International Journal of
Emerging Research in Management &Technology
ISSN: 2278-9359 (Volume-6, Issue-8)

Research Article | **August 2017**

A Comparative Approach for Standard Shadow Detection Methods

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Abstract:

False tracking is the biggest problem identified in tracking. The reasons for this is identified as shadow of the object to be tracked which have their shape mapping to the shape of the object. Dynamic shadow detection is the field in which videos are used. Dynamic shadow detection is found to be more exposed in literature due to the possibility of comparison, frame differentiation, background subtraction. All this not being possible in case of static images as they represent a single frame and are not used to that extent. Taking this as a challenge this paper presents static shadow detection in which the static shadow detection methods are mapped with dynamic images within the domain of image processing.The results so obtained are then authenticated from the user side. Every user may have different views, so as to bring the evaluation at a standard level this qualitative evaluation is quantified so as to be represented in form of tables and graphs for further analysis.

Keywords: False tracking, shadow detection, standard methods, quantitative evaluation, metric mapping

I. INTRODUCTION

False tracking being defined as the problem domain and static shadow detection being defined as the working domain within the limits of image processingthen by examining the shadow detection taxonomy it is observed that there are four standard methods possible. These methods are based on the properties which are most prominently observable and measurable within the images. These methods are intensity based, chromaticity based, geometry based and texture based. In the module named as Methods, the working principle used for algorithm development is discussed. In the next module i.e. Results all the results obtained are presented for viewing. In the next module named as Evaluation these images are evaluated. In case of quantitative evaluation the accuracy values if high the output acceptable. The images marked as acceptable by qualitative may not be that clear and observable thus may not be accepted by user. For this qualitative evaluation is done whereas per need different metrics are defined.

In this work these metric are numerically quantified so as to be used for comparison and representation in tabular and graphical form so as to be able to make the user selection more justifiable.

II. METHODS

Four standard shadow detection methods are considered which are explained below.

II.1. INTENSITY BASED METHOD

In these images only the intensity of the pixels change but its colour information remains constant. The proposed algorithm selects gray scale and RGB images. For the images to work in the linearity range, they should be in-house and should have single and uniform light source. The threshold of the entire image is obtained and the digital inverted input image is then compared with this threshold value. Pixels above the threshold are marked as one as they represent the shadows and those below are marked as zero as they form the shadows and dark objects [1] [2].

II.2. CHROMATICITY BASED METHOD

The colour and the intensity information both changes. The colour based images can be indoor or outdoor with limited environmental conditions. The linearity range can now be extended by using HSV colour models. In place of single threshold, region wise threshold is obtained which acts as the global threshold for that particular region [3] [4].

II.3. GEOMETRY BASED METHOD

Those images in which the object and its shadow forms a single BLOB with a single point of contact with the angle of orientation go for geometry based method [5] [6].

II.4. TEXTURE BASED METHOD

The basic assumption done in most of the image type is that the surface is plane but this may not be the case in all the images. There are certain images with textured regions in this case textured based method with histogram analysis, entropy calculations and probability calculations are used[7] [8].

III. RESULTS

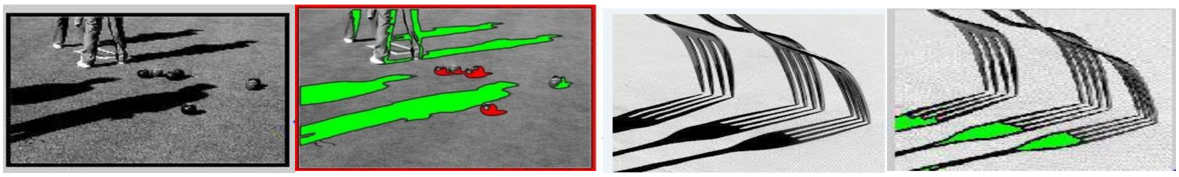

Fig3.1:- Input and output images

For intensity based method, two images are considered. Figure number 3.1 represents these input images with their outputs. The right side represents an input and output pair similarly the left side also represents the input and output pair.

In case of chromaticity based methods, two sets of algorithms the global existing as a reference the local proposed by this work are presented. The global algorithm images are represented by figure number 3.2 as input output pair. Similarly the local algorithm images in figure number 3.3 are represented as input and output pair. Similarly figure number 3.3 and figure number 3.4 represent the input output image pairs for geometry based and texture based methods respectively.

