AUTOMATIC HELMET DETECTION ON CAPTURING IMAGE

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ABSTRACT
One of the major causes of serious injuries or death in accidents involving two-wheelers is that the rider was not wearing a helmet. Policemen manually checking whether the riders are using helmets are the only available method employed presently. The objective of this research is to develop an application for enforcing helmet wearing using CCTV cameras. The developed application aims to help law enforcement by police, and eventually resulting in changing risk behaviors and consequently reducing the number of accidents and its severity. So there is a need for systems that can be automatically detect whether a rider is wearing helmet or not. This system can also be used to prevent the rider from starting the bike if he is not wearing a helmet. So we designed a device that detects the presence of a helmet automatically and allows the driver to switch on his vehicle only if he wears the helmet. In this paper, we presented a method to detect whether the rider wears a helmet or not. Here the camera is fitted in such a manner that it focuses the rider automatically when he turns on his bike. In so far existing models they used single shot multi box detectors which have a demerit of focusing on smaller objects and the problem is resolved in this paper. We programmed it with datasets of a person with helmets and without helmets and we used relays for switching on and off vehicles based on the output from monitor the display. Our proposed model achieved 96%efficiency in detecting persons with and without helmets.

I INTRODUCTION

According to the World Health Organization (WHO) reports, India is prone to road accidents and most of the cases are two-wheeler accidents. Hence to provide a safety and security system for bike riders we came up with a solution which is rider safety measures using raspberry pi. The device which checks helmet is properly worn or not. According to the survey made by Transportation Research & Injury Prevention Programmer-Road Safety in India Status Report2020, Motorized Two-Wheeler (M.T.W) owners are increasing rapidly day by day, this leads to heavy traffic creation and road accidents. India recorded 3, 54,796 cases of road accidents during 2020 in which 1, 33,201 people died, in this 29.82% of people lost their lives because of not wearing a helmet.

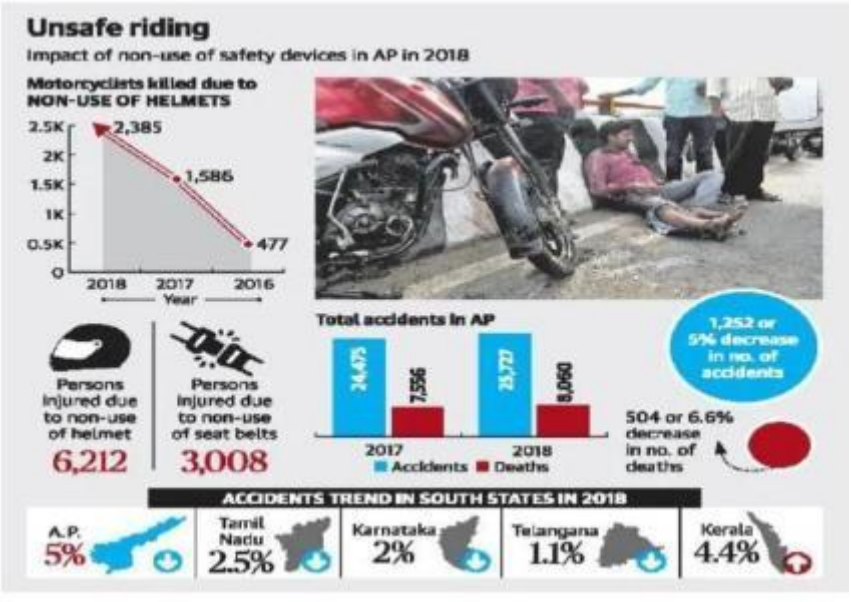


Fig-1: The Hindu Article depicting survey of road accidents

According to the report titled “Road Accident Analysis in Tamil Nadu March 2019”, out of the 978 persons killed in the accidents involving two-wheelers, 508 riders and pillion riders did not wear helmets.“About 52 percent of the death in two wheelers occurred due to non-wearing of helmets”.

Month	2-wheeler deaths	Deaths due to non-wearing of helmets
January	368	174
February	318	161
March	292	173
Total	978	508

Chennai: According to the report titled "Road Accident Analysis in Tamil Nadu March 2019", out of the 978 persons killed in the accidents involving two-wheelers, 508 riders and pillion riders did not wear a helmet. "About 52 per cent of the death in two-wheelers were occurred due to non-wearing of helmets," it said.

