Shadow Detection Using Double Threshold Neural Networks

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Problem

- Shadows whose intensity and hue fall in between those of the scene and objectives are often viewed as non-shadows. Moreover, entities with similar or darker hue and intensity may be wrongly classified as shadows

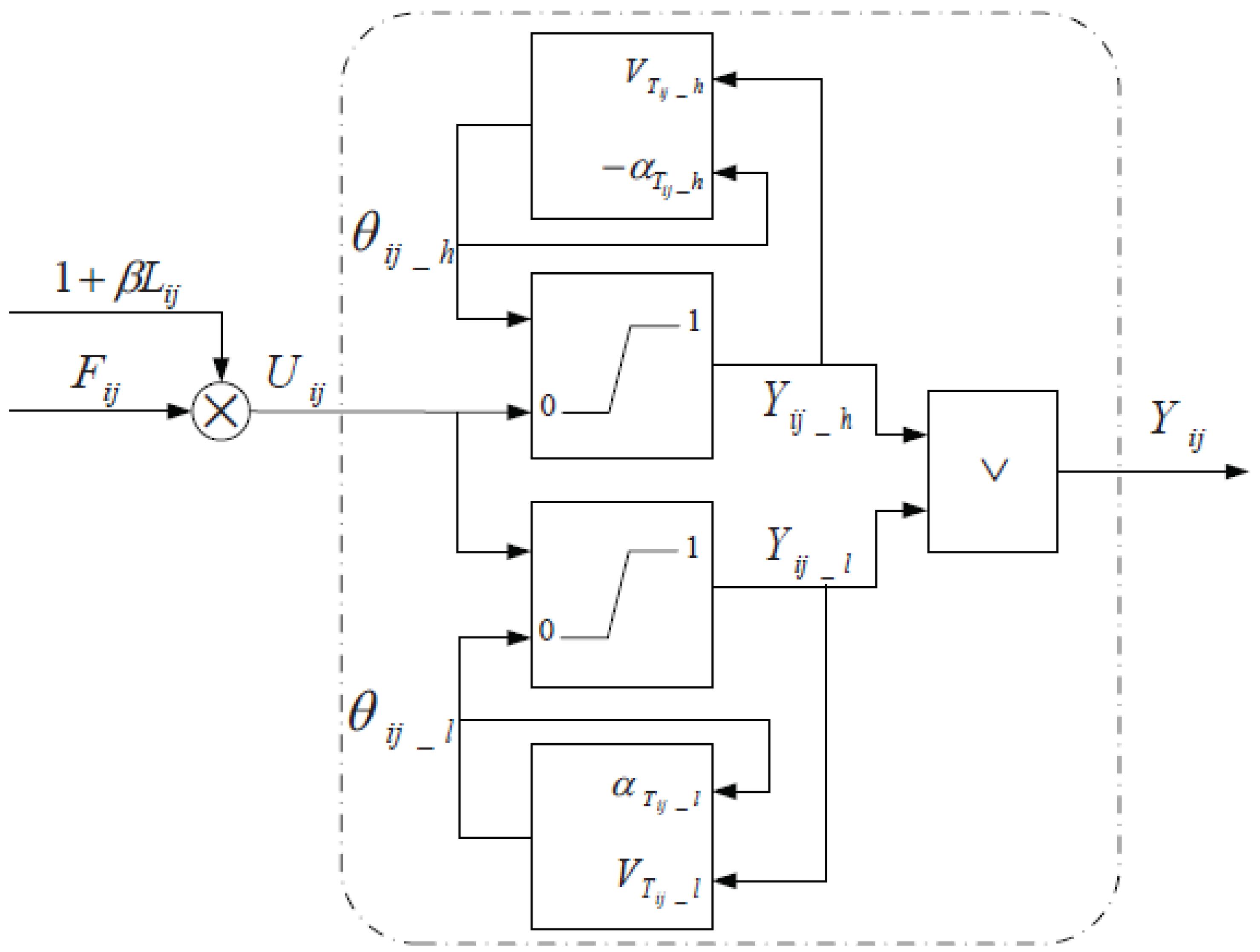
Proposed Solution

- The misclassification of the pixels are reduced by the proposed DTPCNN where we take two threshold that iteratively alter. The upper threshold decreases and the lower threshold increases with every iteration until the stop constraints are met.

