Latest IEEE 2017-18 Image Processing projects

1) ONE-TIME PASSWORD FOR BIOMETRIC SYSTEMS: DISPOSABLE FEATURE TEMPLATES

Biometric access control systems are becoming more commonplace in society. However, these systems are susceptible to replay attacks. During a replay attack, an attacker can capture packets of data that represents an individual's biometric. The attacker can then replay the data and gain unauthorized access into the system. Traditional password based systems have the ability to use a one-time password scheme. This allows for a unique password to authenticate an individual and it is then disposed. Any captured password will not be effective. Traditional biometric systems use a single feature extraction method to represent an individual, making captured data harder to change than a password. There are hashing techniques that can be used to transmute biometric data into a unique form, but techniques like this require some external dongle to work successfully. The proposed technique in this work can uniquely represent individuals with each access attempt. The amount of unique representations will be further increased by a genetic feature selection technique that uses a unique subset of biometric features. The features extracted are from an improved geneticbased extraction technique that performed well on periocular images. The results in this manuscript show that the improved extraction technique coupled with the feature selection technique has an improved identification performance compared with the traditional genetic based extraction approach. The features are also shown to be unique enough to determine a replay attack is occurring, compared with a more traditional feature extraction technique.

2) EFFECTIVE AND EFFICIENT GLOBAL CONTEXT VERIFICATION FOR IMAGE COPY DETECTION

To detect illegal copies of copyrighted images, recent copy detection methods mostly rely on the bag-of-visual-words (BOW) model, in which local features are quantized into visual words for image matching. However, both the limited discriminability of local features and the BOW quantization errors will lead to many false local matches, which make it hard to distinguish similar images from copies. Geometric consistency verification is a popular technology for reducing the

false matches, but it neglects global context information of local features and thus cannot solve this problem well. To address this problem, this paper proposes a global context verification scheme to filter false matches for copy detection. More specifically, after obtaining initial scale invariant feature transform (SIFT) matches between images based on the BOW quantization, the overlapping region-based global context descriptor (OR-GCD) is proposed for verification of these matches to filter false matches. The OR-GCD not only encodes relatively rich global context information of SIFT features but also has good robustness and efficiency. Thus it allows an effective and efficient verification.

3) FACE RECOGNITION USING SPARSE FINGERPRINT CLASSIFICATION ALGORITHM

Unconstrained face recognition is still an open problem as state-of-the-art algorithms have not yet reached high recognition performance in real-world environments. This paper addresses this problem by proposing a new approach called Sparse Fingerprint Classification Algorithm (SFCA). In the training phase, for each enrolled subject, a grid of patches is extracted from each subject's face images in order to construct representative dictionaries. In the testing phase, a grid is extracted from the query image and every patch is transformed into a binary sparse representation using the dictionary, creating a fingerprint of the face. The binary coefficients vote for their corresponding classes and the maximum-vote class decides the identity of the query image. Experiments were carried out on seven widely-used face databases. The results demonstrate that when the size of the dataset is small or medium (e.g., the number of subjects is not greater than one hundred), SFCA is able to deal with a larger degree of variability in ambient lighting, pose, expression, occlusion, face size, and distance from the camera than other current state-of-the-art algorithms.

4) A NEW RULE FOR COST REASSIGNMENT IN ADAPTIVE STEGANOGRAPHY

In steganography schemes, the distortion function is used to define modification costs on cover elements, which is distinctly vital to the security of modern adaptive steganography. There are several successful rules for reassigning the costs defined by a given distortion function, which can promote the security level of the corresponding steganographic algorithm. In this paper, we propose a novel cost reassignment rule which is applied to not one but a batch of existing distortion functions. We find that the costs assigned on some pixels by several steganographic methods may be very different even though these methods exhibit close security levels. We call such pixels *"controversial pixel"*. Experimental results show that steganalysis features are not sensitive to controversial pixels, therefore these pixels are suitable to carry more payloads. We name this rule the Controversial Pixels Prior (CPP) rule. Following the rule, we propose a cost reassignment scheme. Through extensive experiments on several kinds of stego algorithms, steganalysis features and cover databases, we demonstrate that the CPP rule can improve the security of state-of-the-art steganographic algorithms for spatial images.