Fig-2: Article depicting survey of loss of lives due to road accidents

To avoid such a problem, The Government of India made many awareness programs and rules, to make helmet mandatory for two-wheeler users even though many of us fail to follow the serules and regulations. Hence to make helmets mandatory for riding in two-wheelers we make a proto type work which is an automatic helmet detector. The major reason why we are not using helmets is because of carelessness. To overcome this we made an automatic helmet detector that analyses whether the person wears a helmet or not. If the person wears a helmet then the device will allow him to switch on his vehicle if he doesn't wear a helmet device will not allow him to switch on his vehicle and it will glow a red LED as a warning to the rider which will remind them to wear a helmet. Once they wear a helmet, the device will repeat the process again for helmet detection once the rider satisfies all the conditions the buzzer will glow green and allow him to ride the bike.

II LITERATURE SURVAY

N. BOURBAKIS, A. ESPOSITO, AND D. KAVRAKI, EXTRACTING AND ASSOCIATING META-FEATURES FOR UNDERSTANDING PEOPLE'S EMOTIONAL BEHAVIOUR: FACE AND SPEECH

In face analysis, a key issue is the descriptor of the face appearance. The efficiency of the descriptor depends on its representation and the ease of extracting it from the face. Ideally, a good descriptor should have a high variance among classes (between different persons or expressions), but little or no variation within classes (same person or expression in different conditions). These descriptors are used in several areas, such as, facial expression and face recognition. There are two common approaches to extract facial features: geometric-feature-based and appearance-based methods. The former, encodes the shape and locations of different facial components, which are combined into a feature vector that represents the face. An instance of these methods is the graph-based methods, which use several facial components to create a representation of the face and process it. Moreover, the Local-Global Graph algorithm is an interesting approach that uses Voronoi tessellation and Delaunay

graphs to segment local features and builds a graph for face and expression recognition. These features are mixed into a local graph, and then the algorithm creates a skeleton (global graph) by inter relating the local graphs to represent the topology of the face. Furthermore, facial features are widely used in expression recognition, as the pioneer work of Ekman and Friesen identifying six basic emotions produced a system to categorize the expressions, known as Facial Action Coding System, and later it was simplified to the Emotional Facial Action Coding System. However, the geometric-feature-based methods usually require accurate and reliable facial feature detection and tracking, which is difficult to accommodate in many situations. The appearance-based methods use image filters, either on the whole-face, to create holistic features, or some specific face-region, to create local features, to extract the appearance changes in the face image. The performance of the appearance-based methods is excellent in constrained environment but their performances degrade in environmental variation. Emotion is a research area that has received much attention during the last 10 years, both in the context of speech synthesis, image understanding as well as in automatic speech recognition, interactive dialogues systems and wearable computing. There are promising studies on the emotional behaviour of people, mainly based on human observations. Only a few are based on automatic machine detection due to the lack of Information Technology and Engineering (ITE) techniques that can make available a deeper and large-scale noninvasive analysis and evaluation of people's emotional behaviour and provide tools and support for helping them to overcome social barriers. The present paper reports a study for extracting and associating emotional meta-features to support the development of emotionally rich man–machine interfaces (interactive dialogue systems and intelligent avatars).

ADVANTAGES

- The strong need for user- friendly systems that can secure our assets and protect our privacy without losing our identity in a sea of numbers is obvious.
- The experiment results show that the algorithm reduces the dimension of face feature and finds a best subspace for the classification of human face.

DISADVANTAGES

- Need to improve the classification result.
- The recognition is somewhat degraded if the noise presents in images.

T. JABID, M. H. KABIR, AND O. CHAE, ROBUST FACIAL EXPRESSION RECOGNITION BASED ON LOCAL DIRECTIONAL PATTERN

Automatic facial expression recognition has many potential applications in different areas of human computer interaction. However, they are not yet fully realized due to the lack of an effective facial feature descriptor. In this paper, we present a new appearance-based feature descriptor, the local directional pattern (LDP), to represent facial geometry and analyze its performance in expression recognition. An LDP feature is obtained by computing the edge response values in 8 directions at each pixel and encoding them into an 8 bit binary number using the relative strength of these edge responses. The LDP descriptor, a distribution of LDP

codes within an image or image patch, is used to describe each expression image. The effectiveness of dimensionality reduction techniques, such as principal component analysis and AdaBoost, is also analyzed in terms of computational cost saving and classification accuracy.