Project Overview

- The proposed method is double threshold pulse coupled neural networks, used to detect the shadows from single images. In this approach, we consider two dynamic thresholds that iteratively alter. The upper threshold decreases and the lower threshold increases until the stop constraints are met. The detection result is obtained by a fusion of two detection components.

Methodology



$$F_{ij}[n] = \sum_{k,s} M_{ijks} Y_{ks}[n-1] + I_{ij}$$

$$L_{ij}[n] = \sum_{k,s} W_{ijks} Y_{ks}[n-1]$$

$$U_{ij}[n] = F_{ij}[n](1+\beta L_{ij}[n])$$

$$Y_{ij\_h}[n] = U_{ij}[n] - \theta_{ij\_h}[n-1]$$

$$= \begin{cases} 1 & U_{ij}[n] > \theta_{ij\_h}[n-1] \\ 0 & U_{ij}[n] \le \theta_{ij\_h}[n-1] \end{cases}$$

$$Y_{ij\_l}[n] = U_{ij}[n] - \theta_{ij\_l}[n-1]$$

$$= \begin{cases} 1 & U_{ij}[n] < \theta_{ij\_l}[n-1] \\ 0 & U_{ij}[n] \ge \theta_{ij\_l}[n-1] \end{cases}$$

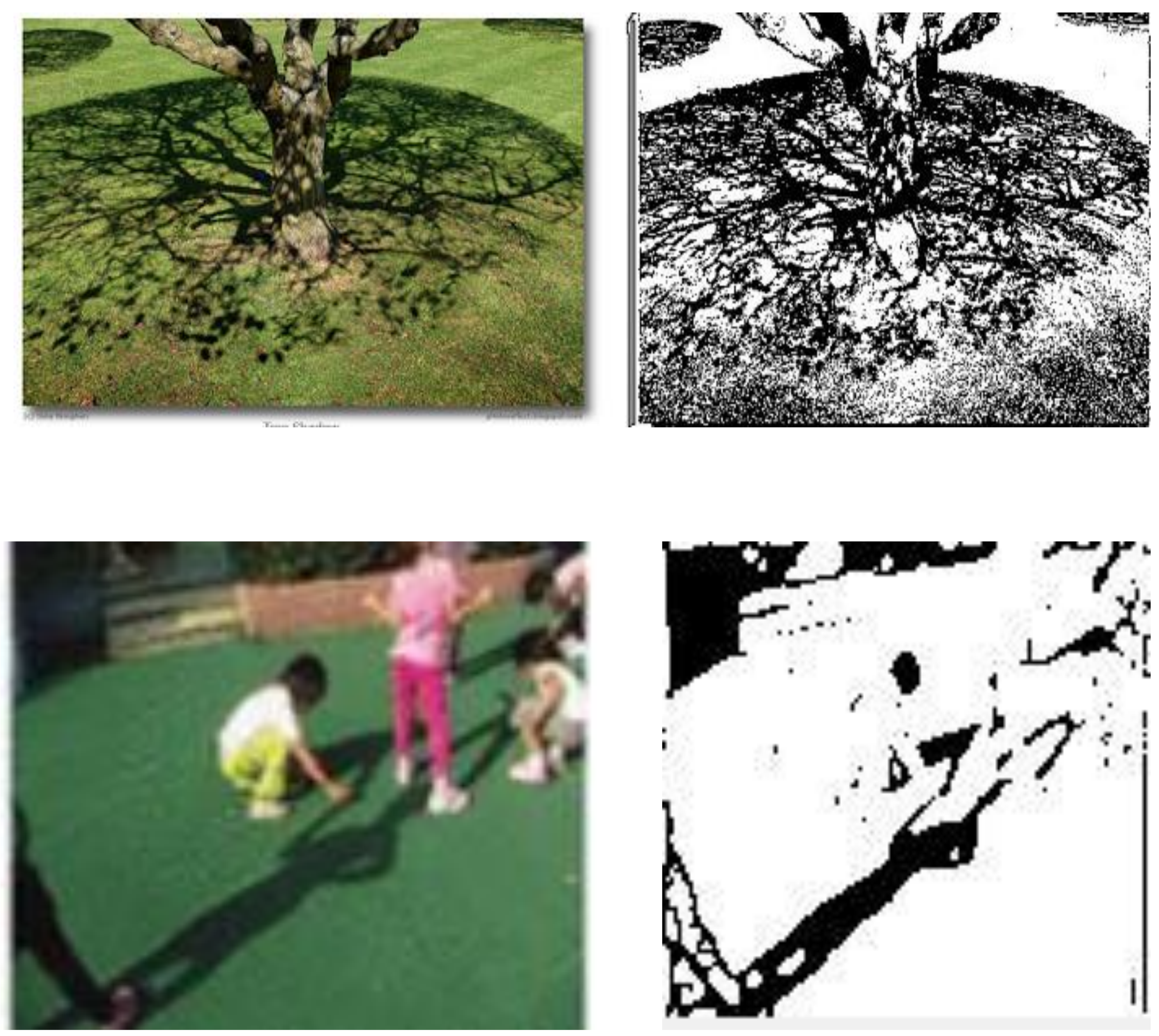
$$\theta_{ij\_h}[n] = e^{-\alpha T_{ij\_h}} \theta_{ij\_h}[n-1] + V_{T_{ij\_h}} Y_{ij\_h}[n]$$

