince	integrate
reproduce	demonstrate	construct	point out	defend	modify
tabulate	estimate	dramatize	prioritize	estimate	organize
tell	express	interpret	subdivide	find errors	prepare
copy	identify	manipulate	survey	grade	produce
discover	indicate	paint	advertise	measure	rearrange
duplicate	infer	prepare	appraise	predict	rewrite
enumerate	relate	produce	break down	rank	role-play
listen	restate	report	calculate	score	adapt
observe	select	teach	conclude	select	anticipate
omit	translate	act	correlate	test	arrange
read	ask	administer	criticize	argue	assemble
recite	cite	articulate	deduce	conclude	choose
record	discover	chart	devise	consider	collaborate
repeat	generalize	collect	diagram	critique	collect
retell	give examples	compute	dissect	debate	devise
visualize	group	determine	estimate	distinguish	express
	illustrate	develop	evaluate	editorialize	facilitate
	judge	employ	experiment	justify	imagine
	observe	establish	focus	persuade	infer
	order	examine	illustrate	rate	intervene
	report	explain	organize	weigh	justify
	represent	interview	outline		make
	research	judge	plan		manage
	review	list	question		negotiate
	rewrite	operate	test		originate
	show	practice			propose
	trace	predict			reorganize
	transform	record			report
		schedule			revise
		simulate			schematize
		transfer			simulate
		write			solve
					speculate
					structure
					support
					test
					validate

Center for University Teaching, Learning, and Assessment http://uwf.edu/cutla/SLO/ActionWords.pdf

REVISED Bloom's Taxonomy Action Verbs

Definitions	I. Remembering	II. Understanding	III. Applying	IV. Analyzing	V. Evaluating	VI. Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	• Choose • Define • Find • How • Label • List • Match • Name • Omit • Recall • Relate • Select • Show • Spell • Tell • What • When • Where • Which • Who • Why	• Classify • Compare • Contrast • Demonstrate • Explain • Extend • Illustrate • Infer • Interpret • Outline • Relate • Rephrase • Show • Summarize • Translate	• Apply • Build • Choose • Construct • Develop • Experiment with • Identify • Interview • Make use of • Model • Organize • Plan • Select • Solve • Utilize	• Analyze • Assume • Categorize • Classify • Compare • Conclusion • Contrast • Discover • Dissect • Distinguish • Divide • Examine • Function • Inference • Inspect • List • Motive • Relationships • Simplify • Survey • Take part in • Test for • Theme	• Agree • Appraise • Assess • Award • Choose • Compare • Conclude • Criteria • Criticize • Decide • Deduct • Defend • Determine • Disprove • Estimate • Evaluate • Explain • Importance • Influence • Interpret • Judge • Justify • Mark • Measure • Opinion • Perceive • Prioritize • Prove • Rate • Recommend • Rule on • Select • Support • Value	• Adapt • Build • Change • Choose • Combine • Compile • Compose • Construct • Create • Delete • Design • Develop • Discuss • Elaborate • Estimate • Formulate • Happen • Imagine • Improve • Invent • Make up • Maximize • Minimize • Modify • Original • Originate • Plan • Predict • Propose • Solution • Solve • Suppose • Test • Theory

Anderson, L. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing, Abridged Edition. Boston, MA: Allyn and Bacon.

4. SYLLABUS COPY and Suggested/Reference Books

COMPUTER VISION

B.TECH IV YEAR I SEM
COURSE CODE: CS864PE

UNIT - I

IMAGE PROCESSING FOUNDATIONS

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.

UNIT - II

SHAPES AND REGIONS

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary

length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

UNIT – III

HOUGH TRANSFORM

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

UNIT – IV

3D VISION AND MOTION

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

UNIT - V

APPLICATIONS

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

TEXT BOOKS:

1. Simon J. D. Prince, ―Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.
2. Mark Nixon and Alberto S. Aquado, ―Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
3. E. R. Davies, ―Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.