5) PASSFRAME: GENERATING IMAGE-BASED PASSWORDS FROM EGOCENTRIC VIDEOS

In this paper, we analyze first-person-view videos to develop a personalized user authentication mechanism. Our proposed algorithm generates provisional image-based passwords which benefit a variety of purposes such as unlocking a mobile device or fallback authentication. First, representative frames are extracted from the egocentric videos. Then, they are split into distinguishable segments before a clustering procedure is applied to discard repetitive scenes. The whole process aims to retain memorable images to form the authentication challenges. We integrate eye tracking data to select informative sequences of video frames and suggest another alternative method if an eye-facing camera is not available. To evaluate our system, we perform experiments in different settings including object- interaction activities and traveling contexts. Even though our mechanism produces variable graphical passwords, the log-in effort for the user is comparable with approaches based on static challenges. We verified the authentication scheme in the presence of an informed attacker and observed that the effort is significantly higher than that of the legitimate user.

6) ENHANCED PASSWORD PROCESSING SCHEME BASED ON VISUAL CRYPTOGRAPHY AND OCR

Traditional password conversion scheme for user authentication is to transform the passwords into hash values. These hash-based password schemes are comparatively simple and fast because those are based on text and famed cryptography. However, those can be exposed to cyber-attacks utilizing password by cracking tool or hash-cracking online sites. Attackers can thoroughly figure out an original password from hash value when that is relatively simple and plain. As a result, many hacking accidents have been happened predominantly in systems adopting those hash-based schemes. In this work, we suggest enhanced password processing scheme based on image using visual cryptography (VC). Different from the traditional scheme based on hash and text, our scheme transforms a user ID of text type to two images encrypted by VC. The user should make two images consisted of subpixels by random function with SEED which includes personal information. The server only has user's ID and one of the images instead of password. When the user logs in and sends another image, the server can extract ID by utilizing OCR (Optical Character Recognition). As a result, it can authenticate user by comparing extracted ID with the saved one. Our proposal has lower computation, prevents cyber-attack aimed at hashcracking, and supports authentication not to expose personal information such as ID to attackers.

7) FINGERPRINT RECOGNITION OF YOUNG CHILDREN

In 1899, Galton first captured ink-on-paper fingerprints of a single child from birth until the age of 4.5 years, manually compared the prints, and concluded that "the print of a child at the age of 2.5 years would serve to identify him ever after". Since then, ink-on-paper fingerprinting and manual comparison methods have been superseded by digital capture and automatic fingerprint comparison techniques, but only a few feasibility studies on child fingerprint recognition have been conducted. Here, we present the first systematic and rigorous longitudinal study that addresses the following questions: (i) Do fingerprints of young children possess the salient features required to uniquely recognize a child? (ii) If so, at what age can a child's fingerprints be captured with sufficient fidelity for recognition? (iii) Can a child's fingerprints be used to reliably recognize the child as he ages? For our study, we collected fingerprints of 309 children (0-5 years old) four different times over a one year period. We show, for the first time, that fingerprints acquired from a child as young as 6 hours old exhibit distinguishing features necessary for recognition, and that state-of-the-art fingerprint technology achieves high recognition accuracy (98.9% true accept rate at 0.1% false accept rate) for children older than 6 months.

8) FULLY INCREMENTING VISUAL CRYPTOGRAPHY FROM A SUCCINCT NON-MONOTONIC STRUCTURE

Visual cryptography (VC) is a variant form of secret sharing. In generalthreshold setting, the k-out-of-n VC allows that, in a set of n participants, any k can recover and reconstruct the secret by stacking their shares. Recently, the notion of multiple-secret VC has been introduced to embed multiple secrets. Region incrementing visual cryptography (RIVC) is referred to as a new type of multi-secret VC. RIVC defines s layers and takes s secrets, and then embeds each secret into each layer. The layers are defined by the number of participants; for example, let two secrets and two layers be S2; S3 and L2;L3 in 2-out-of-3 RIVC, where any two participants in L2 can recover S2 and three in L3 can recover S2; S3. However, there is another multi-secret VC, called fully incrementing visual cryptography (FIVC), which also has the layers, but only one secret Si will reveal in one layer Li. In this paper, our stating point is to propose a new notion of non-monotonic visual cryptography (NVC) for human vision system as a primitive to construct FIVC. We firstly present an ideal construction of simple NVC which relies on a slightly unreasonable assumption.

