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Gravitational Force (GF) based Machine Learning Technique for Face Detection

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Abstract

Especially with the rapid growth of multimedia content, facial recognition has received a lot of attention, especially in recent years. A face as an object is made up of a number of detectable features. Therefore, it remains the most challenging area of research for computer vision and image processing scientists. This research article tried to cover most facial features, such as coherent posture, aging, brightness, and partial occlusion. It is considered an indispensable element in the face recognition system when working with face images.

Keywords: *Gravitational Force (GF), Facial recognition, Image processing, Machine learning, Face detection*

INTRODUCTION

The 21st century is the era of modern science, in which people have made many advances to speed up the performance of human tasks. To support the above statement, today the use of computer technology is an indispensable part of life. Computers are used in a wide range of applications ranging from simple problem-solving methods to complex ones. Among these contributions, facial recognition technology emerges as a useful tool for recognizing facial features through their inherent characteristics, and it is one of the most studied areas in the field of pattern recognition and computer vision. However, due to being widely used in a multitude of applications such as biometrics, information security, law enforcement access control, surveillance systems, and smart cards.

Emotions are complex emotional states and conscious experiences Leads to physical and psychological changes that affect each other Personal behavior. Often it is associated Personality, temperament, mood, motivation, propensity, etc. Psychological theories about human emotions classify emotions In 6 categories: anger, disgust, happiness, sadness, surprise, etc. And fear [1].

1. Newton's Law of Gravitational Force (NLGF):

Every image which is captured in this world is an object that is made up of pixels. Pixels are basic blocks of an object. In astrophysics unknown star mass can be calculated by using its luminosity (i.e. amount of total light energy emitted from the object). Every image K (row_i, $colum_i$) at every point (row_i, $colum_i$) is represented as the multiplication of R (r_i, c_i) reflectance component and L (r_i, c_i) an illumination component.

I (row_i, $colum_i$) =Reflectance (row_i, $colum_i$) x Luminance (row_i, $colum_i$) (1)

row_i= represents row index in x-axis; $colum_i$=represents column index in y-axis

Here L (row_i, $colum_i$) is luminance represents the amount of light falling on an object that depends on the source of light. R (row_i, $colum_i$) is reflectance that represents facial points like edges or structures and it depends on the surface characteristics of an object. There are some assumptions made that Luminance varies very slowly but reflectance varies abruptly, so if we eliminate luminance from an object but still it's possible to represent key facial features by using reflectance R. Low frequency part of an object corresponds to luminance but reflectance belongs to the high frequency components in an image. When luminance is combined with reflectance smoothing can be achieved and when you eliminate luminance from an image that will increase sharpness of reflectance component so we can say that reflectance R (row_i, $colum_i$) is an illumination invariant.

Eliminating illumination from an image can be achieved by using following approach

a) For adjacent pixels division method is applied throughout the image to eliminate illumination. Assume adjacent pixels are represented as (row_i, $colum_i$), (row_i+1, $colum_i$+1) the ratio of intensities between these pixels is

$$\frac{K(\text{row i+1}),colum_i}{K(row_i,colum_i)} = \frac{R(row_i+1,colum_i)L(row_i+1,colum_i)}{R(row_i,colum_i)L(row_i,colum_i)} \quad (2)$$

$$\frac{R(row_i+1,colum_i)L(row_i,colum_i)}{R(row_i,colum_i)L(row_i,colum_i)} = \frac{R(row_i+1,colum_i)}{R(row_i,colum_i)} \quad (3)$$

Here L (row_i+1, $colum_i$) and L (row_i ,$colum_i$) both are approximately equal because Luminance varies slowly. The following equation represents thresholding technique

$$(I_i - I_c) \geq 0 \quad (4)$$

Here I_c central pixel intensity value; I_i represents i^{th} index neighborhood value.

$$I_i \geq I_c) \ \frac{Ii}{Ic} \geq 1 = \frac{Ri\ Li}{Rc\ Lc} \geq 1 \quad (5)$$

Over 3x3 neighborhoods L remains constant therefore Eq: 5 rewrite as

$$\frac{Ri}{Rc} \geq 1 \quad (6)$$

As demonstrated in the equations below, the difference (dif) between two neighboring pixels in the logarithmic domain is determined.

$$dif = logn(Ii) - logn(Ic) \quad (7)$$

$$) \ dif = logn\ (Ri) + logn\ (Li) - logn\ (Rc) - logn\ (Lc) \quad (8)$$

$$) \ dif = logn\ (Ri) - logn(Rc);\ \because Li = Lc \quad (9)$$

The logarithmic-domain pixel values of two neighboring pixels ‘c' and i are logn(I_c) and logn(I_i) respectively.

$$dif = logn(I_i) - logn(I_c) = logn\frac{Ii}{Ic} \quad (10)$$

According to illumination reflectance the eq 6 written as

$$dif = logn\left(\frac{RiLi}{RcLc}\right) \quad (11)$$

$$\approx logn\left[\frac{Ri}{Rc}\right] \quad (12)$$

From Eq. 12 the difference between two neighboring pixels in the logarithmic domain is exactly the logarithm of one pixel divided by one of its neighboring pixels.

It's tough to measure and subtract the L component in the first approach. The illumination component (L) is easily eliminated in the second approach because it is a division method. When the denominator is zero, however, the division method has a disadvantage. When the value of a pixel is zero, the identical problem might occur in logarithmic computations (i.e., a black pixel). A modest value δm of less than or equal to 1 is consistently added to the entire image to overcome this problem.

