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# Fingerprint Authentication System

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***Abstract:*** *Fingerprint authentication is one of the safest and the easiest method as compared to other biometric authentication system. In this reprt, we have present the use of fingerprint towards the security. Fingerprint authentication provides an alternative and easiest approach to the exisiting method of providing the security for the log-in purpose.*
***Keywords:*** *Fingerprint; Security*

## I. Introduction

The current online shopping system for transaction and sign- up, we use the traditional approach which consists of Name, email-id, contact number and password. There are many possibilities that it can be exploited by the attacker to get access of the confidential information of the authenticated user. So to overcome this flaw as per the user point of view, we propose a secure online shopping system that gives the Internet users the confidence to use their online shopping cards or their credit cards without the need to worry about the hackers or the online shopping frauds.

The proposed system uses a fingerprint verification technique to verify the customer (cardholder). Since fingerprint is one of the most unique personal identities, so it can be used for the security assurance of the authentication. By using this approach we will be able to get high level of confidentiality, integrity and reliability.

The fingerprint which was taken at the time of the sign-up will be encrypted and at the time of the transaction the current fingerprint of the user should match with the stored fingerprint in the database for the further access.

## II. Point Pattern Matching Algorithm

A point set can be represented by a complete graph as follows. A vertex denotes a point and the weight of an edge connecting two vertices represents the Euclidean distance between the corresponding two points. For a given point set, if the point number is n, the edge number of its corresponding complete graph is $n(n-1)/2$. Clearly, if V and V' are two matched point sets under reflection transform, or transform of translation and rotation, the corresponding edges of their complete graphs are equal, and vice versa. In general, translation and rotation transform and reflection transform are collectively called Euclidean transform.

Definition 2.1. If all corresponding edges of two complete graphs are equal, they are congruent graphs.

Let G(V) and G(V') be the complete graphs of V and V', respectively, and G(V) equivalent to G(V') represent that G(V) and G(V') are congruent graphs. Thus, there is a property of congruent graphs.

Property 1. If G(V) equivalent to G(V'), the point sets V and V' are the matching sets under Euclidean transform. If two point sets are the matching sets under Euclidean transform, corresponding edges of congruent graphs formed by these point sets are equal, and vice versa. As shown in Figure 1, since G({p1,p2,p3,p4}) equivalent to G({q1,q2,q3,q4}),

{ p1,p2,p3,p4} and { q1,q2,q3,q4}, are the matching sets under reflection transform. Similarly, {p1,p2,p3,p4} and

{ v1,v2,v3,v4} are the matching sets under translation and rotation transform sinceG({p1,p2,p3,p4}) equivalent to

G({v1,v2,v3,v4}) .
Let V = {v1,v2,…,vk}(k>=3) and V'={v1',v2',…,vk'} be two planar point sets. If we use the Euclidean distance between any two points to represent the corresponding edge weight of graph, the complete graph of each point set has k(k- 1)/2 edges. Clearly, we can find congruent complete graphs by calculating all edges and establishing their corresponding relations. However, such computational cost is large. To reduce computation, we can calculate matched edges based on the following theorem.

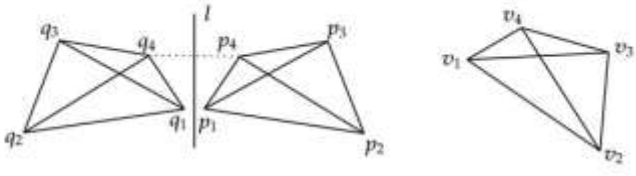



**Figure 1:** Congruent complete graphs and corresponding point sets.

Theorem 2.2. Let (va,va')and (vb,vb') be two pairs of matched points between V and V'. Thus, we have G(V)=G(V') if they satisfy the following conditions.
(1)|vavi|= |va'vi'| (i=1,2,..,k, i≠a ) and |vbvi|= |vb'vi'| (i=1,2,..,k, i≠b ) .
(2) If v1,v2,…,vk (i≠a, i≠b)are on one side of the straight line vavb, their corresponding points v1',v2',…,vk' are also on the corresponding side of the straight line va'vb' .
(3) If vavb , vk (i≠a, i≠b) and are collinear, their corresponding points va',vb', vi' and are also collinear.

