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Face Detection Attendance System Using RFID with Improved Facial Image Comparison

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Abstract— The method usually followed to take attendance, records on paper particularly in an organization with more number of people's ratio is not only adifficult process but also costs our precious time.In order to eliminate the above defined problem we come with a solution using two techniques Face Detection and RFID technology.Face Detection system is a field of identifying a person from a facial database or from a live web camera source specially used in security systems and RFID technology revolves around the concept of reading hidden information in a RFID tag either passive or active. The main aim of this system is to reduce the time it actually takes to maintain the attendance in any organisation without erring due to impersonation.

Keywords—RFID, Facial Recognition, Attendance, Tags, Short range reader. EMGU CV, EigenFace.

I. INTRODUCTION

Face recognition is one of the emerging technologies which plays a very important role in various application. It has captured the attention of various research scholars since its inception. This technology has found many application areas such as human-computer interaction, representationbased video coding, security control systems and so on. Eventually there have been rise in the number of applications based on Radio Frequency Identification (RFID) systems and is successfully applied to different areas like transportation, agriculture, health-care and hospitality industry to name a few. In the proposed system, an attempt is made to solve employee attendance monitoring problem using RFID technology. The application of combined use of RFID System and facial recognition technology to attendance monitoring system as proposed and in development phase is capable of eliminating the time wasted during manual collection of attendance. "Time is precious" as the saying describes, this proposed system focuses on reducing the time it generally takes to mark attendance for the employees which indeed was one of the major factor of time consumption in most of the organisations and companies. On combining the concept of Face detection and RFID Based attendance system, we can reduce the effort and time it takes than any normal Attendance system. Also this system focuses on the facial changes of the human (employee) over a certain time period which is achieved through an automated script.

II. RELATED WORKS

A number of related works exists in literature in the application of RFID and Facial Recognition to different areas of attendance monitoring problem.

[1] The authors have proposed a solution for attendance monitoring problem which involves the concept of RFID based attendance system. As the proposed system involves only the usage of RFID,impersonation by erring candidates is possible.

[2]This system uses face recognition technique to overcome the problem of impersonation but is prone to few drawbacks during low light scenario.

[3]Here, by using the concepts of both Artificial Neural Networks and Facial Recognition, security door system was developed where authorization of users is possible only with thefacial appearance of privilege users available in the database and is the only guarantee for entrance. In the system, the personal computer processes the face recognized by the system digital camera and compares data with privileged users found in the database. The system either sends a signal to open the electromechanical door upon facial existence of privileged user or deny the entry of other users.

[4]In this system, authors proposed a simplified and cost effective model of embedded computer based solution to the manual method of managing student lecture attendance problem in higher institutions in developing countries. The developed system is capable of speeding up the process of taking students lecture attendance and allows for error free and faster verification process of authenticating student lecture attendance policy required for writing examination in a campus environment but could not provide absolute solution to the problem of impersonation by erring students.

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[5] The author proposed the use of finger print to solve attendance monitoring problem. The fingerprint technique verification was achieved using extraction of the fingerprint of candidates. The proposed system was successful in monitoring attendance but this proposal lacks the inclusion of a report generation and also is time consuming.

[6] As per the authors' proposal this system was implemented for the effective attendance system during lectures. It involves reduced level of impersonation comparatively. This system could only be deployed in the lecture halls.

In this paper the authors have proposed a similar attendance maintenance system which is capable of eliminating the impersonation erring by the candidates and also the reporting feature for the administrator but when the application is considered for a long run period, there comes the drawback of facial appearance changes due to age factoring. It fails to maintain the facial data for a long term period as the image captured by this system is only once and the same images are been used for facial comparison process over a long period of time. This system fails to meet the challenges of facial appearance changes, as the human face tends to change over the certain period of time called as aging factors. [7] proposed a system which uses intermediate features of maximum overlap wavelet transform (IMOWT) as a pre-processing step. The coefficients derived from IMOWT are subjected to 2D histogram Grouping. This method is simple, fast and unsupervised. 2D histograms are used to obtain Grouping of color image. This Grouping output gives three segmentation maps which are fused together to get the final segmented output. This method produces good segmentation results when compared to the direct application of 2D Histogram Grouping. IMOWT is the efficient transform in which a set of wavelet features of the same size of various levels of resolutions and different local window sizes for different levels are used. IMOWT is efficient because of its time effectiveness, flexibility and translation invariance which are useful for good segmentation results.

Considering the above problems, we have proposed a biometric solution to the problem of attendance monitoring system. The current process of taking attendance particularly in an environment or organisation or company with higher employee ratio is not only a difficult process but also robs of the precious time that could be used for an effective working. The incorporation of these technologies (Facial Recognition and RFID Techniques) to attendance maintenance system problem as demonstrated in this paper is capable of eliminating time wasted during classical/manual collection of attendance, provide solution to the problem of impersonation liable to similar solution as proposed and also the effect of facial changes over the years.

