Description of individual educational component (module)	
بینایی ماشین **Machine Vision**	
کارشناسی ارشد *Master of Science (M.Sc)*	
Organisation	Sari Agricultural Sciences and Natural Resources University (SANRU)
Faculty	Agricultural engineering
Department	Mechanics of Biosystems engineering
Responsible person	Assoc. Prof. Dr. –Ing. Davood Kalantari
Type of course unit	Elective Course
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	3rd semester
Number of ECTS credits allocated	3 Iranian Credits (Theoretical Credits: 2, Practical Credit: 1) (Equal to 11.5 ECTS)
Total hours	--
Contact hours	80 (32+48)
Self-study hours	Not specified
Mode of delivery	Face-to-face
Maximum attendance	20
Name of lecturer(s)	Dr. Sajad Sabzi
Prerequisites and co-requisites	Prerequisites: Basic Mathematics, Basic Physics, Basic Optics, Programing with Matlab
Course contents	1**. Introduction to the Agricultural Machine Vision** Topic 1. Elements of an agricultural machine vision system, image formation in eye and in a camera, the image sensors, photosensitive sensors, basic parameters of a digital image, lens Equation, image resolution, and depth of Field, **2. Digital image properties** Topic 2. Introduction: visual perception of the image, Image quality, noise in images, topological properties of digital images, histograms, Topic 3. Digital color images: Physics of color, color spaces, the RGB color space, other color representations such as HIS, HSV, YUV and YCbCr, converting digital color images to digital grayscale images, Topic 4. Chromatic images: color equipment's and conversion, conversion of gray images to colored, color separation with image processing, digital grayscale images, Topic 5. Binary images: Formation of binary images, geometric properties, topological properties, object recognition in binary images, binary algorithms **3. Image pre-processing** Topic 6. Pixel pre-processing: pixel brightness, brightness interpolation, Position-dependent brightness correction, gray-scale transformation, pixel coordinate transformations, Topic 7. Local pre-processing: Image smoothing, edge detectors, Canny edge detection, Gaussian Edge Detection, parametric edge models, line detection by local pre-processing operators, detection of

	corners, scale in image processing, Topic 8. Image segmentation: Partitioning an image, segmentation by thresholding, edge-based segmentation, region-based segmentation, watershed segmentation, splitting and merging, segmentation of surfaces, segmentation of curves, active contours. Topic 9. Geometric transformations: Translations, scaling, rotation, shearing and combining the transforms, backward mapping, interpolation and holography **4. Image enhancement** Topic 10. Image enhancement in frequency field, histogram Modification, gray scale modification, image restoration enhancement using the Laplacian operator, Topic 11. Image filtering operations and enhancements: Sharpening operators, smoothing, averaging, linear filters, Median filter, Gaussian Smoothing **5. More specified Image processing** Topic 12. Morphological image processing: Binary erosion/dilation, opening/closing, hit-or-miss transforms, Topic 13. Blob analysis: Blob features, Blob classification, Blob extraction, the Recursive Grass-Fire algorithm, the Sequential Grass-Fire algorithm.
Recommended or required reading and other learning resources/tools	1. Acharya, T., Ray, A. K. 2005. Image processing principles and applications. John Wiley and Sons 2. Bovik, A., C .2009. The essential guide to image processing. Academic Press 3. Davies, E, R.2005. Machine vision, theory, algorithms, and practicalities. Elsevier 4. Gonzalez, R.C., Woods, E. R. 2008. Digital image processing. Prentice Hall. 5. Hornberg, A .2006. Handbook of machine vision, Wiley-VCH. 6. Moeslund, T.B. 2012. Introduction to video and image processing: Building real systems and applications. Springer-Verlag, London. 7. Petrou M. and Petrou, C. 2010. Image Processing: The Fundamentals. John Wiley and Sons. 8. Pratt, W.K. 2007. Digital Image Processing. 4th edition. Wiley. 9. Sonka, M., Hlavac, V., Boyle, D. R. 2014. Image processing: Analysis and Machine Vision, 4th edition, Cengage Learning. 10. Sun D-W. 2007. Computer vision technology for food quality evaluation, Academic press.
Language of instruction	• Persian/English

Learning outcomes of the course unit
Learning outcome of the course unit includes the ability to analyze a digital image and extract the necessary information, together with the ability to use different mathematical models for image processing such as hidden Markov models; Kalman lters; point distribution models, and pattern recognition.

Planned learning activities and teaching methods
Lectures, tutorials, and problem solving

Assessment methods and criteria
The final grade is based on a three-point system. It may consist of the results of a final written assignment for the final exam (70%), Literature review (20%), and Report quality (10%) according the «Assessment criteria table».

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
- Different types of image transforms, - Image data compression, - Describing the image segmentation using different methods, - Description of shape representation, - Describing the 2D and 3D Vision, -Describing the motion analysis.	**On successful competition of this module students should be able to:** 1. analyze and enhance a digital image and transform it, 2. use the computer tools and programs for extracting the necessary information from a given image, 3. do a case study based on digital image processing and analysis; 4. use the Matlab software for performing a specified case study, such as using the image processing technique in intelligent weeding machine based on machine vision.

	Assessment criteria table				
Attribute	**Grade A (18-20 out of 20) (Excellent)**	**Grade B (16-18 out of 20) (Very good)**	**Grade C (14-16 out of 20) (Good)**	**Grade D/E (12-16 out of 20) (Satisfactory)**	**Grade F/FX (<12 out of 20) Failed / Insufficient**
Final Exam-written part (70%)	The complete solution of the task without serious flaws is given. The correct answer is provided.	The roughly complete solution of the task is provided. The correct answer with some minor mistakes in interim steps is received.	The content of the solution is good. The answer with some weaknesses in interim steps is received.	The content of the task is satisfactory but with several weaknesses regarding evidence and/or some lack of clarity.	The task of the work fell short of that required to pass due to lack of evidence base/or very poor clarity.
Literature review (20%)	The literature library assembled by the student was outstanding with no serious missing articles.	The literature library assembled by the student was very good with only a few missing key articles.	The literature library assembled had a number of missing key articles and lacked breadth.	The literature library lacked breadth to a great degree and was missing many key articles.	The literature library was lacking in breadth and key articles to an extent that fell short of a passing grade.
Report quality (10%)	The style and clarity of the report was excellent.	The style and/or clarity of the report were very good.	The style and/or clarity of the report were good.	The style and/or clarity of the report were adequate.	The style and/or clarity of the report fell short of a passing grade.

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