9) SOMEONE IN YOUR CONTACT LIST: CUED RECALL-BASED TEXTUAL PASSWORDS

Textual passwords remain the most commonly employed user authentication mechanism, and potentially will continue to be so for years to come. Despite the well-known security and usability issues concerning textual passwords, none of the numerous proposed authentication alternatives appear to have achieved a sufficient level of adoption to dominate in the foreseeable future. Password hints, consisting of a user generated text saved at the account setup stage, are employed

in several authentication systems to help users to recall forgotten passwords. However, users are often unable to create hints that jog the memory without revealing too much information regarding the passwords themselves.
We propose a rethink of password hints by introducing S`YNTHIMA, a novel cued recall-based textual password method that reveals no information regarding the password, requires no modifications to authentication servers, and requires no additional setup or registration steps.

10) PASSBYOP: BRING YOUR OWN PICTURE FOR SECURING GRAPHICAL PASSWORDS

PassBYOP is a new graphical password scheme for public terminals that replaces the static digital images typically used in graphical password systems with personalized physical tokens, herein in the form of digital pictures displayed on a physical user-owned device such as a mobile phone. Users present these images to a system camera and then enter their password as a sequence of selections on live video of the token. Highly distinctive optical features are extracted from these selections and used as the password. We present three feasibility studies of PassBYOP examining its reliability, usability, and security against observation. The reliability study shows that image-feature based passwords are viable and suggests appropriate system thresholds - password items should contain a minimum of seven features, 40% of which must geometrically match originals stored on an authentication server in order to be judged equivalent. The usability study measures task completion times and error rates, revealing these to be 7.5 s and 9%, broadly comparable with prior graphical password systems that use static digital images. Finally, the security study highlights PassBYOP's resistance to observation attack - three attackers are unable to compromise a password using shoulder surfing, camera-based observation, or malware. These results indicate that PassBYOP shows promise for security while maintaining the usability of current graphical password schemes.

11) A SHOULDER SURFING RESISTANT GRAPHICAL AUTHENTICATION SYSTEM.

Authentication based on passwords is used largely in applications for computer security and privacy. However, human actions such as choosing bad passwords and inputting passwords in an insecure way are regarded as ”the weakest link” in the authentication chain. Rather than arbitrary alphanumeric strings, users tend to choose passwords either short or meaningful for easy memorization. With web applications and mobile apps piling up, people can access these applications anytime and anywhere with various devices. This evolution brings great convenience but also increases the probability of exposing passwords to shoulder surfing attacks. Attackers can observe directly or use external recording devices to collect users’ credentials. To overcome this problem, we proposed a novel authentication system PassMatrix, based on graphical passwords to resist shoulder surfing attacks. With a one-time valid login indicator and circulative horizontal and vertical bars covering the entire scope of pass-images, PassMatrix offers no hint for attackers to figure out or narrow down the password even they conduct multiple camera-based attacks. We

also implemented a PassMatrix prototype on Android and carried out real user experiments to evaluate its memorability and usability. From the experimental result, the proposed system achieves better resistance to shoulder surfing attacks while maintaining usability.

12) SINGLE SAMPLE FACE RECOGNITION BASED ON LPP FEATURE TRANSFER

Due to its wide applications in practice, face recognition has been an active research topic. With the availability of adequate training samples, many machine learning methods could yield high face recognition accuracy. However, under the circumstance of inadequate training samples, especially the extreme case of having only a single training sample, face recognition becomes challenging.How to deal with conflicting concerns of the small sample size and high dimensionality in one sample face recognition is critical for its achievable recognition accuracy and feasibility in practice. Being different from conventional methods for global face recognition based on generalization ability promotion and local face recognition depending on image segmentation, a single sample face recognition algorithm based on Locality Preserving Projection (LPP) feature transfer is proposed here.