$$\theta_{ij\_l}[n] = e^{-\alpha T_{ij\_l}} \theta_{ij\_l}[n-1] + V_{T_{ij\_l}} Y_{ij\_l}[n]$$

Algorithm

(1) Initialize the parameters and matrices as $min = 0.004$, $L = 0, U = 0, Y = 0$. Normalize F as $min \le F \le 1$.
(2) $L = Y * K$, $U_{ij} = F_{ij}(1+\beta L_{ij})$.
(3) If $U_{ij} > \theta_{ij\_h}$,
$Y_{ij\_h} = 1$,
$G_{ij\_h} = \theta_{ij\_h}$,
$Q_{ij\_h} = F(i,j)/G_{ij\_h}$,
$\theta_{ij\_h} = 100$,
else
$Y_{ij\_h} = 0$,
$\theta_{ij\_h} = \theta_{ij\_h} - \Delta_h$.
(4) If $U_{ij} < \theta_{ij\_l}$,
$Y_{ij\_l} = 1$,
$G_{ij\_l} = \theta_{ij\_l}$,
$Q_{ij\_l} = F(i,j)/G_{ij\_l}$,
$\theta_{ij\_l} = 0$,
else
$Y_{ij\_l} = 0$,
$\theta_{ij\_l} = \theta_{ij\_l} + \Delta_l$.
(5) Iterate (2) to (4) N times. $SD = Q_h + Q_l$.

Results



Conclusion

The proposed detection algorithm significantly reduces the false detection in single images only. The beta value is not constant, it changes every time for different experiments. The values of the various parameters depend on the scenes.

References

- [1]. J. L. Johnson, M. L. Padgett, “PCNN Models and Applications,”IEEE Trans. Neural Networks, vol. 10, issue.3, pp. 480-498, 1999
- [2]. X. D. Gu, D. H. Yu, L. M. Zhang, “Image Shadow Removal Using Pulse Coupled Neural Network,” IEEE Trans. Neural Networks, vol. 16, no. 3, pp. 692-698, May 2005.