III. TECHNOLOGY OUTLINE

1. Facial Recognition:

A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. It is typically used in security systems and can be compared to other biometrics such as fingerprint or eye irirs recognition system.

2. RFID Technology:

Radio-frequency identification (RFID) is the wireless non-contact use of radio-frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by and read at short ranges (a few meters) via magnetic fields (electromagnetic induction). Others use a local power source such as a battery, or else have no battery but collect energy from the interrogating EM field, and then act as a passive transponder to emit microwaves or UHF radio waves (i.e., electromagnetic radiation at high frequencies). Battery powered tags may operate at hundreds of meters. Unlike a bar code, the tag does not necessarily need to be within line of sight of the reader, and may be embedded in the tracked object.

IV. MATERIALS AND METHODS

A. SYSTEM OVERVIEW:

This system is being developed for attendance management scenario for an organisation. The system manages the employee attendance using a Windows Application system and the developing RFID and Face Recognition based attendance model. The application system contains anadmin

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module. The function of this module is to handle the entire administrator task: Adding, editing and deleting employee details. Only the administrator can view, add and delete data in the attendance system. Figure 1.0 shows the general block diagram of the system.

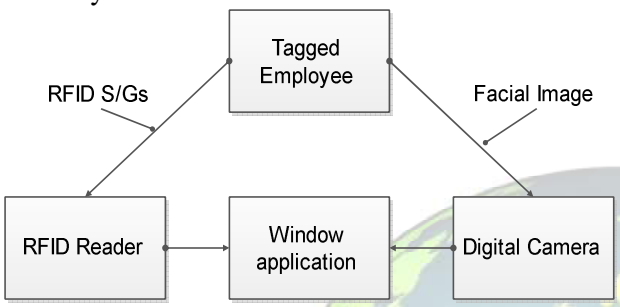

Figure 1.0

A. ***Design Considerations:***

The proposed attendance management system in this work consists of the following considerations:

a. Hardware Design Considerations:

The RFID reader and tags goes in hand with each other, these electronic tags communicate with the reader through radio waves. There are three types of RFID tags: active, semi active or passive. These electronic tags need not require effort to communicate with the reader, as they use the power source which is emitted from the reader. Tags absorbs the power and transmits the data it contains. In our system generally it is the employee id that is going to be transmitted by the tags. The range for transmission is from 10mm to 5 meters. There are four different kinds of tags in use, categorized by their radio frequency: low frequency (between 125 to 134 KHz), high frequency (13.56MHz), UHF (868 to 956 MHz), and microwave (2.45 GHz).The tag has a unique set of numbers which makes every card unique, in each case a reader must scan the tag for the data it contains.

RFID Requirements:

- TR-R01-OEM reader board and antenna
- RFID Tags/Transponders
- 9V DC Battery
- Battery Adapter – plugs the 9V DC battery to the reader
- RS232 (Male DB9) to USB connector cable

Facial Recognition/Comparison

A simple web camera is used here due to costing factor and this camera is used to capture the image that appears in the frame. This frame is given as input to the windows application to process the image. The image is captured when the facial representation appears in the frame.

b. Software Design Consideration:

For creating the window application Microsoft C# language is used and is being built using the Microsoft Visual Studio 2010 IDE. In the development phase of this system, developing decisions are taken considering the hardware componentsused and also the managerial convenience are taken into consideration for developing the system. A proper UID design is required so that it doesn't create complexity in using the system. The modules are also being developed considering the fact of coupling. Care is taken to reduce the coupling so that each module developed remains independent.

Software Requirements:

- FRONT END - Microsoft C# .NET Framework 4.0
- IDE - Microsoft Visual Studio 2010
- BACK END - Microsoft SQL Server 5.0.6
- OS - Windows 95/98/2000/XP/7/8

B. **Implementation:**

C# (C Sharp)is a multi-paradigm-programming-language encompassing strong typing, imperative, declarative functional, procedural, generic, object-oriented and component oriented programming disciplines. It was developed by Microsoft within its .NET initiative and later approved as a standard by ECMA (ECMA-334) and ISO (ISO/IEC 23270:2006). C♯ is one of the programming languages designed for the Common Language Infrastructure. C# is built on the syntax and semantics of C++, allowing C programmers to take advantage of .NET and the common language runtime.C♯ is intended to be a simple, modern, general-purpose, object-oriented programming language. The language, and implementations thereof, will provide support for software engineering principles such as strong type checking, array bounds checking, detection of attempts to use uninitialized variables, and automatic garbage collection. Software robustness, durability, and programmer productivity are important.The language is intended for use in developing software components suitable for deployment in distributed environments.Source code portability is very important, as is programmer portability, especially for those programmers already familiar with C and C++.

Microsoft Visual Studio (2008) is an integrated development environment (IDE) from Microsoft. It is used to develop console and graphical user interface applications along with Windows forms or WPF applications, Windows Store apps in both native code together with managed code for all platforms supported by Microsoft Windows, