Journal of International Trade, Logistics and Law, Vol. 3, Num. 2, 2017, 50-57

CLOUD COMPUTING INTEGRATED MULTI-FACTOR AUTHENTICATION FRAMEWORK APPLICATION IN LOGISTICS INFORMATION SYSTEMS

Zeynel Erdi Karabulut,

Istanbul Commerce University, Turkey

Mustafa Cem Kasapbaşı (Ph.D)

Istanbul Commerce University, Turkey

Received: Dec. 09, 2017 Accepted: Dec. 21, 2017 Published: Dec. 25, 2017

Abstract:

As new technology enables firms to perform many daily processes easier the need of authentication and authorization process is becoming an integral part of many businesses. Also mobile applications are very popular nowadays play an important role in our lives. Such demands are not only limited to Logistics Information Systems (LIS) but many field of information system as well. In this study multi-dimensional authentication which consist of online biometric face detection integrated as cloud computing software as a Service (SaaS), Near Field Communication (NFC) card authentication, location confirmation, and temporal data confirmation are gathered together to fulfill different scenarios of authentication needs of business. Microsoft Face API (Application Program Interface, SAAS (software as a service) has been used in face recognition module of developed mobile application. The face recognition module of the mobile application has been tested with Yale Face Database. Location, temporal data and NFC card information are collected and confirmed by the mobile application for authentication and authorization. These images were tested with our facial recognition module and confusion matrices were created. The accuracy of the system after the facial recognition test was found to be 100%. NFC card, location and temporal data authentication not only further increases security level but also fulfils many business authentication scenarios successfully. To the best of our knowledge there is no other authentication model other than implemented one that has a-4-factor confirmation including biometric face identification, NFC card authentication, location confirmation and temporal data confirmation.

Keywords:

Logistic Information Systems, Biometric, Authentication, Mobile

1. Introduction

Logistic Information systems are subsets of the Information system of the company which are designed to fulfill requirements of inbound, outbound if possible reverse logistics. Inbound logistic process is related to the receipt of materials, the subsequent storage handling, and receipt of parts or resale products from external suppliers and transportation requirements for the sake of manufacturing or marketing distribution (Bowersox et al., 2002). Outbound logistic process is related to transferring the final product and related information from end of production line to end user (Christopher, 1998). And lastly Reverse Logistics is also a part of supply chain management process and it is dedicated to reverse transformation of the product and materials for repair, remanufacture, refurbish, repair or recycle.

As new technologies emerge the need of authentication in logistics can be satisfied easily. With the ever-increasing use of mobile devices, mobile devices are now an indispensable part of everyday life.

Loss of cargo has a negative impact in company business and major issue in logistics management but few studies dealt with the loss of cargo. Some of the major factors of cargo loss are transit types, product categories, and shipping destinations (Pei-Ju et al., 2017).

With this study it is aimed to establish a bridge between mobile system and regarding authentication and authorization process in logistic information system. In this study it's also aimed to create a system that is going to

help and identify cargo loss issues of cargo damage, cargo theft, and cargo liability insurance through exploiting real cargo loss data. In literature it is indicated that creating secure system will boost the trust and perceived view of the company as well.
This article briefly describes and gives the literature review. After that methodology and implemented model will be discussed and some technical test of the implemented model will be given and concluding remarks will be given in the end.

2. Background Works

To the best of our knowledge there is no other authentication model other than implemented one that has a-4-factor confirmation including biometric face identification, NFC card authentication, location confirmation and temporal data confirmation. Therefore, some of studies with the similar background works are going to be discussed in this section.
In (Adalan 2017) a mobile authentication application which offers face recognition, NFC and audio control to open the lock of the door. This study is concentrated on whether the recognized face is alive or not. However not enough tests were carried out and implemented system was very sensitive to light change background.
In another graduate study (Narol 2014), NFC technology is used in a public transportation application. In this study it is aimed to develop a contactless mobile payment system in order to obtain high quality, easily accessible and secure authentication.
In their study (Antonia and Andrea, 2013) they have successfully implemented people identification with two factors NFC card and face recognition, they have tested their system with limited number of images.
(Assarasee et al. 2017) used cloud computing service of Microsoft to detect and recognize the faces successfully. Microsoft Face API also used in the study.
In (Ramnath 2002) it is implemented that secure transactions in Electronic commerce (EC) in transactions will influence the customers' attitude and establish a trust relation between company and customer in positive way. However according to study it has marginal effect of financial liability on consumers' trust in EC.

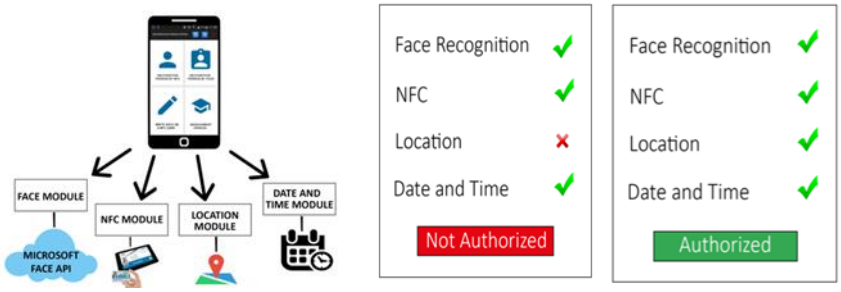
3. Implemented Model of the Framework

As Logistic Information System is concerned, there are thousands of daily inbound, outbound or reverse logistic transactions and many of which include sensitive information that needs to be handled authenticated and secure way. As mentioned in (Ramnath 2002) secure transactions between company and customer will establish a trust relation and possible loyalty against company.
Implemented secure authentication model consist of 4 modules, Microsoft Cloud Face API as SaaS, and a MySQL used as Database. Module names are Face Module, NFC Module, Location Module, Date and Time Module as depicted in Figure 1. All of these modules are implemented in the Android mobile platform. There is an external MySQL database to store the property information of the company. In order to describe better some scenarios are given.
Scenario 1: System Admin registers an outbound logistic event and associate customer information with the cargo information (face information, loyalty card information NFC, location to pick up, and time to pick up). Cargo man uses his hand held device to authenticate customer, date and place of the delivery location. When transaction completed no party can deny the cargo handover.
Scenario 2: Customer registers a reverse Logistic event in Logistic information system, (Enter user's information, location, date time), System associates a cargo man with this event. Customer uses Company Mobile App to authenticate the cargo man, also cargo man uses his hand held device to authenticate customer.
Scenario 3: Company uses customer uploaded face image in the cover of the package, and package is transferred to customer. Customer uses Company Mobile App to authenticate the cargo package in a custom way.
Scenario 4: Supplier Company send procurement cargo with the exact location and time therefore cargo is delivered to the right person, in right location and in right time.

If it is included, Face Module is responsible for capturing the image and querying the face with the database, if any match is found with the associated event confirmation tick is checked. If it is included NFC module in the scenario confirms the validity of the loyalty card with the event and confirmation tick is checked. If it is included Location

and Temporal data are check with the event, confirmation tick is checked. Symbolic representation is given in Figure 1.

Figure 1: Application modules and interaction and result



4. Methodology and Tests

As it can be inferred form the text the core difficulty in the study is registering, identifying the faces and it must be performed in real time. Since Microsoft Face API has been selected for identifying the faces and certain steps should be performed to overcome the difficulties. These steps are titled as below and details of which are given in (Microsoft Face API documentation, 2017):

Step 1: Authorize the API call
Step 2: Create the person group
Step 2.1 Define people for the person group
Step 2.2 Detect faces and register them to correct person
Step 3: Train the person group
Step 4: Identify a face against a defined person group

After these step carried out some validation and evaluation metrics are calculated such as the Sensitivity, Accuracy, Miss Rate, Specificity, F1 Score, and Matthews Correlation Coefficient.

4.1. Testing of face recognition module with Yale Face Database

Yale face database contains 165 grayscale images in GIF format. These pictures belong to 15 people, 11 pictures per person. These images are categorized and tested one by one for different face expressions or configurations. Picture categories, center light, glasses, happy, left light, normal without glasses, right light, sad, sleepy, confused and blinking. The size of the dataset is 6.4 MB (Yale Face Database 2016). Only normal without glasses category pictures are used to register individuals rest of the 150 pictures are used for testing the performance.

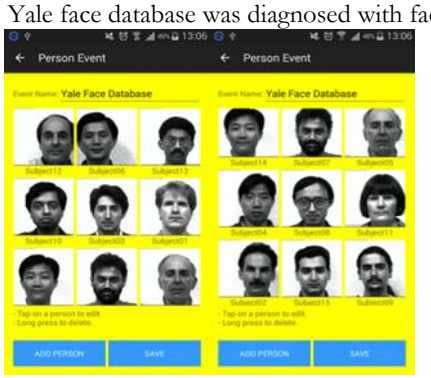
Microsoft face API was used to implement the face recognition module. The application was made in the android environment. The reference faces and information of the people in the Yale face database have been saved to the MySQL server using the php script language. The user interface of the face recognition module of the application developed in Figure 2 appears.

General steps to test the face recognition module:

- A normal image and name of 15 people in the Yale face database are saved to the system using the phone camera
- By selecting the face recognition module from the application, the person picture is taken from the person's phone camera and it is determined who the person is.
- During this test, 165 photographs are used in the face database.

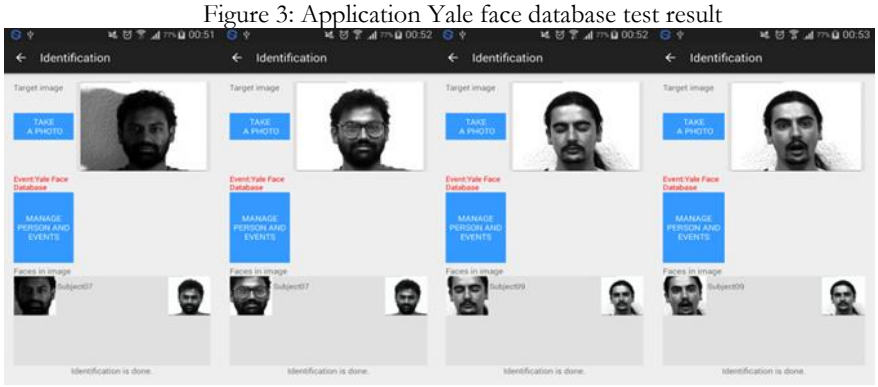
The following tests and results of Yale Face database are visible. 1-Normal, 2 Normal-Central Light, 3 Normal-Happy, 4 Normal-Left and Right-Light on the face of each person's face.

Figure 2: Yale face database was diagnosed with face module



As you can see in Figure 2, normal photographs of fifteen people in the Yale Face database have been introduced, and tested with related 10 pictures in various other positions.

Figure 3: Application Yale face database test result



As shown in Figure 3, the people in the Yale Face database began to be tested. Confusion matrices are obtained for every 15 people. One of the matrices of our cloud face recognition system for the normal view. Some metrics from the matrix are calculated to find and evaluate the success rates of the applied methods. These methods are based on the following equations

in the following equations: True Positive (TP), False Positive (FP), True Negative (TN), False Negative (FN), Sensitivity, Accuracy, Miss Rate, Specificity, F1 Score, and Matthews Correlation Coefficient and formulas appear. 1-6

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \quad (1)$$

$$Miss\ Rate = \frac{FN}{FN+TP} \quad (2)$$

$$Sensitivity = \frac{TP}{FN+TP} \quad (3)$$

$$Specificity = \frac{TN}{FP+TN} \quad (4)$$

$$F1-score = \frac{2TP}{2TP+FP+FN} \quad (5)$$

$$MCC = \frac{TP*TN-FP*FN}{\sqrt{(TP+FP)(TP+FN)(TN+FP)(TP+FN)}} \quad (6)$$

Table 1. The implementation of our face recognition module Yale Face database and confusion matrix.

Actual \ Predicted	01.	02.	03.	04.	05.	06.	07.	08.	09.	10.	11.	12.	13.	14.	15.	Null
01.	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02.	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03.	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0
04.	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
05.	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0
06.	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0
07.	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0
08.	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0
09.	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0
10.	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0
11.	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
12.	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0
13.	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
14.	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0
15.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0

4.2. Testing of other modules

Location, NFC and data time module is integrated part of the mobile device, therefore they are not tested as thorough as face recognition module. However different types of NFC cards are tested successfully.

5. Evaluation of Methodology

After we get the complexity matrix for our cloud face recognition module, evaluation metrics are calculated. Table 2 shows the average metric values of the tested methods. These method names are the same as we mentioned earlier. Accuracy, F1 Score, MCC, and Sensitivity.

Table 2. Cloud Face Recognition Module Average Metric Values

Picture Form	Average Accuracy	Average F1 score	Average MCC	Average Sensitivity
Normal	%100	%100	%100	%100
Normal – Central Light	%100	%100	%100	%100
Normal-Happy	%100	%100	%100	%100
Normal- Left and Right Light	%100	%100	%100	%100
Average	%100	%100	%100	%100

As shown in Table 2, our test results for the cloud face recognition module have reached 100% success. As shown in the chart above, the success rate of the methods we work on is 100%.

In other algorithms used in facial recognition studies, the maximum success rate ranges from 86.1% to 97.8%. The cloud-based face recognition module we use in our application is a near-perfect face recognition module. Successfully recognize all images among 165 images in a Yale Face database containing a wide variety of image exposures with a famous face recognition data set.

5.1. Comparative results with other studies

Table 3 shows the comparison of some facial recognition modules tested with the Yale Face in the literature. As shown in Table 3, the results of our cloud based face recognition module are compared with other studies and the recommended face recognition module is cloud based face recognition module (Tolba et al. 2016).

Table 3. Comparison with the previous studies

Refs.	Methods Employed	Accuracy %	Note
(Deniz et al. 2003)	SVM+PCA SVM+ICA	99.39% 99.39%	Only Accuracy is compared in
(Tang et al. 2003)	Face recognition committee machine (FRCM) includes Eigen face, Fisher face, Elastic Graph Matching (EGM), SVM, and Neural network	From 86.1% to 97.8%	Only Accuracy is compared in
(Huang 2004)	Markov random field (MRF)	96.11	Only Accuracy is compared in
Implemented study	Cloud, SaaS	100%	Accuracy and other metrics

6. Conclusions

As Logistic Information System is concerned, there are thousands of daily inbound, outbound or reverse logistic transactions and many of which include sensitive information that needs to be handled authenticated and secure way. In the system we have developed a tool for logistic information system which can be very easily controlled. Moreover, this system is very inexpensive; it can be easily used with an application developed with an android phone. It is a great advantage that this application's face recognition module is tested with Yale Face database and extracts the confusion matrices and achieves close to 100% of the results. The developed event not only for logistic information system but also it is enough to have only one smart android phone to use the guest control application, and it is easy to control events such as meetings, weddings, lessons, etc. with face recognition module only on a smartphone. Moreover, the improved mobile application manages to be server-based, preventing it from being dependent solely on a mobile phone, the user is smart and can control created events and invitations with a mobile phone username and password. In our application, NFC card information is used to identify people, but people forgetting the cards can sometimes cause problems, and face recognition is a biometric system and distinguishes it is a great advantage.

References

Adalan K., (2017), Yüz Tanıma, NFC ve Ses Kontrollü Kapı Kilidi Açma Sistemi, Yüksek Lisans Tezi, Yıldız Teknik Üniversitesi, Elektrik Elektronik Fakültesi

Antonia R., Andrea C., (2013), Identity verification through face recognition, Android smartphones and NFC, Joint Research Centre European Commission Ispra (VA), Italy, 162-163.

Assarasee P., W. Krathu, T. Triyason, V. Vanijja and C. Arpnikanondt, (2017), Meerkat: A framework for developing presence monitoring software based on face recognition, 10th International Conference on Ubi-media Computing and Workshops (Ubi-Media)

Bowersox, D.J., Closs, D.J., & Cooper, B.M. (2002), Supply Chain Logistics Management. McGraw Hill, Burr Ridge, Boston.

Christopher, M. (1998), Logistics and Supply Chain Management: Strategies for reducing cost and improving service, (2nd Ed.), Prentice Hall, New York.

de Brito M.P., Dekker R. (2004), A Framework for Reverse Logistics. In: Dekker R., Fleischmann M., Inderfurth K., Van Wassenhove L.N. (eds), Reverse Logistics. Springer, Berlin, Heidelberg, 3-27

Deniz O., Castrillon M., Hernandez M., (2003), Face recognition using independent component analysis and support vector machines, Pattern Recognition Letters, vol. 24, pp. 2153-2157

Microsoft Face API documentation (2017) https://docs.microsoft.com/en-us/azure/cognitive-services/face/face-api-how-to-topics/howtoidentifyfacesinimage (Accessed 15.12.2017)

Narol T. (2014), NFC teknolojisinin toplu ulaşımda uygulanması, Yüksek Lisans Tezi, Yıldız Teknik Üniversitesi Fen Bilimleri Enstitüsü.

Huang R., Pavlovic V., and Metaxas D. N., (2004), A hybrid face recognition method using Markov random fields, ICPR (3) , pp. 157-160.

Pei-Ju Wu, Mu-Chen Chen, Chih-Kai Tsau, (2017) "The data-driven analytics for investigating cargo loss in logistics systems", International Journal of Physical Distribution & Logistics Management, Vol. 47 Issue: 1, pp.68-83, https://doi.org/10.1108/IJPDLM-02-2016-0061

Ramnath K. Chellappa, Paul A. Pavlou, (2002) "Perceived information security, financial liability and consumer trust in electronic commerce transactions", Logistics Information Management, Vol. 15 Issue: 5/6, pp.358-368,

Tang H., Lyu M., and King I. (2003), Face recognition committee machine, In Proceedings of IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2003), pp. 837- 840, April 6-10

Tolba A. S., El-Baz A.H., El-Harby A.A., (2006), Face Recognition: A Literature Review, International Journal of Signal Processing 2;2

Yale Face Database, 2016. http://vismod.media.mit.edu/vismod/classes/mas622-00/datasets/ (Accessed 17.03.2017).