Consider the case that vertices are collinear. If va , vb and vi are collinear, va',vb' and vi' are also collinear (Condition 3). If vj and vj' are on the straight lines vavb and va'vb' respectively, it is clearly that |vivj|=| vi'vj' |. If they are not on the straight lines as shown in Figure 2(b), |vivj|=|vi'vj'| is also available.
From the above analysis, it can be found that |vivj|=|vi'vj'| can be derived if the vertices vi and vj satisfy the above- mentioned conditions. So G(V)=G(V').
Obviously, the pattern matching between two point sets and under Euclidean transform can be achieved by calculating their congruent complete graphs. The detailed algorithm is as follows.
(1) For each vertex pi € P(i=1,2,…,n), calculate the Euclidean distance |pip| (i≠j) between pi and pj and sort these distances to make an ascending sequence.
(2) For each vertex qi € Q(i=1,2,…,m), calculate the Euclidean distance |qiqj| (i≠j) between qi and qj and sort these distances to make an ascending sequence.
(3) Compute the congruent complete graphs between G(P) and G(Q) by Theorem 2.2 and determine whether or not P and Q are matched.

**Parameters Of Congruent Complete Graphs**
If two point sets are matched, one can be viewed as the transformed result of the other, where the transform may be translation and rotation transform or reflection transform. Note that Euclidean distance between two points is invariant under these transforms. Parameters of the above transforms are discussed as follows. (1) Translation and rotation transform denoted as Tθ,tx,ty : let (x,y) be the coordinates of a point and (x',y') the coordinates of its transformed version. If they satisfy the following equation:

$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} t_x \\ t_y \end{pmatrix} + \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix}, \qquad (2.1)$$

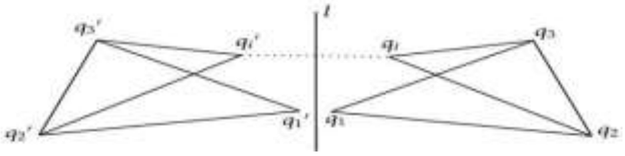
the transform is called translation and rotation transform, where θ is the rotation angle tx and ty are the translations along x-axis and y-axis, respectively. The θ, tx, and ty are the parameters of translation and rotation transform. (2) Reflection transform denoted as T*l*: if *l* is the perpendicular bisector of the line segment connecting (x,y) and (x',y'), the two points are a pair of matched points under the T*l*, where *l* is the symmetry axis and the parameter of the reflection transform. Parameter calculations are as follows.

For translation and rotation transform, let (p1,q1 ) and (p2,q2 ) be two pairs of matched points under translation and rotation transform, that is Tθ,tx,ty(qi)=pi (i=1,2) where the coordinates of qi and pi are (xi,yi) and (x'i,yi'), respectively. Substitute the coordinates of each pair of points into (2.1) and then obtain the following equation:

$$t_x = x_1' - x_1 \cos\theta + y_1 \sin\theta,$$
$$t_y = y_1' - x_1 \sin\theta - y_1 \cos\theta, \qquad (2.2)$$
$$\theta = \theta_{q_1q_2} - \theta_{p_1p_2},$$

where θ is the included angle between $q_1q_2$ and $p_1p_2$ . From (2.2), it is found that the transform parameters $t_x$,$t_y$ and θ can be uniquely determined by two pairs of matched points.

For reflection transform, suppose that {$q'_1$,$q'_2$,…,$q'_r$} is the transformed result of {$q_1$,$q_2$,..,$q_r$} under the transform $T_l$ , as shown in Figure 3. If $q_i$(i=1,2,..,r) and are $q'_i$ not the same point, the perpendicular bisector *l* of the line segment connecting $q_i$ and $q'_i$ is the symmetry axis of the reflection transform.



From the above analysis, it is clearly that the parameters $t_x$,$t_y$ ,θ and can uniquely determine a translation and rotation transform, and the symmetry axis *l* can determine a reflection transform. If V'={$v'_1$,$v'_2$,…,$v'_k$} (k≥3) is the transformed result of V={$v_1$,$v_2$,…,$v_k$} under the Euclidean transform, V and V' are a pair of matched point sets.

**Calculation Of Congruent Complete Graphs**

Let P={$p_1$,$p_2$,…,$p_m$} and Q={$q_1$,$q_2$,..,$q_n$} be two matched point sets in a 2D plane. To find the congruent complete graphs containing vertices $p_a$ and $p_b$, we calculate the distances $|p_ap_i|$ (i=1,2,..,m i≠a) and $|q_bq_j|$ (j=1,2,..,n j≠b), and make these distances in ascending order, where the sorted result of $|p_ap_i|$ is {$d_1$,$d_2$,..,$d_{m-1}$} and that of $|q_bq_j|$ is {$s_1$,$s_2$,..,$s_{n-1}$}. Thus, congruent complete graphs can be calculated by the following steps.