Fig. 3.2:- Global Images

Fig. 3.3:- Local Images

Fig.3.4:-Geometrical Image

Fig. 3.5: Texture Images

IV. EVALUTION

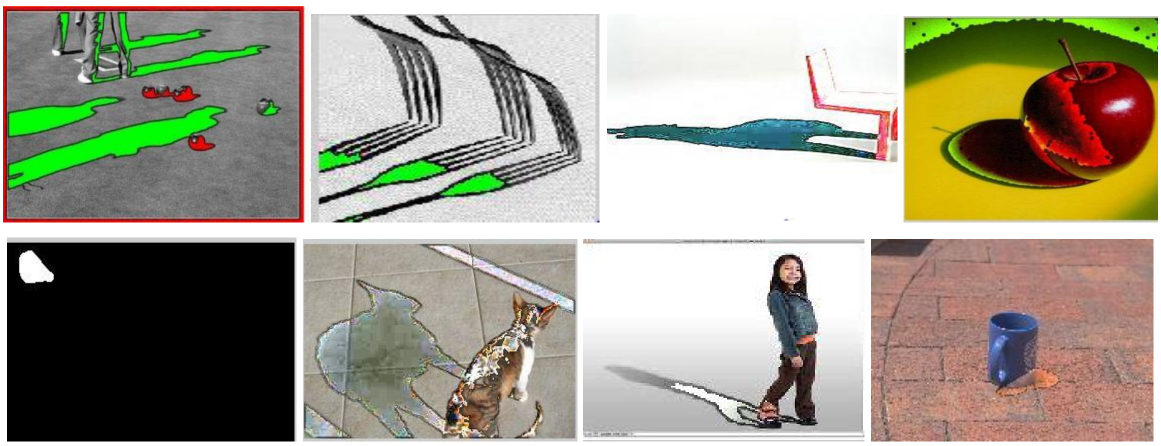

Fig.4.5:- Quantitative evaluation

Figure number 4.5 only represents the results which are selected for quantitative evaluation where the percentage of true detection is given by the accuracy measurement. Numbering from top right as one, the combined accuracy T, represented by equation number 4.1 where[9] [10],

T = (TP+TN)/(TP+TN+FP+FN)…………………………………4.1

One: 89%, Two: 91%, Three: 96%, Four: 88%, Five: 86%, Six: 92%, Seven: 97%, Eight: 99%, Nine: 63%, Ten: 69% and Eleven: 92%

It is observed that even though the accuracy is high but most of the output images are not acceptable at the visual level. Thus there was a need for defining some metrics of measurement which can be from the user's satisfaction levels from different viewpoints so as to be able to authenticate the image with his acceptance level. Such type of evaluation is called as the Quantitative evaluation. The metrics so defined within the domain of image processing so as to be applied for the image evaluation are:

Robustness to Noise (RN), Object Independency (OI), Scene Independency (SI), Computational Load (CC), Shadow Independence (SID), Flexibility to Shadow Strength (FS), Width and Shape of Shadow(SS) , Detection of Indirect Cast Shadows and Penumbra (PD), Illumination Independence(ID), Detection/Discrimination Trade Off (DT), Chromatic Shadows (CS), Shadow Camouflage (SC), Surface Topology (ST) [11].

For each algorithm as per the output images obtained, these metrics are mapped to the image in terms of AVM and RVM where AVM is Absolute value measure which specified the nearness of that metrics to the output image conditions specified in that metrics. RVM is the relative value measure value which specifies as how closely the metrics fall in the group of other metrics related to the output image [12].

The existing methods with its identified shortcomings are also rated as E and the proposed algorithms with its improvements are rated as P from one to five where one: very good, two: good three: Fair, Four: poor, Five: very poor.

V. METRIC MAPPING

For all the metrics applied in shadow detection, they are mapped for AVM and RVM for existing (E) and proposed (P) algorithms with values from one to five. Value i.e. good is taken as the reference for comparison.

Table No 5.1: Intensity Metric Evaluation

Metric	**RN**		**OI**		**SI**		**CC**		**SID**		**PD**		**ID**		**DT**		**CS**		**SC**		**ST**	
	E	P	E	P	E	P	E	P	E	P	E	P	E	P	E	P	E	P	E	P	E	P
AMV	3	2	4	2	3	2	3	4	3	2	2	2	4	4	3	2	5	5	4	4	2	2
RMV	3	2	3	2	3	2	2	2	3	2	2	2	5	5	2	2	5	5	4	4	3	3

Table No 5.2: Colour Metric Evaluation

Metric	**RN**		**OI**		**SI**		**CC**		**SID**		**PD**		**ID**		**DT**		**CS**		**SC**		**ST**	
	E	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*
AMV	3	2	3	2	3	2	2	3	3	2	3	2	4	2	3	2	2	2	4	4	2	2
RMV	2	2	2	2	3	2	2	2	1	1	2	2	2	2	2	2	3	3	4	4	3	3

Table No 5.3: Geometry Metric Evaluation

Metric	**RN**		**OI**		**SI**		**CC**		**SID**		**PD**		**ID**		**DT**		**CS**		**SC**		**ST**	
	E	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*
AMV	3	2	3	2	3	2	2	3	4	3	2	2	3	2	3	2	4	5	5	5	2	2
RMV	3	2	2	2	4	4	2	2	1	1	2	2	4	4	2	2	5	5	4	3	3	3

Table No 5.4: Texture Metric Evaluation

Metric	**RN**		**OI**		**SI**		**CC**		**SID**		**PD**		**ID**		**DT**		**CS**		**SC**		**ST**	
	E	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*	*E*	*P*
AMV	3	2	3	2	3	2	3	4	3	2	3	2	3	2	3	2	4	4	1	1	2	2
RMV	5	5	4	4	4	4	3	3	4	4	3	3	3	3	2	2	3	3	1	1	2	2

Table No 5.5: Comparative Table

Conditions	Intensity	Colour	Geometry	Texture
+ve Improvement	5 (63%)	7 (70%)	5 (63%)	7 (78%)
Same level(2)	2	2	2	1
_ve Improvement	1	1	1	2
Not applicable	3	1	3	1

Positive improvement implies how many metrics in a particular method have their value going from low to two to above two i.e. good. In intensity this improvement is 63% as only intensity is the variable which changes. In case of colour based methods both intensity and colour changes and due to local thresholding the improvement is 70%. In case of geometry based method the improvement is also 63% as very less number of metrics are applicable. The texture based method due to entropy and histogram utilization shows a improvement of 78%.

The negative improvement is seen in all the methods for the metrics computational load as the load increases due to addition of more programming modules.

VI. CONCLUSION

The evaluation work has to be done in both quantitative as well as qualitative so as to be able to justify the results completely. For better results as more programing modules added the computational load also increases

VII. FUTURE SCOPE

To improve the computational load there should be parallel processing implemented.

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