Two well-known machine learning methods, template matching and support vector machine, are used for classification using the Cohn-Kanade and Japanese female facial expression databases. Better classification accuracy shows the superiority of LDP descriptor against other appearance-based feature descriptors. Facial expression provides the most natural and immediate indication about a person's emotions and intentions. Therefore, automatic facial expression analysis is an important and challenging task that has had great impact in such areas as human computer interaction and data-driven animation. Furthermore, video cameras have recently become an integral part of many consumer devices and can be used for capturing facial images for recognition of people and their emotions. This ability to recognize emotions can enable customized applications. Even though much work has already been done on automatic facial expression recognition higher accuracy with reasonable speed still remains a great challenge [8]. Consequently, a fast but robust facial expression recognition system is very much needed to support these applications. The most critical aspect for any successful facial expression recognition system is to find an efficient facial feature representation [9]. An extracted facial feature can be considered an efficient representation if it can fulfill three criteria: first, it minimizes within-class variations of expressions while maximizes between-class variations; second, it can be easily extracted from the raw face image; and third, it can be described in a low-dimensional feature space to ensure computational speed during the classification step. The goal of the facial feature extraction is thus to find an efficient and effective representation of the facial images which would provide robustness during recognition process. Two types of approaches have been proposed to extract facial features for expression recognition: a geometric feature-based system and an appearance-based system. In the geometric feature extraction system, the shape and Robust Facial Expression Recognition Based on Local Directional Pattern location of facial components are considered, and geometric relationships between these components are used to form a feature vector. These geometric relationships may be example positions, distances, and angles.

For instance, Zhang and others used the geometric positions of 34 fiducial points as facial features to represent facial images. Another widely-used facial description is the Facial Action Coding System, where facial expressions are represented by one or more action units (AUs). Valstar and others presented detection by classifying features calculated from tracked fiducialfacial points and urged that geometric approaches have similar or better performance than appearance-based approaches in facial expression analysis.

However, geometric representation of facial geometry requires accurate and reliable facial component detection and tracking, which are difficult to accommodate in many situations. The appearance-based system models the face images by applying an image filter or filter banks on the whole face or some specific regions of the face to extract changes in facial appearance. Principal component analysis (PCA) has been widely applied to extract features for face recognition. PCA is primarily used in a holistic manner. More recently, independent component analysis (ICA) enhanced ICA and Gabor wavelet have been utilized to extract

facial feature either from whole-face or specific face regions for modeling facial changes. Do nato and others performed a comprehensive analysis of different techniques, including PCA, ICA, local feature analysis, and Gabor wavelet, to represent images of faces for facial action recognition and demonstrate that the best performance can be achieved by ICA and Gabor wavelet. However, convoluting a facial image with multiple Gabor filters of multiple scales and orientations makes the Gabor representation very intensive as regards time and memory.

Among the appearance-based feature extraction methods, the local binary pattern (LBP) method which was originally introduced for the purpose of texture analysis and its variants were used as a feature descriptor for facial expression representation. The LBP method is computationally efficient and robust to monotonic illumination changes. However, it is sensitive to non-monotonic illumination variation and also shows poor performance in the presence of random noise. The local directional pattern (LDP) method, a more robust facial feature proposed by Jabid and others demonstrated better performance for face recognition compared to LBP. In this work, we have analyzed the performance of the proposed LDP feature in characterizing different facial expression. We empirically study the effectiveness of facial image representation based on LDP for recognizing human expression. The performance of this representation is evaluated using template matching and support vector machine (SVM).

Extensive experiments with two widely-used expression databases, namely, the Cohn-Kanade (CK) facial expression database and the Japanese female facial expression (JAFFE) database, demonstrate that the LDP feature is more robust in extracting the facial features, and it is also superior in classifying expressions compared to LBP and Gabor wavelet features. We also find that the LDP method performs stably and robustly over a useful range of lower resolution face images.

