

**UNIVERSITY GRANTS COMMISSION**

Bahadur Shah Zafar Marg, New Delhi Pin: 110002

**PONDICHERRY UNIVERSITY**

**PONDICHERRY**

**ASSESSMENT/EVALUATION REPORT UGC MRP**

<b>A</b>	<b>DETAILS OF PROJECT</b>	
	Title of the Project	Human Skin Segmentation in Color Images using Mixed Statistical Models in Identifying the Criminals and Terrorists
	Total Duration of the Project	From 01.07.2012 to 30.06.2015.
	Project Status	Completed
	Subject	Computer Science and Engineering
	File Number: UGC Reference Number and Date	F.No. 41-628/2012(SR)_Dated 16-Jul-2012
	Grant Approved	Rs. 12,26,100/-
<b>B</b>	<b>EVALUATION REPORT OF EXPERT MEMBER</b>	
1.	Name of Principal Investigator	<b>Dr.S.Ravi</b>
2.	Designation	Associate Professor
3.	Address with Email and Mobile Number I	<b>Dr.S.Ravi</b> Associate Professor Dept of Computer Science School of Engineering and Technology Pondicherry University, Puducherry - 605014 E-Mail: <i>sravicate@gmail.com</i>
4.	Whether is focussed on the title of the project	Yes, the project is focussed on the title of the project
5.	Whether the original work is done	Yes original work is done
6.	Whether significant contribution done by the Principal Investigator	Yes significant contribution is done by the Principal Investigator
7.	Whether the proposed work have relevance to the society/scientific community	Yes, the proposed work has relevance to the society/scientific community. The primary applications of skin detection system are: ❖ Facial analysis ❖ Gesture analysis ❖ Video surveillance ❖ Human-machine interface ❖ Image content filtering ❖ Face tracking
8.	What type of the contribution found in the final report Theoretical/Practical. If there are theoretical contributions given by the principal investigator, whether real applications are given	Both the theoretical and practical contributions are found in the final report
9.	What the Theoretical	Yes, following the research works have been

	<p>contributions and their results and findings are published</p>	<p>published.</p> <p><b>RESEARCH PAPERS PUBLISHED:</b></p> <p><b>INTERNATIONAL JOURNALS:</b></p> <p>1] Richa Mishra, Ravi Subban, "Human Face Localization Using Normalized RGB Color Space", "Advances in Natural and Applied Sciences" with ISSN-19950772, , 9(6) Special 2015, Pages: 322-326</p> <p>2] Ravi Subban and Richa Mishra, "The Design and Analysis on Human Face Detection in Color Images using Artificial Neural Networks", "International Journal of Applied Engineering Research (IJAER) with ISSN 0973-4562, Volume 10, Number 21 (2015) , pp.19931-19936, (SCImago Journal Rank (SJR): 0.2) (Impact Factor – 0.14)</p> <p>3] Pasupathi Perumalsamy, Ravi Subban, et.al., "Morphological Based Skin Segmentation Using Computer Graphics Color Model", Advances in Natural and Applied Sciences, 9(12) Pages: 95-99 ISSN:1995-0772, EISSN: 1998-1090, August 2015</p> <p>4] Ravi Subban, Pasupathi Perumalsamy, Muthukumar Subramanyam, "Adaptive Threshold based Skin Detection", International Journal of Applied Engineering Research (IJAER) with ISSN 0973-4562, Volume 10, Number 77 (2015). (SCImago Journal Rank (SJR): 0.2) (Impact Factor – 0.14). (UGC APPROVED JOURNALS).</p> <p>5] Dr Ravi Subban, S. Dhivyalakshmi, "Filtering Objectionable Contents for Blocking Nude Images Based On Bayesian Color Classification", "Advances in Natural and Applied Sciences" with ISSN-19950772, , 9(6) Special 2015, Pages: 65-70</p> <p>6] Dr Ravi Subban and RamyaChandran, "Facial Feature Detection Methods", "International Journal of Applied Engineering Research (IJAER) with ISSN 0973-4562, Volume 10, Number 21 (2015), pp.20295-20307, (SCImago Journal Rank (SJR): 0.2) (Impact Factor – 0.14). (UGC APPROVED</p>
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**JOURNALS).**

- [7] Dr Ravi Subban, P. Pasupathi, "A Novel Piece-Wise Linear Algorithm for Human Skin Segmentation", Applied Mechanics and Materials, ISSN: 1662-7482, Vol. 743 (2015) pp 317-320. January 2015.