(1) Let i=1 and j=1. If $d_i$=$s_j$, record the matched points forming the matched sets and let i←i+1. If $d_i$>$s_j$, let j←j+1 . If $d_i$<$s_j$ , let i←i+1 . Repeat the computation until i=m or j=n.

(2) Select a pair of matched points $p_c$ and $q_f$ from the above matched sets, whose distances to $p_a$ and $q_b$ are equal. Calculate the distances from $p_c$ and $p_f$ to other corresponding matched points, respectively, and compute the congruent complete graphs by the Theorem 2.2. If the congruent complete graphs are available, we extract other congruent complete graphs from the rest points. Otherwise, we select another matched pair to calculate congruent complete graphs until all matched pairs are used.

**Matching Algorithm Based On Complete Graphs**

For incomplete matching problem, if we calculate complete graphs of all points to identify congruent graphs, the computational cost is large. In here, nearest neighbor algorithm is exploited to improve efficiency. Let P={$p_1$,$p_2$,..,$p_m$} and Q={$q_1$,$q_2$,…,$q_n$} be two matched point sets, and the matched probability in P is p , that is, $p_m$ points of P have matched points in Q. Thus, the matched probability p' in Q can be calculated by
p'=pm/n.

Note that the minimum point number of congruent complete graphs is 3. Suppose that the selected neighbor point numbers in P and Q are k and t. For each point of P and Q, we apply the method to find its nearest neighbor points. A small number of neighbor points is helpful to improve computational speed. However, average matched point number for each point could not be smaller than 3. In the words, the k or t value must satisfy $p_k$≥3 or $p'_t$≥3 . Thus, we have

k=3/p

So we have,

t=3/p = 3n/pm

Detailed steps of the proposed matching algorithm are as follows.

Step 1. For each point of Q, extract t neighbor points by the method [19], calculate the distances to the neighbor points, and sort these distances.

Step 2. Randomly select a point from P and find its K neighbor points by the method [19] again. Next, calculate its distances to the k neighbor points, and sort these distances. Apply the Theorem 2.2 to determine matched graphs between the complete graph forming by these k+1 points of P and the other complete graph of each point of Q . During the determination, we record the transform parameters and the transform type, that is, translation and rotation transform or reflection transform.

Step 3. Repeat Step 2 and merge the congruent complete graphs with the same transform parameters and the same transform type. If the point number of the congruent complete graphs is bigger than a predefined threshold

T, we recalculate the transform parameters. If the calculated results are equal to the prior values, the corresponding points forming the congruent complete graphs are the matched points. The algorithm is done. Otherwise, turn to Step 2.

## III. Experimental Results

To validate the proposed algorithm, many experiments are conducted and all results show the effectiveness of our algorithm. In here, typical examples including the synthesized point sets and the real point sets from fingerprints are presented. For the synthesized examples, point sets under the two kinds of Euclidean transform are both considered, where the matched probability in P is 0.8, that is, p=0.8 . As the points may be perturbed by noises in a real-world situation, we define a threshold €=4. If the difference between two distances is smaller than the threshold, their corresponding edges are considered as a matched pair.

***Application advantages:***

The system will be designed to proytect an unauthorised log-in and it will provide an ease of access to the user to get logged in. Due to the use of the fingerprint as a biometric aunthentication the level of security will be very high,

## IV. Conclusion

Online shopping will become increasingly important as more and more manufactures sell products on the Internet, and many users are using the Internet to express and share their opinions. Thus our Goal is to find the favorable or interesting products for an individual user among a huge amount of products. In this project we propose a product ranking system where users can specify product features to get back the ranking results of all matched products. We use opinion mining techniques to identify the sentence polarity in product reviews, and then calculate the scores of all matched products using the defined formulas. The experimental results show that the system is practical and the ranking results are interesting.

This Web based application will ultimately help the user to assemble PC without hassles of going and researching the whole market thereby wasting a lot of money and time. Overall our application will give a final rating based on the components or peripheral selected and the user will be easily be able to make their PC with getting all the required parameter like cost, performance, throughput etc

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