ADVANTAGES

- Well suitable for real time application
- Maintain a high recognition rate

DISADVANTAGES

- It is relatively more expensive than that of LBP
- It needs to compute different edge responses with a compass mask

M. KABIR, T. JABID, AND O. CHAE, A LOCAL DIRECTIONAL PATTERN VARIANCE (LDPV) BASED FACE DESCRIPTOR FOR HUMAN FACIAL EXPRESSION RECOGNITION

Facial expression is one of the most powerful, natural, and immediate means for human beings to communicate their emotions and intentions. Automatic facial expression recognition has attracted much attention from behavioral scientists since the work of Darwin in 1872 and has gained significant importance in applications of human-computer interactions. Although much work has been done with automatic facial expression analysis, recognition with high accuracy remains difficult due to the complexity and variety of facial expressions. A survey of existing research on facial expression analysis can be found.

Extracting an effective facial representation from human face images is a vital component of any successful facial expression recognition system. The derived representation should retain essential information possessing high discrimination power and stability which minimizes within-class variations o f expressions whilst maximizes between-class variations. Classification performance is heavily influenced by the information contained in the expression representations. Two types of facial feature extraction approaches are commonly found: the geometric feature-based system and the appearance-based system. Geometric feature vectors represent the shape s and locations of facial components by encoding the face geometry from the position, distance, angle, and other geometric relationships between these components. Zhang et al .pre presented facial images using the geometric positions of 34 fiducial points as facial features. A widely used facial description is the facial action coding system, where facial expressions are decomposed into one or more Action Units (AUs). Valstar et al .detected AUs by tracking several fiducial points on face and urged that geometric approaches have similar or better performance than appearance-based approaches in facial expression analysis. However, geometric feature-based methods require accurate and reliable facial component detection which is difficult to accommodate in many situations. Recent psychological research suggests that the whole spatial relationship of the facial features can be an additional source of information in the perception of facial emotions. Therefore, in appearance- a based method a single image filter or filter bank is applied to the whole face or some specific region o f the face to extract appearance changes. Among the holistic methods, Principal Component Analysis (PCA) has been widely applied to facial images to extract features for recognition purposes. PCA is also used for dimensionality reduction in feature space. Lately, Independent Component Analysis (ICA) Enhanced ICA (EICA), and Zernike Moments (ZM) have been utilized to extract local Directional Pattern Variance (LDPv): A Robust Feature Descriptor for Facial Expression Recognition 383 features and facial changes. Donatoet al. performed a comprehensive analysis of different techniques, including PCA, ICA, Local Feature Analysis (LFA), Gabor-wavelet and local Principal Components (PCs), to represent face images for facial action recognition. The best performance was achieved by ICA and Gabor-wavelet. Since then Gabor-wavelet representations have been widely adopted in face image analysis by other methods.

However, convoluting a facial image with multiple Gabor filters of many scales and orientations makes the Gabor representation time and memory intensive. Lajevardi and Hussain have utilized log-Gabor filters to overcome some limitations of Gabor-wavelet representations but the dimensionality of resulting feature vector is still high. Recently, Local Binary Pattern (LBP) and its variants have been introduced as a feature descriptor for facial expression representation. Originally, LBP was introduced for texture analysis. A comprehensive study of LBP in facial expression recognition can be found in. Although LBP is computationally efficient and shows robustness to monotonic illumination change, it is sensitive to non monotonic illumination variation and also shows poor performance in the presence of random noise. A more robust facial descriptor, named as Local Directional Pattern (LDP), was devised by Jabid et al. where the LDP representation of face demonstrated better recognition performance than LBP. The LDP feature overcomes the limitations of LBP features since LDP is derived from the edge responses which are less sensitive to illumination changes and noises. In this work, we propose the LDP variance

(LDPv), which characterizes both spatial structure LDP and contrast variance of local texture information for more accurate facial expression recognition performance. We empirically study the facial representation based on LDPv for human expression recognition. The performance of LDv representation is evaluated with two machine learning methods: Template matching and Support Vector Machines (SVM) with different kernels. Extensive results from the standard expression database Cohn- Kanade facial expression database demonstrate that LDPv feature is more robust in extracting facial features, and have a superior recognition rate, as compared to LBP, Gabor-wavelet features, and other appearance based methods. LDPv descriptor also performs stably and robustly over a useful range of low-resolution face images.

