Customized NFC card for Attendance and Transaction using Face Recognition

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ABSTRACT

Attendance of every student is maintained by every school, college and university. The staff or respective teachers have to maintain proper record for the attendance. This system is used to keep a record of the attendance of any person and hence is implemented in the schools, universities, industries, working places and many other places. The manual attendance record system is less efficient and is time consuming. Also to keep a record and check the average attendance of each student is tedious task. The traditional way for taking attendance has too many drawbacks. Old conventional methods for student attendance are still in practice. This leads to students signing proxy of their friends who are not there or not present in the institute. Hence, we need transformation in a system which can solve the issues of a student record management and their average attendance calculation. Such a technology based attendance model including biometrics smart cards based attendance system have reduced the human involvement and errors .The proposed system should store the attendance of student's attendance details in digital format & hence its maintenance becomes easy. Also system provides access of NFC cards at the Canteen which can be used to buy any food items and at college stationary. Amount will be deducted from student account.

Keywords
UNO-Arduino, NFC, Face Detection Module, Attendance Module, Transaction Module, MS-SQL Database.

1. INTRODUCTION

Attendance of every student is maintained by every school, college and university. The staff or respective teacher has to maintain proper record for the attendance. Attendance system is used to track the attendance of any person and is implemented in the schools, universities, industries, working places and many other places. The manual attendance record system is less efficient and is time consuming. Also to calculate the average attendance of each student is tedious task. The traditional way for taking attendance has too many drawbacks. Old conventional methods for student attendance are still in practice. This leads to students signing proxy attendance for students who are absent for that particular session.

Hence we need transformation in a system that will solve the problem of student record management and their average attendance calculation. The technology-based attendance system such as smart cards and biometrics based attendance system reduced human involvement and errors .The proposed system should store the absent and present student's attendance details in digital format so that management of attendance becomes easy. Also system provides access of NFC cards at Canteen to purchase any food items and at college stationary. Amount will be deducted from student account. This reduces the need to carry hard cash as well as the problem of change for the denomination is extinct.

To overcome this problem an integrated system is required within the scope where the students can mark there attendance in an efficient way along with the possibility of transactions made during the curriculum.

The technique of face recognition system is segregated into basically two steps: detection of the face and its recognition. Firstly, to mark the attendance of students, the image of students' faces will be required. This image is captured from the webcam device located on the college gate or classroom or at a suitable location from where the students entry can be easily located. This image will be given as input to the system. For the detection of face, we use procedures like grayscale and histogram equalization& conversion of image [8].

This input image will be passed to perform face detection. In the face detection step, we are using Ada-Boost procedure for effective results by using the [9] [10] haar feature classifiers and cascade concepts of Ada-Boost algorithm.

NFC stands for Near field Communication. These are short range wireless communication technology used for contactless

communication between two NFC enabled devices. These devices support contactless communication protocols such as ISO 14443[4], FeliCa[5] and Mifare Standard [6]. Further information on the potential of NFC technology is in[7].

NFC is a relatively new technology that allows the handset to emulate both a contactless card and a contactless reader. Its ease of use when conducting short range communication and compatibility with existing contactless payment systems are some reasons why it is seen as a key enabling technology for mobile payment services.

2. RELATED WORK

Various research projects were implemented in order to improvise the existing attendance system. Some systems were online and some were offline. The implemented online systems were highly unreliable and caused several problems to load. For example, a desktop application was developed by Jain *et al*. [11] in which all the list of registered students for a particular course will be displayed when the lecturer start the application. The attendance registration is done by clicking a check box next to the name of students that are present, and then a register button is clicked to mark their presence. This creates time wastage, but still it is an improvement on the manual process since attendance data can be stored safely and reports can be easily generated.

However, Zhang *et al*. [12] are with the opinion that attendance management is ignored by current educational administration management system, focusing only on register management, education plan, course management, etc. as a result they developed attendance management system using VisualStudio.NET and Oracle. Their system is a web based that used card technology for student's identification, and registering attendance into the database.

NFC (near-field communication) allows two devices placed within a few centimeters of each other to exchange data. In order for this to work, both devices must be equipped with an NFC chip. In the real world, there are essentially two ways this works.

Two-way communication: This involves two devices that can both read and write to each other. Commonly also known as Active NFC. The working for the same is as follows, you can touch two Android devices together to transfer data like contacts, links, or photos.

One-way communication: Here, a powered device (like a phone, credit card reader, or commuter card terminal) reads and writes to an NFC chip. Commonly also known as Passive NFC. So, when you tap your commuter card on the terminal, the NFC-powered terminal displays the content regarding the same. Mostly used for advertisements purpose. Contactless technology especially NFC can be utilized to make university life easier. Biometric identification is added to NFC to avoid impersonation. The students register their attendance from a terminal that has NFC and face recognition using only card that stores student ID and face samples. The terminals store the attendance data. The database generates the report from the data received from the terminals on a monthly basis and the teachers/administrators can then send the data to the respective parents of the students through an android application.

3. ARCHITECTURE AND IMPLEMENTATION

The system has two main modules as shown in Fig. 1. The modules are attendance module and transaction module. Each of these module has hardware and software components. Essentially, the hardware components for the reader units are NFC-enabled tags and reader, **UNO-Arduino,** Webcam for Face Recognition, while for the web server unit is a computer that can host web services. Whereas, the software required in the reader unit is the client application that will be installed on NFC-enabled devices. The software requirement for the web server unit is the IDE required; Microsoft Visual Studio 2012, Microsoft SQL Server 2008. Whereas the language used is asp.net.

a. System Architecture

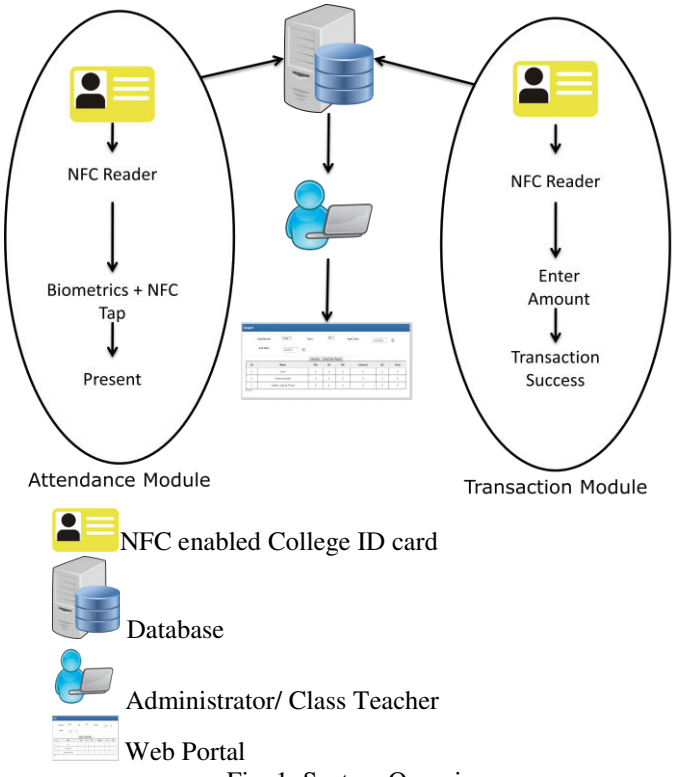


Fig. 1: System Overview

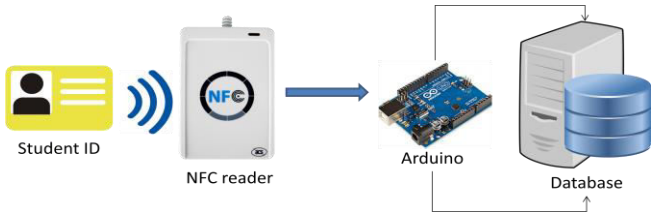


Fig. 2: NFC Scanning and detection for Attendance

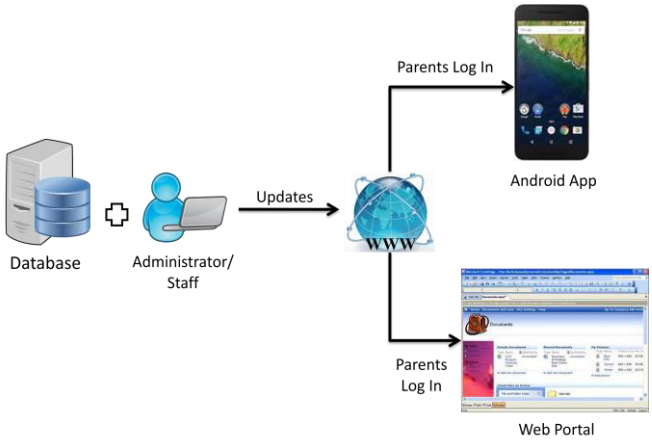


Fig. 3: Information Sharing

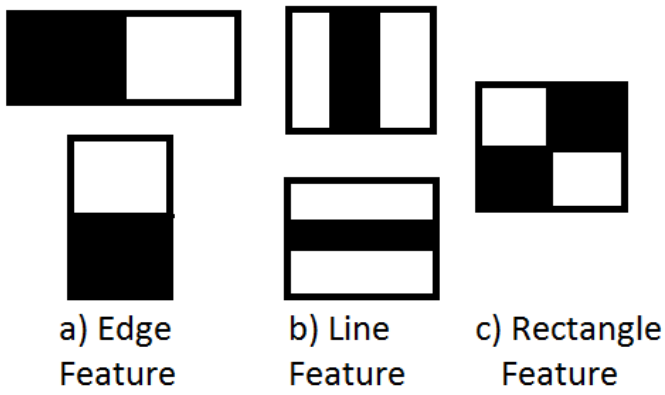


Fig. 4: Types of feature

3. ALGORITHMS

3.1 Haar-Cascade Algorithm

Haar-Cascade is very efficient algorithm for Face detection. It is machine learning approach where cascade function is trained from number of positive and negative cascade. Then further it is used for detection of image. Initially to make a proper cascade we need lot of positive and negative image. Once the cascade is prepared then we have to extract the feature from it. These are haar Features.

3.1.1 Related Terms

Positive Image: Positive Image is nothing but the image where any face is present.
Negative Image: Negative Image is nothing but the image where there is no any face present.
Feature: It is a single value entity. According to pattern and types there are multiple Features. .It is nothing but subtraction of number of white pixels and Black pixels present in that particular Feature.

Feature = (∑ White Pixels) – (∑ Black Pixels)
Refer Fig. 4

3.1.2 Types of Features

As the number of pattern is faces varies in the same way types of Features varies. There are millions of features found. Some of basic features are edge, line and rectangle features.
Line Feature: Line feature is nothing but the pattern which distinguishes line in between. Like in our example Line feature will be the one which describe the line in between two eyes. In computer Vision region of eyes are comparatively darker than the region of Nose Bridge.
Edge Feature: It distinguishes edge. For example region of eye is comparatively darker than the region of chicks. This gives us Edge feature.

3.1.3 Cascade Implementation

First we need to load the required XML classifiers. Then load our input image (or video) in grayscale mode.

```
import numpy as np
import cv2

face_cascade =
 cv2.CascadeClassifier('haarcascade_frontalfa
 ce_default.xml')
eye_cascade =
 cv2.CascadeClassifier('haarcascade_eye.xml')

img = cv2.imread('pratik.jpg')
gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
```

Now we find the faces in the image. If faces are found, it returns the positions of detected faces as Rect (x,y,w,h). Once we get these locations, we can create a ROI for the face and apply eye detection on this ROI (since eyes are always on the face!!!).

```
 Faces=face_cascade.detectMultiScale(gray,1.3,
 5)
for (x,y,w,h) in faces:

 cv2.rectangle(img,(x,y),(x+w,y+h),(255,0,0),2
 )
  roi_gray = gray[y:y+h, x:x+w]
  roi_color = img[y:y+h, x:x+w]
  eyes = eye_cascade.detectMultiScale(roi_gray)
  for (ex,ey,ew,eh) in eyes:

 cv2.rectangle(roi_color,(ex,ey),(ex+ew,ey+eh)
 ,(0,255,0),2)

cv2.imshow('img',img)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

3.2 Template Matching Algorithm

One way to handle translation problems on images, using template matching is to compare the intensities of the pixels, using the SAD (Sum of absolute differences) measure.

A pixel in the search image with coordinates (x_s, y_s) has intensity $I_s(x_s, y_s)$ and a pixel in the template with coordinates (x_t, y_t) has intensity $I_t(x_t, y_t)$. Thus the absolute difference in the pixel intensities is defined as $\text{Diff}(x_s, y_s, x_t, y_t) = | I_s(x_s, y_s) - I_t(x_t, y_t) |$.

$$SAD(x,y) = \sum_{i=0}^{T_{rows}} \sum_{j=0}^{T_{cols}} \text{Diff}(x+i, y+j, i, j)$$

The mathematical representation of the idea about looping through the pixels in the search image as we translate the origin of the template at every pixel and take the SAD measure is the following:

$$\sum_{x=0}^{S_{rows}} \sum_{y=0}^{S_{cols}} SAD(x,y)$$

$\mathbf{S_{rows}}$ and $\mathbf{S_{cols}}$ denote the rows and the columns of the search image and $\mathbf{T_{rows}}$ and $\mathbf{T_{cols}}$ denote the rows and the columns of the template image, respectively. In this method the lowest SAD score gives the estimate for the best position of template within the search image. The method is simple to implement and understand, but it is one of the slowest methods.

3.3 NFC registration and detection

3.3.1 UNO-Arduino Implementation

```
uint8_t dataRX[35];//Receive buffer.
uint8_t dataTX[35];//Transmit buffer.
uint8_t _UID[4];// stores the UID
(unique identifier) of a card.
uint8_t keyAccess[] = {0xFF, 0xFF,
0xFF, 0xFF, 0xFF, 0xFF } ;// stores
the key or password.
uint8_t address = 0x04;//Address to
read.
uint8_t ATQ[2];//Answer to request
uint8_t state;//state of the process
uint8_t aux[16];//Auxiliar buffer.

void setup(){...}
void loop(){...}
```

3.3.2 Reading / Writing Tags

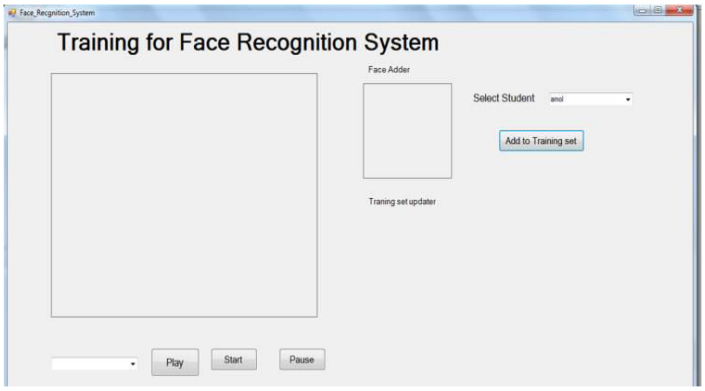
```
//!The goal of this command is to detect
as many targets (maximum MaxTg)
// as possible in passive mode.
uint8_t init(uint8_t *UID , uint8_t *ATQ)
//! Request InListPassive
{...}

//!A block must be authenticated before
read and write operations
uint8_t authenticate(uint8_t *UID,
uint8_t blockAddress, uint8_t *keyAccess)
{...}

uint8_t writeData(uint8_t address,
uint8_t *blockData)  //!Writing
{...}

uint8_t readData(uint8_t address, uint8_t
*readData) //!Reading
{...}
```

4. Implementation

Implementation of this system includes face detection, face recognition, NFC registration, NFC detection, transaction using NFC.

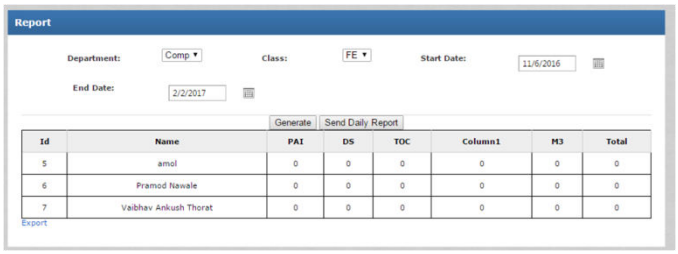
3.2.1 Face recognition and detection

As shown in the above figure we can see how the image gets added to the database along with its various features. When a new student is admitted we need to add his information using this training set. The database will then identify the face of the student entering through the main gate as well as recognize the NFC card of the same and register his attendance.



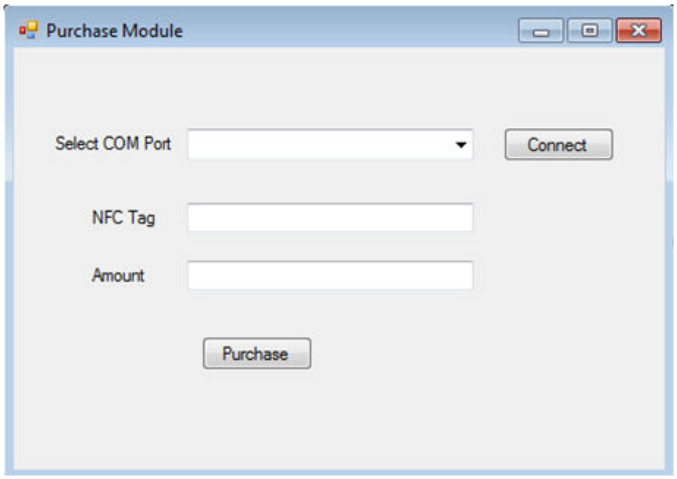
3.2.2 Report generation

Based on the validation of the attendance of the particular student a department wise report is then generated. This generated report can be sent to the respective parent/guardian of the student so as to track their academic record as well as their attendance.

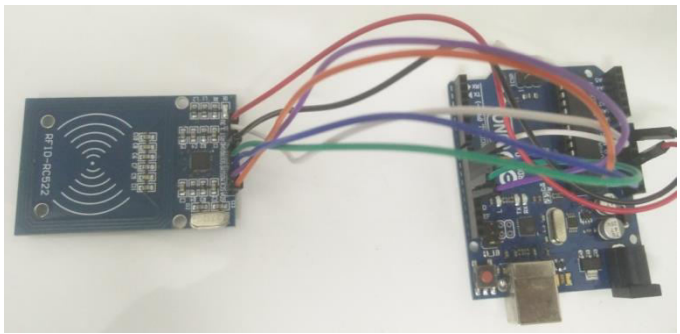


3.2.3 Canteen Purchase Module

The below figure represents the purchase module and all the attributes that are needed to connect to the database. The user is supposed to enter the transaction details. The specified amount will be deducted from the user's virtual wallet.



3.2.4 Hardware Arrangement



This shows the arrangement of the hardware that is the UNO-UNO-Arduino and the NFC reader. The interfacing is done with the help of wires soldered into the UNO-Arduino along with the reader. The NFC tag is scanned through the NFC reader. The NFC reader is interface with the UNO-Arduino which in return stores the attendance of the student into the database server.

5. FUTURE SCOPE

a. **Cloud services:** In the future, the system can also be accessible through Cloud services for better reliability and ease of access.

b. **Secure Access:** Now a day NFC cards are inbuilt inside the smart phones along with finger print scanner. Hence with the advancement of technology we can have secure access only through fingerprint sensors.

c. **GPS:** Location tracking of the student is also possible in future.

6. CONCLUSION

Typically student's attendance is marked manually which spends a lot of time. Proposed system gives automated attendance of student's via NFC and Face Recognition.In the proposed project we will be able to make transactions virtually instead of carrying hard cash.

7. ACKNOWLEDGMENT

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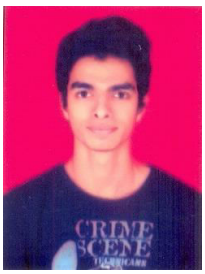

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