13) REVERSIBLE DATA HIDING IN ENCRYPTED IMAGES BASED ON PROGRESSIVE RECOVERY

Reversible data hiding (RDH) in encrypted images has attained more attention recently in research community. Privacy protection of additional data as well as cover media makes it attractive for applications in medical imaging, cloud storage, forensics etc. In this paper, a new method for reversible data hiding in encrypted images (RDH-EI), is proposed. Our method adopts the approach of reserving sufficient space for the additional data before encrypting the cover image. First we identify suitable blocks for hiding data from various parts of the image. Before encrypting the image, one or more LSB-planes of these blocks are backed-up into remaining parts of the image using a high-performing traditional RDH method that works on unencrypted images. After encrypting the image, those LSBplanes are used to hide additional data. Recovery of original cover image and error-free extraction of additional data is guaranteed always.

14) A LOCALITY SENSITIVE LOW-RANK MODEL FOR IMAGE TAG COMPLETION

Many visual applications have benefited from the outburst of web images, yet the imprecise and incomplete tags arbitrarily provided by users, as the thorn of the rose, may hamper the performance of retrieval or indexing systems relying on such data. In this paper, we propose a novel locality sensitive low-rank model for image tag completion, which approximates the global nonlinear model with a collection of local linear models. To effectively infuse the idea of locality sensitivity, a simple and effective pre-processing module is designed to learn suitable representation for data partition, and a global consensus regularizer is introduced to mitigate the risk of over fitting.

Meanwhile, low-rank matrix factorization is employed as local models, where the local geometry structures are preserved for the low-dimensional representation of both tags and samples. Extensive empirical evaluations conducted on three datasets demonstrate the effectiveness and efficiency of the proposed method, where our method outperforms previous ones by a large margin.

15) A SCALABLE APPROACH FOR CONTENT-BASED IMAGE RETRIEVAL IN PEER-TO-PEER NETWORKS.

Peer-to-peer networking offers a scalable solution for sharing multimedia data across the network. With a large amount of visual data distributed among different nodes, it is an important but challenging issue to perform content-based retrieval in peer-to-peer networks. While most of the existing methods focus on indexing high dimensional visual features and have limitations of scalability, in this paper we propose a scalable approach for content-based image retrieval in peer-to-peer networks by employing the bag-of-visual-words model. Compared with centralized environments, the key challenge is to efficiently obtain a global codebook, as images are distributed across the whole peer-to-peer network. In addition, a peer-to-peer network often evolves dynamically, which makes a static codebook less effective for retrieval tasks. Therefore, we propose a dynamic codebook updating method by optimizing the mutual information between the resultant codebook and relevance information, and the workload balance among nodes that manage different codewords. In order to further improve retrieval performance and reduce network cost, indexing pruning techniques are developed. Our comprehensive experimental results indicate that the proposed approach is scalable in evolving and distributed peer-to-peer networks, while achieving improved retrieval accuracy.

16) LEARNING OF MULTIMODAL REPRESENTATIONS WITH RANDOM WALKS ON THE CLICK GRAPH

In multimedia information retrieval, most classic approaches tend to represent different modalities of media in the same feature space. With the click data collected from the users' searching behavior, existing approaches take either one-to-one paired data (text-image pairs) or ranking examples (text-query-image and/or image-query-text ranking lists) as training examples, which do not make full use of the click data, particularly the implicit connections among the data objects. In this paper, we treat the click data as a large click graph, in which vertices are images/text queries and edges indicate the clicks between an image and a query. We consider learning a multimodal representation from the perspective of encoding the explicit/implicit relevance relationship between the vertices in the click graph. By minimizing both the truncated random walk loss as well as the distance between the learned representation of vertices and their corresponding deep neural network output, the proposed model which is named multimodal random walk neural network (MRW-NN) can be applied to not only learn robust representation of the existing

multimodal data in the click graph, but also deal with the unseen queries and images to support cross-modal retrieval. We evaluate the latent representation learned by MRW-NN on a public large-scale click log data set Clickture and further show that MRW-NN achieves much better cross-modal retrieval performance on the unseen queries/images than the other state-of-the-art methods.