ADVANTAGES

- Facial expressions can be recognized more accurately from sequence images than from a single image
- High recognition rate with lower computational cost

DISADVANTAGES

- It is difficult to extract geometric feature
- Performance can be improved when incorporate temporal information into the LDPv descriptor

B. ZHANG, Y. GAO, S. ZHAO, AND J. LIU, LOCAL DERIVATIVE PATTERN VERSUS LOCAL BINARY PATTERN: FACE RECOGNITION WITH HIGH-ORDER LOCAL PATTERN DESCRIPTOR

This paper proposes a novel high-order local pattern descriptor, local derivative pattern (LDP), for face recognition. LDP is a general framework to encode directional pattern features based on local derivative variations. The nth order LDP is proposed to encode the (n-1) th order local derivative direction variations, which can capture more detailed information than the first-order local pattern used in local binary pattern (LBP). Different from LBP encoding the relationship between the central point and its neighbors, the LDP templates extract high-order local information by encoding various distinctive spatial relationships contained in a given local region. Both gray-level images and Gabor feature images are used to evaluate the comparative performances of LDP and LBP. Extensive experimental results on FERET, CAS-PEAL, CMU-PIE, Extended Yale B, and FRGC databases show that the high-order LDP consistently performs much better than LBP for both face identification and face verification under various conditions. Representation for AFR; however all of these representations suffer during illumination variation and alignment error. One of the most successful local face appearance representations are Gabor features. A spatial histogram model local binary patterns (LBP) has also been proposed to represent visual objects, and successfully applied for different application in facial image analysis like human detection, face recognition or expression recognition. LBP is basically a fine-scale descriptor that captures small texture details, in contrast to Gabor features which encode facial shape and appearance over a range of scales. Using LBP, Ahonen et al. have reported impressive results

on the FERET database. Nevertheless LBP considers only first order intensity pattern change in a local neighborhood which fails to extract detailed information especially during changes in face image due to non-monotonic illumination variation, random noise, and change in age, expression. A more robust facial descriptor, named as Local Directional Pattern (LDP), was devised by Jabid et al., where the LDP representation of face demonstrated better recognition performance than LBP.

ADVANTAGES

- It is robust and insensitive to noise and non monotonous illumination changes
- It can be used in consumer products for human-computer interaction by facial expressions.

DISADVANTAGES

- Dissimilarity measure with all the images from gallery image set should be improved.
- However, texture with significant contrast should impact more since human eyes are more sensitive to high contrast regions should be considered.