**SPRINGER JOURNAL (SPECIAL VOLUMES BOOK SERIES) - (SCOPUS INDEXED)**

- [8] Dr. Ravi Subban, Richa Mishra, "Human Skin Segmentation in Color Images using Gaussian Color Model", **Special Volume in Recent Advances in Intelligent Informatics in the Advances in Intelligent and Soft Computing (Springer) Series (SPRINGER)**, ISSN: 2194-5357 (Print) 2194-5365 (Online), Vol. 235, pp. 13-21, August 2013. . **(SCOPUS INDEXED) (UGC APPROVED JOURNALS)**
- [9] Ravi Subban and Dattatreya P. Mankame, "Human Face Recognition Biometric Techniques: Analysis and Review", **Special Volume in Recent Advances in Intelligent Informatics in the Advances in Intelligent and Soft Computing (Springer) Series (SPRINGER)**, ISSN: 2194-5357 (Print) 2194-5365 (Online), Vol. 235, pp. 455-463, August 2013. **(SCOPUS INDEXED) (UGC APPROVED JOURNALS)**

**SPRINGER JOURNAL PROCEEDINGS (SCOPUS INDEXED)**

- [10] Dr. Ravi Subban, Richa Mishra, "Face Detection in Color Images Based on Explicitly-Defined Skin Color Model", Communications in Computer and Information Science series (SPRINGER), ISSN: 1865-0929, Vol, 0361, December 2012. **(SCOPUS INDEXED)(UGC APPROVED JOURNALS)**

**OTHER INTERNATIONAL JOURNALS**

- [11] Richa Mishra and Dr. Ravi Subban\*, "Taxonomy of Skin Detection Models Based on Human Skin-Color: A Survey",

Asian Journal of Mathematics and Computer Research, 2015, Vol 6 Issue 2

- [12] Richa Mishra, and Dr. Ravi Subban, "Face Detection For Video Summary Using Enhancement Based Fusion Strategy", IJRET: International Journal of Research in Engineering and Technology, eISSN: 2319-1163, pISSN: 2321-7308, Volume: 03, Special Issue, 03<sup>rd</sup> May-2014, pp: 69 – 74.
- [13] Sadique Nayeem, Dr. RaviSubban, "A Study on Face Recognition Technique based on Eigenface", International Journal of Applied Information Systems, IJAIS, Vol.ISSN : 2249-0868 Foundation of Computer Science FCS, New York, USA Volume 5- No.4, pp. 57 – 62, March 2013.
- [14] Dr. Ravi Subban, Richa Mishra, "Human Skin Detection using Combination of Color Spaces in Color Images", the International Journal of Software and Web Sciences (IJSWS), ISSN (Print): 2279-0063, ISSN (Online): 2279-0071, Issue 5, Vol. 1 & 2, pp. June-August, 2013.
- [15] Dr. Ravi Subban, Richa Mishra, "Skin Segmentation based on Gaussian Model by Combining Color Spaces", International Journal of Emerging Technologies in Computational and Applied Sciences (IJETCAS), ISSN (Print): 2279-0047, ISSN (Online): 2279-0055, Issue 5, Vol. 1, 2, & 3, June-August, 2013.
- [16] Dr. Ravi Subban, P.Pasupathi, S. Muthukumar, D.Shasikala, Dr.N.Krishnan," A Survey on Face Detection Techniques - A Survey", Book with ISBN No. 2013, Puducherry, India.

#### ELSVIER JOURNAL PROCEEDINGS

- [17] Ravi Subban, Sadique Nayeem, and P.Pasupathi, S. Muthukumar, "Genetic Algorithm Based Human Face Recognition", Fifth International Conference on Advances in Communication, Network, and