17) ONLINE MULTI-MODAL DISTANCE METRIC LEARNING WITH APPLICATION TO IMAGE RETRIEVAL

Distance metric learning (DML) is an important technique to improve similarity search in content-based image retrieval. Despite being studied extensively, most existing DML approaches typically adopt a single-modal learning framework that learns the distance metric on either a single feature type or a combined feature space where multiple types of features are simply concatenated. Such single-modal DML methods suffer from some critical limitations: (i) some type of features may significantly dominate the others in the DML task due to diverse feature representations; and (ii) learning a distance metric on the combined high-dimensional feature space can be extremely time-consuming using the naive feature concatenation approach. To address these limitations, in this paper, we investigate a novel scheme of online multi-modal distance metric learning (OMDML), which explores a unified two-level online learning scheme: (i) it learns to optimize a distance metric on each individual feature space; and (ii) then it learns to find the optimal combination of diverse types of features. To further reduce the expensive cost of DML on high-dimensional feature space, we propose a low-rank OMDML algorithm which not only significantly reduces the computational cost but also retains highly competing or even better learning accuracy. We conduct extensive experiments to evaluate the performance of the proposed algorithms for multi-modal image retrieval, in which encouraging results validate the effectiveness of the proposed technique

18) TAG BASED IMAGE SEARCH BY SOCIAL RE-RANKING

Social media sharing websites like Flickr allow users to annotate images with free tags, which significantly contribute to the development of the web image retrieval and organization. Tag-based image search is an important method to find images contributed by social users in such social websites. However, how to make the top ranked result relevant and, with diversity, is challenging. In this paper, we propose a social re-ranking system for tag-based image retrieval with the consideration of an image's relevance and diversity. We aim at re-ranking images according to their visual information, semantic information, and social clues. The initial results include images contributed by different social users. Usually each user contributes several images. First, we sort these images by inter-user re-ranking. Users that have higher contribution to the given query rank higher. Then we sequentially implement intra-user re-ranking on the ranked user's image set, and only the most relevant image from each user's image set is selected. These selected images compose the final retrieved results. We build an inverted index structure for the social image

dataset to accelerate the searching process. Experimental results on a Flickr dataset show that our social re-ranking method is effective and efficient.

19) AUTOMATIC FACE NAMING BY LEARNING DISCRIMINATIVE AFFINITY MATRICES FROM WEAKLY LABELED IMAGES

Given a collection of images, where each image contains several faces and is associated with a few names in the corresponding caption, the goal of face naming is to infer the correct name for each face. In this paper, we propose two new methods to effectively solve this problem by learning two discriminative affinity matrices from these weakly labeled images. We first propose a new method called regularized low-rank representation by effectively utilizing weakly supervised information to learn a low-rank reconstruction coefficient matrix while exploring multiple subspace structures of the data. Specifically, by introducing a specially designed regularizer to the low-rank representation method, we penalize the corresponding reconstruction coefficients related to the situations where a face is reconstructed by using face images from other subjects or by using itself. With the inferred reconstruction coefficient matrix, a discriminative affinity matrix can be obtained. Moreover, we also develop a new distance metric learning method called ambiguously supervised structural metric learning by using weakly supervised information to seek a discriminative distance metric. Hence, another discriminative affinity matrix can be obtained using the similarity matrix (i.e., the kernel matrix) based on the Mahalanobis distances of the data. Observing that these two affinity matrices contain complementary information, we further combine them to obtain a fused affinity matrix, based on which we develop a new iterative scheme to infer the name of each face. Comprehensive experiments demonstrate the effectiveness of our approach.

20) SUPER RESOLUTION – BASED INPAINTING

This paper introduces a novel framework for examplar-based inpainting. It consists in performing first the inpainting on a coarse version of the input image. A hierarchical super-resolution algorithm is then used to recover details on the missing areas. The advantage of this approach is that it is easier to inpaint low-resolution pictures than high-resolution ones. The gain is both in terms of computational complexity and visual quality. However, to be less sensitive to the parameter setting of the inpainting method, the low-resolution input picture is inpainted several times with different configurations. Results are efficiently combined with a loopy belief propagation and details are recovered by a single-image super-resolution algorithm. Experimental results in a context of image editing and texture synthesis demonstrate the effectiveness of the proposed method. Results are compared to five state-of-the-art inpainting methods.