III THEORETICAL BACKGROUND

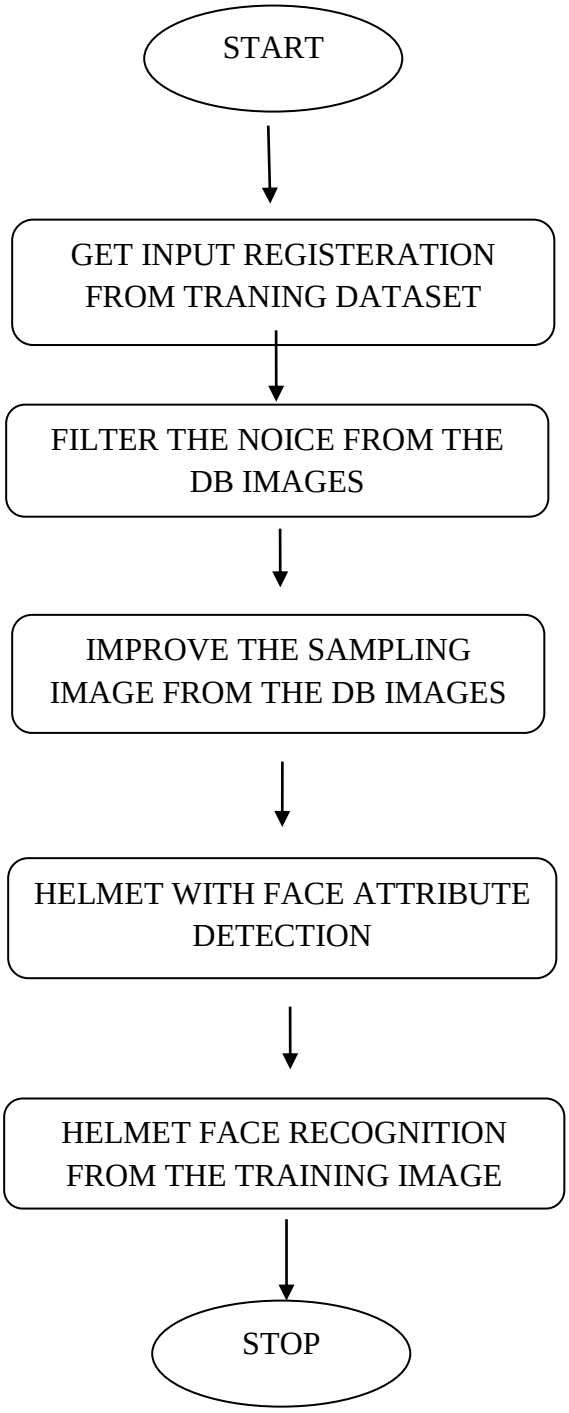
3.1 PROBLEM IDENTIFICATION

- The major problem here is detecting the helmet using a camera; object detection is an AI hard problem and can give rise to several false positives and false negatives.
- The only drawback is the requirement for some legislation to implement the same.
- Please note that the lack of an intuitive UI is due to the idea of implementing it in a two-wheeler, where the user has nothing to do (idea is Machine to Machine Interaction).

3.2 PROBLEM SOLVING

- In proposed system we can use pattern based tamper proof hologram stickers for the helmet using unique patterns.
- This paper aims for avoidance of accidents and develop helmet detection system.
- We intend to use background subtraction and optical character recognition for fall detection and for helmet detection we use background subtraction and Hough transform descriptor.
- So that this pattern can be detected which can confirm the presence of the helmet?
- This is also a low cost method as tamper proof hologram stickers are very cheap.
- It also has some hardware requirements including the setup of a camera, which can also be used for other purposes such as detecting accidents.

3.3 SYSTEM ARCHITECTURE



IV SYSTEM IMPLEMETATION

4.1. VISION BASED METHOD

- It is one of the most popular techniques for traffic surveillance due to low hardware cost.

4.2. BACKGROUND SUBTRACTION

- This is one of the methods where image background is extracted for further processing.
- It is the best approach for detecting objects from videos taken by static cameras.

- There are many techniques and both expert and new comers can be confused about limitations and benefits of it.
- This method based on static background hypothesis not applicable in real environments.

4.3. OBJECT DETECTION

- It is process of finding instance of real world objects such as faces.
- We can use Local Binary Pattern, Histogram of Oriented Gradients and Hough transform descriptors.

4.4. LOCAL BINARY PATTERN

- It is used for face recognition in computer vision.
- In this method image is divided into several small segments and from which features are extracted.
- It consists of binary patterns and describes surrounding of pixels.
- The features from segment are joint into single feature histogram. This method provides good result in term of speed.

4.5 HISTOGRAM OF ORIENTED GRADIENTS DESCRIPTOR

- Provides better performance than other existing feature sets.
- It is used to extract human feature from visible spectrum images.
- It has been determined that when LBP combined with HOG descriptor it improves, detection, performance considerably on some data sets.

4. 6 HOUGH TRANSFORM DESCRIPTOR

- It is a technique and can be used to isolate features of particular shape with an image.
- It requires some features in parametric form.
- It is most commonly used for detecting regular curves such as lines, circles, ellipses etc.

V CONCLUSION & FUTURE WORK

5.1 CONCLUSION

- In this paper we have proposed an approach which would detect helmet wearing of a two wheeler driver capturing image.
- Hence it ensures safety of the drivers while driving.
- Automatic Helmet detection and reporting system is the motivation of this project.
- To prevent road accidents, our approach is very useful. Thus safety of bike riders is ensured.

5.2 FUTURE ENHANCEMENT

In our future work, we plan to develop alter-native initial alignment techniques. Furthermore, the automatic occlusion detection stage can also be improved: As a future direction, we plan to model occlusions better, so that the overall performance of the system can be increased.

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