		<p>Computing, CNC 2014, Feb 21-22, 2014, pp. 417-426, Chennai, India.(Science Direct)</p> <p>18] Ravi Subban, Muthukumar Subramanyam, Pasupathi. P, Shasikala .D., " A Review On Face Detection Approaches", Fifth International Conference on Advances in Communication, Network, and Computing , CNC 2014, Feb 21-22, 2014, Chennai, India. (Science Direct)</p> <p><b>IET JOURNAL PROCEEDINGS</b></p> <p>19] Dr.S.Ravi and Sadique Nayeem, "Face Recognition Using PCA and LDA: Analysis And Comparison", Fifth International Conference on Advances in Recent Technologies in Communication and Computing, ARCOM 2013, Bangalore India, Sep 19-20, 2013; January 2013 p. 6 - 16, Bangalore, India.</p> <p><b>IDES JOURNAL PROCEEDINGS</b></p> <p>20] Ravi Subban, Richa Mishra, "Combining Color Spaces for Human Skin Detection in Color Images using Skin Cluster Classifier", Fifth International Conference on Advances in Recent Technologies in Electrical and Electronics, ARTEE 2013, Bangalore India, Sep 19-20, 2013; pp. 68 -73, Bangalore, India.</p> <p><b>IEEE CONFERENCES PROCEEDINGS</b></p> <p>21] Dr Ravi Subban, Pasupathi Perumalsamy, "Human Skin Detection Using a Novel Explicit Skin Color Threshold Methodology under Varying Luminance Conditions", First International Conference on Science, Engineering and Management Research(ICSEMR2014), 27 to 29 November 2014 Chennai, Tamilnadu, India.</p> <p>22] Richa Mishra, Dr Ravi Subban," Face Detection for Video Summary using Enhancement-based Fusion Strategy</p>
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under Varying Illumination Conditions", **First International Conference on Science, Engineering and Management Research(ICSEMR2014)**, 27 to 29 November 2014 Chennai, Tamilnadu, India.

- [23] Dr. Ravi Subban, Richa Mishra, "Rule based Face Detection in Color Images using Normalized RGB Color Space – A Comparative Study", 2012 IEEE International Conference on Computational Intelligence and Computing Research (2012 IEEE ICCIC), Coimbatore, Tamilnadu, INDIA, December 2012.

#### **INTERNATIONAL CONFERENCES PROCEEDINGS**

- [24] Dr. Ravi Subban, P.Pasupathi, S. Muthukumar, D.Shasikala, Dr.N.Krishnan," A Survey on Face Detection Techniques - A Survey", International Conference on Recent Developments on Statistical Theory and Practice, ICRDSTAP 2013, Puducherry, India.
- [25] Ravi Subban, S. Chella Ganesh, P.Pasupathi, S. Muthukumar," Face Recognition Bio-metric System: A Study and Analysis", International Conference on Recent Developments on Statistical Theory and Practice, ICRDSTAP 2013, Puducherry, India.

#### **NATIONAL CONFERENCES**

- [26] Ravi Subban, Muthukumar Subramaniam, Pasupathi Perumalsamy, "An Adaptive threshold based- piecewise linear skin segmentation with local and global appearance", National Conference on Computing and Communication (NCCC 2015, Chennai.
- [27] Ravi Subban, S.Dhivyalakshmi, "Bayesian Model Based Face Detection Methods", National Conference on Engineering Applications for Developing Smart Cities (NCEADS), Dhirajlal Gandhi College Of Technology, Salem-

		636309, 28-29, March 2015
		28] Ravi Subban, Pasupathi Perumalsamy, Muthukumar Subramanyam, "A Novel Piece-Wise Linear Algorithm For Human Skin Segmentation", National Conference on Engineering Applications for Developing Smart Cities (NCEADS), Dhirajlal Gandhi College Of Technology, Salem-636309, 28-29, March 2015
		29] Ravi Subban, Pasupathi Perumalsamy, Muthukumar Subramanyam, "An Analysis Of Human Skin Using Rule-Based Skin Classifier Under Various Conditions", National Conference on Engineering Applications for Developing Smart Cities (NCEADS), Dhirajlal Gandhi College Of Technology, Salem-636309, 28-29, March 2015
		30] Ravi Subban, Pasupathi Perumalsamy, Muthukumar Subramanyam, "Efficient Skin Detection In Color Images With Different Illumination Conditions And Complex Background", National Conference on Engineering Applications for Developing Smart Cities (NCEADS), Dhirajlal Gandhi College Of Technology, Salem-636309, 28-29, March 2015
		31] Ravi Subban, Pasupathi Perumalsamy, Muthukumar Subramanyam, "Skin Detection Using GLHS Color Space", National Conference on Engineering Applications for Developing Smart Cities (NCEADS), Dhirajlal Gandhi College Of Technology, Salem-636309, 28-29, March 2015
		32] Dr Ravi Subban, S.Jayabharathi,," Human Facial Expression Recognition Techniques", National Conference on Engineering Applications for Developing Smart Cities (NCEADS), Dhirajlal Gandhi College Of Technology, Salem-636309, 28-29, March 2015
		33] Ravi Subban, Ramya Chandran, Pavithra Kaliaperumal, Jayashree.M, "Human Face Detection Using Facial Feature Extraction", National Conference on Engineering Applications for Developing Smart Cities (NCEADS), Dhirajlal