21) 2D IMAGE MORPHING

This paper presents estimation of head pose angles from a single 2D face image using a 3D face model morphed from a reference face model. A reference model refers to a 3D face of a person of the same ethnicity and gender as the query subject. The proposed scheme minimizes the disparity between the two sets of prominent facial features on the query face image and the corresponding points on the 3D face model to estimate the head pose angles. The 3D face model used is morphed from a reference model to be more specific to the query face in terms of the depth error at the feature points. The morphing process produces a 3D face model more specific to the query image when multiple 2D face images of the query subject are available for training. The proposed morphing process is computationally efficient since the depth of a 3D face model is adjusted by a scalar depth parameter at feature points. Optimal depth parameters are found by minimizing the disparity between the 2D features of the query face image and the corresponding features on the morphed 3D model projected onto 2D space. The proposed head pose estimation technique was evaluated on two benchmarking databases: 1) the USF Human-ID database for depth estimation and 2) the Pointing'04 database for head pose estimation. Experiment results demonstrate that head pose estimation errors in nodding and shaking angles are as low as 7.93° and 4.65° on average for a single 2D input face image.

22) NOISE REDUCTION BY FUZZY IMAGE FILTERING

A new fuzzy filter is presented for the noise reduction of images corrupted with additive noise. The filter consists of two stages. The first stage computes a fuzzy derivative for eight different directions. The second stage uses these fuzzy derivatives to perform fuzzy smoothing by weighting the contributions of neighboring pixel values. Both stages are based on fuzzy rules which make use of membership functions. The filter can be applied iteratively to effectively reduce heavy noise. In particular, the shape of the membership functions is adapted according to the remaining noise level after each iteration, making use of the distribution of the homogeneity in the image. A statistical model for the noise distribution can be incorporated to relate the homogeneity to the adaptation scheme of the membership functions. Experimental results are obtained to show the feasibility of the proposed approach. These results are also compared to other filters by numerical measures and visual inspection.

23) FACE RECOGNITION USING EIGEN VALUES

The Web services use community to grow with different functionality and location. Today web service can provide satisfactory solution for each and every application. Web services are communicating with face identifier and detect the problem occur in the location. Face recognition is the process of identifying human face based on circumstance. This work implements with a system that is configured to identify faces especially the image caught in ATM camera with certain

environmental constraints. The proposed work enhances this approach using web logic and web services. The mechanism works on the proposed system for all the constraints specified for identifying images and provides feasible solution through broad area spectrum for identifying images and to store images in all other web services. The transitional algorithm uses Eigen values along with Adaboost, Daugman's Method and Global Gabor Phase Pattern which is in turn applied for face recognition in web services. The results are proven to be effective and feasible by which an image identified and the result is well shared among all other web services.

24) NOISE REDUCTION BY USING FUZZY IMAGE FILTERING

The Synthetic Aperture Radar (SAR) image with its advantages is becoming more popular than the optical image in earth observation in using the remote-sensing techniques. However, the speckle noise that occurs in the SAR image causes difficulties in image interpretation. Thus, speckle noise reduction needs prepossessing procedure prior to the use of the SAR images. This study is done by proposed fuzzy filters that utilize SAR data. From the comparison, the combination of Frost-Triangular Moving Average (TMAV) has the best performance in the ability to reduce speckle noise than other filters. This filter improved the Frost filter performance for speckle noise reduction parameter's measurement, shows that 13.41% for Equivalent Number of Looks (ENL) and 6.07% for Speckle Index (SI). While Frost-Asymmetric Triangular Moving Average (ATMAV) has a relatively good performance for preserved texture. This filter improved the texture parameters such as Standard Deviation improved 4.33% and improved Variance for 8.46%. However, for the Mean parameters, Frost-Triangular Median Center (TMED) combination has the best performance compared to other filters, which improved the mean value for 7.10%. The comparative study it has been verified that the fuzzy approach has the robustness in the reduction of speckle noise and preserving the texture when applied in SAR image.

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