REFERENCES BOOKS:

1. D. L. Baggio et al., ―Mastering OpenCV with Practical Computer Vision Projects‖, Packt Publishing, 2012.
2. Jan Erik Solem, ―Programming Computer Vision with Python: Tools and algorithms for analyzing images‖, O'Reilly Media, 2012.
3. R. Szeliski, ―Computer Vision: Algorithms and Applications‖, Springer 2011.

5. INDIVIDUAL TIME TABLE

	I	II	III	IV	V	VI	VII
MON		CV-C				CV-C	
TUE	CV-C			CV-C			
WED					CV-C		CV-C
THU	MAJOR PROJECT STAGE-2				MAJOR PROJECT STAGE-2		
FRI	MAJOR PROJECT STAGE-2				MAJOR PROJECT STAGE-2		
SAT	MAJOR PROJECT STAGE-2				MAJOR PROJECT STAGE-2		

6. SESSION PLAN/LESSON PLAN

S.NO	Topic (JNTU syllabus)	Sub-Topic	NO. OF LECTURES REQUIRED	Suggested Books	Methods
1	UNIT – I IMAGE PROCESSING FOUNDATIONS	Image processing Introduction	L1	T1	M1,M2,M4
2		image processing techniques	L2, L3	T1	M1,M2,M4
3		classical filtering operations	L4, L5	T1	M1,M2,M4
4		thresholding techniques	L6, L7	T1	M4,M5
5		edge detection techniques	L8	T1	M1,M2,M4
6		corner and interest point detection	L9	T1	M1,M2,M4
7		mathematical morphology	L10	T1	M1,M2,M4
8	Unit – II SHAPES AND REGIONS	Introduction	L11	T1	M1,M2,M4
9		Binary shape analysis	L12	T1	M1,M2,M4
10		connectedness – object labeling and counting	L13	T1	M4,M5
11		size filtering – distance functions	L14	T1	M1,M2,M4
12		skeletons and thinning	L15	T1	M1,M2,M4
13		deformable shape analysis	L16	T1	M1,M2,M4
14		boundary tracking procedures	L17, L18	T1	M1,M2,M4
15		active contours – shape models and shape recognition	L19	T1	M1,M2,M4
16		centroidal profiles – handling occlusion	L20	T1	M3,M5,M4
17		boundary length measures – boundary descriptors	L21	T1	M6,M7,M8
18		chain codes – Fourier descriptors	L22		
19		region descriptors – moments	L23		
20		Introduction to Line detection	L24	T1	M9.M4
21		Hough Transform (HT) for line detection	L25	T1	M2,M4
22		foot-of-normal method	L26	T1	M4,M5
23		line localization – line fitting	L27	T1	M1,M2,M4
25		RANSAC for straight line	L28	T1	M1,M2,M4

		detection			
24	**Unit - III** **HOUGH TRANSFORM**	HT based circular object detection	**L29**	**T1**	M1,M2,M4
25		accurate center location – speed problem	**L30**	**T1**	M1,M2,M4
26		ellipse detection	**L31**	**T1**	M1,M2,M4
27		Case study: Human Iris location – hole detection	**L32**	**T1**	M1,M2,M4
28		generalized Hough Transform (GHT)	**L33**	**T1**	M1,M2,M4
29		spatial matched filtering	**L34**	**T1**	M1,M2,M4
30		GHT for ellipse detection	**L35**	**T1**	M4,M5
31		object location	**L36**	**T1**	M4
32		GHT for feature collation.	**L37**	**T1**	M4
32		Real time examples	**L38**	**T1**	M4
33	**Unit – IV** **3D VISION AND MOTION**	Motivation on 3D visions	**L39**	**T1**	M1,M2,M4
34		Methods for 3D vision – projection schemes	**L40**	**T1**	M1,M2,M4
35		shape from shading – photometric stereo	**L41**	**T1**	M1,M2,M4
36		shape from texture – shape from focus	**L42**	**T1**	M1,M2,M4
37		active range finding – surface representations	**L43**	**T1**	M1,M2,M4
38		point-based representation – volumetric representations	**L44**	**T1**	M3,M5,M4
39		3D object recognition – 3D reconstruction	**L45**	**T1**	M6,M7,M8
40		introduction to motion – triangulation	**L46**	**T1**	M9.M4
41		bundle adjustment – translational alignment	**L47**	**T1**	M2,M4
42		parametric motion – spline-based motion	**L48**	**T1**	M1,M2,M4
43		optical flow – layered motion.	**L49**		
44	**Unit – V** **APPLICATIONS**	Introduction.	**L50**	**T1**	M1
45		Application: Photo album – Face detection	**L51**	**T1**	M1
46		Face detection – Face recognition	**L52**	**T1**	M1
47		Eigen faces – Active appearance	**L53**	**T1**	M1
48		foreground-background separation	**L54**	**T1**	M1
49		particle filters – Chamfer matching, tracking, and occlusion	**L55**	**T1**	M1
50		combining views from multiple cameras	**L56**	**T1**	M1
51		In-vehicle vision system	**L57**	**T1**	M1
		locating roadway – road markings	**L58**	**T1**	M1

52		identifying road signs – locating pedestrians	**L59**	**T1**	M1

METHODS OF TEACHING:

M1 : Lecture Method	**M4 : Presentation /PPT**	**M7 : Assignment**
M2 : Demo Method	**M5 : Lab/Practical**	**M8 : Industry Visit**
M3 : Guest Lecture	**M6 : Tutorial**	**M9 : Project Based**

NOTE:

1. Any Subject in a Semester is suppose to be completed in 50 to 60 periods.
2. Each Period is of 50 minutes.
3. Each unit duration & completion should be mentioned in the Remarks Column.
4. List of Suggested books can be marked with Codes like T1, T2, R1, R2 etc.

7. Session Execution Log:

S no	Units	Scheduled started date	Completed date	Remarks
1	**I**	**04-12-23**	**20-01-24**	**Completed**
2	**II**	**21-01-24**	**02-02-24**	**Completed**
3	**III**	**03-02-24**	**20-02-24**	**Completed**
4	**IV**	**21-02-24**	**15-03-24**	**Completed**
5	**V**	**16-03-24**	**27-03-24**	**Completed**

8. LECTURE NOTES (hand written/soft copy print)

9. ASSIGNMENT QUESTIONS ALONG SAMPLE ASSIGNMENT SCRIPTS

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KANDLAKOYA (V), MEDCHAL ROAD, HYDERABAD-501401.
Ph: 08418 200037, 92470 22662, Fax: 08418 200240, www.cmrec.org.

Department of Computer Science & Engineering

Year: CSE , IV YEAR II-SEM **MID EXAMINATIONS-1**
Subject: COMPUTER VISION **Branch: CSE**

COMPUTER VISION

IV B.TECH. II SEM MID-1 ASSIGNMENT QUESTIONS

1. Discuss in detail the following morphological operations:
   a) Erosion b) Dilation
2. List and explain the fundamental steps in digital image processing?
3. Name different types of boundary tracking procedures, explain the square tracing algorithm?
4. Write a short note on following:
   a) Fourier descriptors b) Region descriptors.
5. Distinguish Hough Transform and generalized Hough transform.

IV B.TECH. II SEM MID-2 ASSIGNMENT QUESTIONS

1. Discuss about accurate center location by using Hough transform?
2. How to evaluate extracted shape descriptors in 3D vision? Discuss.
3. Explain about photometric stereo?
4. Discuss about combining views from multiple cameras?
5. Explain the identifying road signs in vehicle vision system?

10. MID EXAM QUESTION PAPER ALONG SAMPLE ANSWER SCRIPTS

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Department of Computer Science & Engineering

IV.B.TECH II SEM - I MID EXAMINATIONS

Subject: COMPUTER VISION **BRANCH: CSE**
Marks: 25 M

Year: CSE, IV YEAR II-SEM **MID EXAMINATIONS-1**
Subject: COMPUTER VISION **Branch: CSE**

Part –A **Total = 25 Marks**
Answer all the Questions: **Marks: 5X2=10M**

1. List basic components of image processing? [CO1]
2. Define image sampling and image quantization?[CO1]
3. What is homomorphic filtering? [CO2]
4. What is Gaussian Noise[CO2]
5. What is the Hough representation[CO3]

Part –B **3X5=15M**
Answer any three Questions:

6. Discuss in detail the following morphological operations:
   a)Erosion b)Dilation[CO1]

(OR)

7. List and explain the fundamental steps in digital image processing. [CO1]

8. Name different types of boundary tracking procedures, explain the square tracing algorithm[CO2]

(OR)

9. Write a short note on following:
   a)Fourier descriptors b) Region descriptors. [CO2]

10 .Distinguish Hough Transform and generalized Hough transform[CO3]

(OR)

11. Discuss about the RANSAC for straight line detection [CO3]

11. Mid-1 Scheme of evaluation

SL.NO		THEORY	MARKS	TOTAL
PART-A	1	basic components of image processing	2	2
	2	image sampling and image quantization	2	2
	3	homomorphic filtering	2	2
	4	Gaussian Noise	2	2
	5	Hough representation	2	2
PART-B	6	fundamental steps in digital image processing	5	5
	7	a)Erosion b)Dilation	5	5
	8	explain the square tracing algorithm	5	5
	9	a)Fourier descriptors b) Region descriptors	5	5
	10	Hough Transform and generalized Hough transform	5	5
	11	about the RANSAC for straight line detection	5	5
TOTAL MARKS				25 M

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Department of Computer Science & Engineering

IV.B.TECH II SEM - II MID EXAMINATIONS

Subject: COMPUTER VISION **BRANCH: CSE**
Marks: 25 M

Year: CSE, IV YEAR II-SEM **MID EXAMINATIONS-2**
Subject: Computer Vision **Branch: CSE**

Part –A **Total = 25 Marks**
Answer all the Questions: **Marks: 5X2=10M**

1. Explain how generalized Hough Transform can be used for feature coalition? [CO3]
2. What are the particular advantages offered by the HT technique?[CO3]
3. Explain shape from shading? [CO4]
4. What do you mean by photometric stereo?[CO4]
5. Explain the recognition of faces using the techniques of computer vision?[CO5]

Part –B **3X5=15M**
Answer any three Questions:

6. What is line detection? Explain the line detection by using HT? [CO3]

(OR)

7. Discuss about accurate center location by using Hough transform? [CO3]

8. How to evaluate extracted shape descriptors in 3D vision? Discuss? [CO4]

(OR)

9. Explain about photometric stereo? [CO4]

10. Discuss about combining views from multiple cameras? [CO5]

(OR)

11. Explain the identifying road signs in vehicle vision system? [CO5]

11. MID-II-SCHEME OF EVALUATION

Sl. No.		THEORY	MARKS	TOTAL
PART-A	1.	Explain how generalized Hough Transform can be used for feature coalition?	**2**	**2**
	2.	What are the particular advantages offered by the HT technique?	**2**	**2**
	3.	Explain shape from shading?	**2**	**2**
	4.	What do you mean by photometric stereo?	**2**	**2**
	5.	Explain the recognition of faces using the techniques of computer vision?	**2**	**2**
PART-B	6.	What is line detection? Explain the line detection by using HT?	**5**	**5**
	7.	Discuss about accurate center location by using Hough transform?	**5**	**5**
	8.	How to evaluate extracted shape descriptors in 3D vision? Discuss?	**5**	**5**
	9.	Explain about photometric stereo?	**5**	**5**
	10.	Discuss about combining views from multiple cameras?	**5**	**5**
	11.	Explain the identifying road signs in vehicle vision system?	**5**	**5**
TOTAL MARKS				**25M**

12. Mapping of Course Objectives, Course Outcomes with PEOs and Pos

	Program Outcome(PO):												
PEOS		1	2	3	4	5	6	7	8	9	10	11	12
	I			x	x	x	x	x	x	x	x		
	II				x	x	x	x	x	x	x		
	III				x		x	x	x	x	x		
	IV				x		x		x	x	x		

Course Outcomes	Relationship of Course outcomes to Program Outcomes (PO AVG)													
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2										2	2	
CO2	2	2			2							2	2	
CO3	3	3			2							2	3	
CO4	3		3		2							2	3	
CO5		2	2		2						3		2	2

13. COs, POs, PSOs Justification:

CO1: **To Implement fundamental image processing techniques required for computer vision.**
Correlated with PO1 slightly: mapped as students will be able to understand the fundamentals of image processing.
Correlated with PO2 moderately: mapped as students will be able to identify working process of computer vision.
Correlated with P12 moderately: Students get knowledge on different image filtering operations.

Correlated with PSO1 moderately: Students able to learn about image texture analysis.

CO2: <u>To Perform Shapes and Regions analysis.</u>
Correlated with PO1 moderately: mapped as students will be able to analyze object shapes and size in image.
Correlated with PO2 moderately: mapped as students will be able to understand shape analysis and boundary tracking.
Correlated with PO5 moderately: mapped as students will be able to perform operations on shape models and shape recognition.
Correlated with PO12 moderately: Students get knowledge on different techniques of object motion so that it motivates student to learn new technologies.
Correlated with PSO1 moderately: Students able analyze the images , objects, shapes in computer vision.

CO3: <u>Apply Hough Transform for line, circle, and ellipse detections.</u>
Correlated with PO1 high: mapped as students can use the concepts of Hough Transform techniques.
Correlated with PO2 high: mapped as students can use the hough transform for line detection.
Correlated with PO5 moderately: mapped as students will be able to identify the features of computer vision.
Correlated with PO12 moderately: Slightly mapped as students will be able to identify the services of Data intensive computing.
Correlated with PSO1 high: mapped as students will be able to understand regions and boundaries of the image processing.

CO4: <u>Apply 3D vision and motion techniques.</u>
Correlated with PO1 high: mapped as students will be able to understand methods for 3D vision.
Correlated with PO3 high: mapped as students will be able to understand methods for 3D vision.
Correlated with PO5 moderately: It contributes only knowledge on developing projection

schemes.
Correlated with PO12 moderately: Students get knowledge on different techniques of surface representation, point-based representation and 3D object recognition.
Correlated with PSO1 high: mapped as students can use the concepts of 3D vision and motion in computer vision.

CO5: <u>Develop applications using computer vision techniques.</u>
Correlated with PO2 moderately: mapped as students will be able to understand the face detection, face recognition applications.
Correlated with PO3 moderately: mapped as students will be able to identify the services of image foreground, background separation and particle filters.
Correlated with PO5 moderately: mapped as students will be able to identify the services of image foreground, background separation and particle filters in computer vision.
Correlated with PO11 high: mapped as the students will be able to apply the gained 3D shape models knowledge in real time problems.
Correlated with PSO1 moderately: Moderately mapped as the students will be able to apply tracking and occlusion application in human gait analysis.
Correlated with PSO2 moderately: Moderately mapped as the students will be able to demonstrate the knowledge and understand the application of vehicle vision system.