		<p>Gandhi College Of Technology, Salem-636309, 28-29, March 2015</p> <p>34] Richa Mishra, Ravi Subban, "Human Face Localization Using Normalized RGB Color Space", National Conference on Intelligent Computing (NCIC 2015), January 30, 2015, Pondicherry, India.</p> <p>35] Ravi Subban, Richa Mishra, "Face Detection in Color Images Based on Explicitly-Defined Skin Color Model", National Conference on Recent Advancement In Computer And Communication Engineering, (RACCE'13), February 2013, Nagercoil, India.</p>
10.	Whether results and findings are significant	Yes, the results and findings are significant
11.	Whether significant publications are made by the principal investigator in Peer Reviewed Journals	Yes, the significant publications are made by the principal investigator in Peer Reviewed Journals
12.	The number of publications made by the principal investigator in standard reputed journals	19
13.	Whether the contributions made by the principal investigator is sufficient	Yes, the contributions made by the principal investigator is very sufficient
14.	The findings and results of the sanctioned major research project are justifiable	<p>A statistical evaluation of skin detection approaches is provided using relevance measure over twelve different color spaces. Unlike single color space, the combinations of two color spaces have produced better results with the altering human face skin tone color as well as lighting conditions. The experimental results reveal the following findings:</p> <ul style="list-style-type: none"> <li>• YCbCr, RGB-YCbCr, YCbCr-YES and YCbCr-YCC are the color spaces that perform well with the rule-based approach as compared to RGB color space;</li> <li>• YUV, YIQ, HSL-YUV, HSL-YPbPr, YUV-YPbPr are the color spaces that perform well with the Gaussian model as compared to RGB color space;</li> <li>• There is a significant difference in the selection of a color space with the selection of skin detection approach;</li> <li>• Rule-based approach outperforms the Gaussian-based approach;</li> <li>• YUV is the color space that performs well with both the rule-based and</li> </ul>



		<p>Gaussian-based approach:</p> <ul style="list-style-type: none"> <li>• The transformation of color space has not consistently improvised the performance of skin detection; and</li> <li>• YCbCr-YCC color space has got the first rank using rule-based approach.</li> </ul> <p>Experimentally, it is found that the proposed techniques have outperformed the traditional enhancement techniques. The fusion strategy is adapted to reduce the FPR and increase the TPR. Since, the accuracy of face detection results depends on the accuracy of skin region extraction from an image. Therefore, the proposed algorithm fixes the delocalization problem of bounding box by correctly identifying skin color with minimum FPR, and to locate the human face. The advantage of the proposed approach is its simplicity and accuracy at the penalty of time complexity.</p>
15.	Whether the completed project work meet the objectives	Yes, the completed project work meets the objectives
16.	Give your brief comments on the overall work of the project	The proposed techniques have outperformed the traditional enhancement techniques. The fusion strategy is adapted to reduce the FPR and increase the TPR. Since, the accuracy of face detection results depends on the accuracy of skin region extraction from an image. Therefore, the proposed algorithm fixes the delocalization problem of bounding box by correctly identifying skin color with minimum FPR, and to locate the human face. The advantage of the proposed approach is its simplicity and accuracy at the penalty of time complexity.
17.	Any specific comments	A good and dedicated research work
18.	Indicate your overall assessment of the project -- Poor/Good/Excellent	Excellent

Date: 31-08-2019

Place: Warangal

Name and Address of the Expert:

Professor

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National Institute of Technology, Warangal  
Telangana, INDIA - 506 004.

*S.G. Sanjeevi*

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