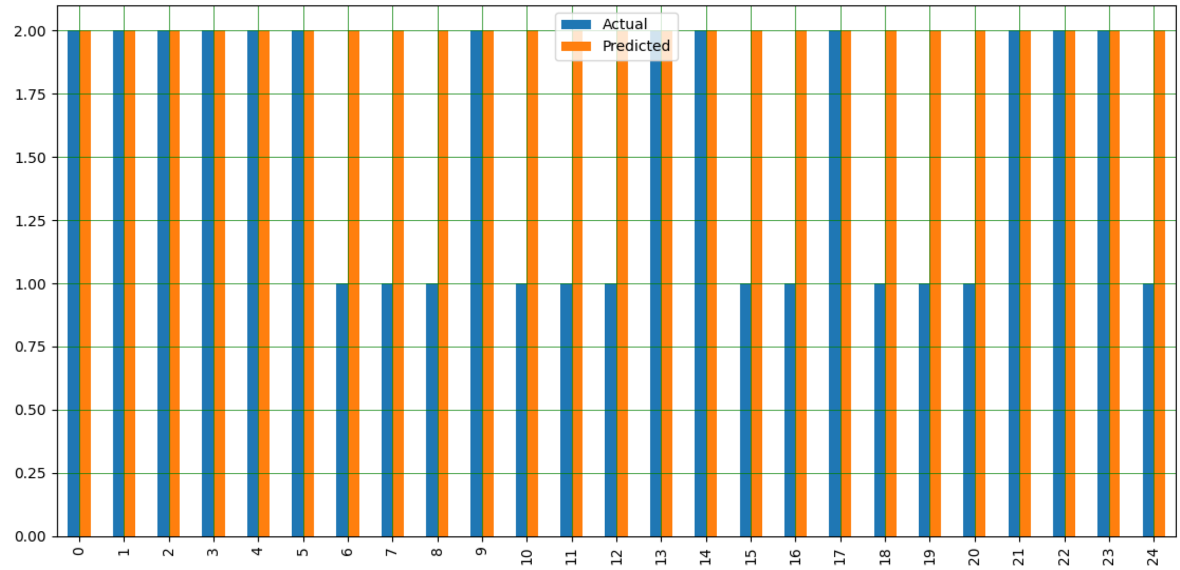

Fig 1 Actual and predicted values

Fig 2

CONCLUSIONS

Face recognition is one of the challenging research concepts of Machine Learning Technologies. In this paper new machine learning techniques is proposed, which works based on the principle of Newton's third law of gravitational force angel to locate the relationship among pixels to pixels and Local gravitational force magnitude and direction are taking care of the illumination variations, rotation invariant and noisy face images. Various machine learning classifiers are used for classification and the accuracy achieved by various classifiers has been discussed.

REFERENCES

1. Paul Ekman, Basic emotions. handbook of cognition and emotion, Wiley, New York, 1999, pp. 301–320.
2. Fan, B., Kong, Q., Trzcinski, T., Wang, Z., Pan, C., & Fua, P. (2014). Receptive fields selection for binary feature description. IEEE Transactions on Image Processing, 26(6), 2583–2595.
3. Trzcinski, T., Christoudias, M., Lepetit, V., & Fua, P. (2012). Learning image descriptors with the boosting-trick. In Advances in neural information processing systems (pp. 269–277).
4. Balntas, V., Tang, L., & Mikolajczyk, K. (2015). Bold - binary online learned descriptor for efficient image matching. In Proceedings of the IEEE conference on computer vision and pattern recognition (CVPR) (pp. 2367–2375)
5. D. Lowe, "Distinctive image features from scale invariant key points," Int. J. Comput. Vis., vol. 60, no. 2, pp. 91–110, 2004.
6. H. Bay, A. Ess, T. Tuytelaars, and L. V. Gool, "Speeded-up robust features (surf)," J. omput. Vis. Img. Understanding, vol. 110, no. 3,pp. 346–359, 2008.
7. E. Tola, V. Lepetit, and P. Fua, "Daisy: An efficient dense descriptor applied to wide-baseline stereo," IEEE Trans. Pattern Anal. Mach. Intell., vol. 32, no. 5, pp. 815–830, 2010.
8. A. Iscen, G. Tolias, P. Gosselin, and H. Jeguo, "A comparison of dense region detectors for image search and fine-grained classification," IEEE Trans. Image Process., vol. 24, no. 8, pp. 2369–2381, 2015.
9. C.Nagaraju, D.Sharadamani, C.Maheswari and D.Vishnu Vardhan Evaluation of LBP-Based

Facial emotions recognition techniques to make consistent decisions Int.J.Pattern Recognition AND Artificial Intelligence 2015.

10. D.G. Lowe, “Distinctive Image Features from Scale Invariant Keypoints,” Int’l J. Computer Vision, vol. 20, no. 2, pp. 91-110, 2004
11. C. Strecha, T. Tuytelaars, and L. Van Gool, “Dense Matching of Multiple Wide Baseline Views,” Proc. Int’l Conf. Computer Vision,2003.
12. Lin, K., Lu, J., Chen, C. S., Zhou, J., & Sun, M. T. (2018). Unsupervised deep learning of compact binary descriptors. IEEE Transactions on Pattern Analysis and Machine Intelligence, 41(6), 1501–514.
13. J Ma, X Jiang , A Fan, J Jiang, J Yan 2021 .image matching from handcrafted to deep features: A survey , International Journal of Computer Vision volume 129, pages23–79 (2021).

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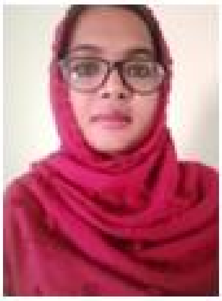

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