14. ATTAINMENT OF CO's, PO's AND PSO's (EXCEL SHEET):

Relationship of Course outcomes to Program Outcomes (PO AVG)													
PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2

ASSESSMENT OF POs THROUGH THE COURSE			
PO	CO	Value	AVG PO (mid)
PO1	CO1		
	CO2		
	CO3		
	CO4		
PO2	CO1		
	CO2		
	CO3		
	CO5		
PO3	CO2		
	CO3		
	CO4		
	CO5		
PO5	CO3		
	CO4		
	CO5		
PO7	CO4		
PO11	CO1		
	CO2		
	CO3		
	CO4		
	CO5		
PO12	CO1		
	CO2		
	CO3		
	CO4		
	CO5		
PSO1	CO2		
	CO3		
PSO2	CO1		
	CO2		
	CO3		
	CO4		
	CO6		

15. PREVIOUS YEAR QUESTION PAPERS.

R16

Code No: 138BH

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year II Semester Examinations, September - 2020
COMPUTER VISION
(Electronics and Communication Engineering)

Time: 2 Hours **Max. Marks: 75**

Answer any Five Questions
All Questions Carry Equal Marks
- - -

1. Discuss in detail the following morphological operations:
   a) Erosion b) Dilation [7+8]

2.a) List various approaches used in Image enhancement and then discuss any one method of it.
b) List and explain the fundamental steps in digital image processing. [7+8]

3. Name different types of boundary tracking procedures, explain the square tracing algorithm. [15]

4. Write a short note on followings:
   a) Fourier descriptors b) Region descriptors. [7+8]

5.a) Distinguish Hough Transform and generalized Hough transform.
b) Discuss about the RANSAC for straight line detection. [7+8]

6.a) What is line detection, Explain the line detection by using HT?
b) Discuss about accurate center location by using Hough transform. [7+8]

7.a) How to evaluate extracted shape descriptors in 3D vision? Discuss.
b) Explain about photometric stereo. [7+8]

8.a) Discuss about combining views from multiple cameras.
b) Explain the identifying road signs in vehicle vision system. [7+8]

---ooOoo---

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Model Question Paper

Seventh Semester B.E. Degree Examination

COMPUTER VISION

Time: 3 hours **Max.Marks: 100**

Note : Answer any FIVE full questions, choosing at least **ONE** question from each **MODULE**.

Module 1

1. What is Computer Vision? Why is vision so difficult? Provide six real-world examples of computer vision and explain. **(10 Marks)**
2. With a neat diagram explain the Image sensing pipeline and its important effects. **(10 Marks)**

OR

1. Explain 2D transformation with a neat diagram. **(5 Marks)**
2. Explain in detail the Bidirectional Reflectance Distribution Function(BRDF). **(8 Marks)**
3. Illustrate with a real-world example for pinhole perspective and explain its behavior under various effects **(7 Marks)**

Module 2

1. Explain Fourier Transform. Justify its properties. **(10 Marks)**
2. Write and explain the Corner Detector and Laplacian of Gaussian algorithm. **(10 Marks)**

OR

1. Explain the popular technique used in Object Detection with a real world example. **(10 Marks)**
2. Explain K-means Clustering for Vector Quantization in detail. **(10 Marks)**

Module 3

1. Explain Epipolar Geometry in detail. **(10 Marks)**
2. Explain Euclidean Structure and Motion from two images. **(10 Marks)**

OR

1. Briefly explain the global methods for binocular fusion in detail. **(10 Marks)**
2. Explain the Projective structure and motion from two images and multiple images. **(10 Marks)**

Module 4

1. Explain background subtraction and shot boundary detection in detail **(10 Marks)**
2. Write an algorithm on 1) Incremental Line Fitting 2) K-means line fitting **(10 Marks)**

OR

1. Explain in detail linear measurements and linear dynamics. **(10 Marks)**
2. Write a short note on 1) divisive clustering 2) agglomerative clustering. **(10 Marks)**

Module 5

1. Illustrate a real-time application used in registration. **(5 Marks)**
2. Explain Koenderink's Theorem. **(5 Marks)**
3. Write a short note on 1) Face detection 2) Pedestrian detection **(10 Marks)**

OR

1. How to detect a deformable object? Explain. **(10 Marks)**
2. Write a short note with an real-time example on 1) Instance segmentation 2) Panoptic segmentation **(10 Marks)**

16. POWER POINT PRESENTATIONS

Computer Vision

Make computers understand images and videos.

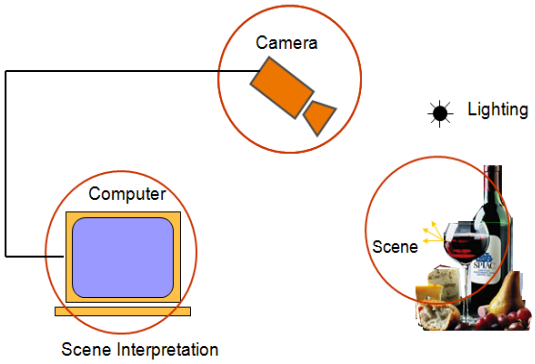
What kind of scene?

Where are the cars?

How far is the building?

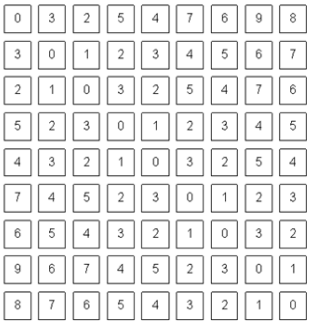
…

Components of a computer vision system



Computer vision vs human vision

What we see

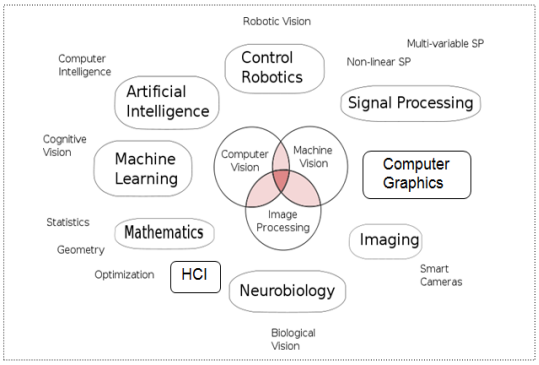


What a computer sees

Vision is really hard

- Vision is an amazing feat of natural intelligence
  - Visual cortex occupies about 50% of Macaque brain
  - More human brain devoted to vision than anything else

Vision is multidisciplinary



Why computer vision matters

Safety

Health

Security

Comfort

Fun

Access

17. INNOVATION TEACHING METHODS (Innovation assignment)

1. Explain the concept of image segmentation in computer vision.
2. What are some of the parameters that need to be adjusted to ensure optimal performance?

18. Websites or URLs e- Resources

1) **https://cs.nyu.edu/~fergus/teaching/vision_2012/1_Intro.pdf**
2) **http://vision.stanford.edu/teaching/cs131_fall1718/files/cs131-class-notes.pdf**
3) **https://faculty.ucmerced.edu/mcarreira-perpinan/teaching/ee589/lecture-notes.pdf**
4) **https://faculty.cc.gatech.edu/~afb/classes/CS4495-Fall2014/slides/CS4495-Ransac.pdf**
5) **http://www.cse.yorku.ca/~kosta/CompVis_Notes/ransac.pdf**
6) **https://en.wikipedia.org/wiki/Hough_transform**
7) **https://www.scaler.com/topics/hough-transform-in-image-processing/**
8) **https://opencv.org/blog/computer-vision-and-image-processing/**
9) **https://link.springer.com/chapter/10.1007/978-3-642-28661-2_8**
10) **https://www.diva-portal.org/smash/get/diva2:1395007/FULLTEXT01.pdf**
11) **https://www.researchgate.net/publication/257247132_Computer_Vision_Systems_in_Road_Vehicles_A_Review**
12) **https://aircconline.com/sipij/V6N5/6515sipij05.pdf**
13) **https://pages.cs.wisc.edu/~lizhang/courses/cs766-2008f/syllabus/10-09-shading/shading.pdf**
14) **https://cseweb.ucsd.edu/classes/fa21/cse252A-a/lec4.pdf**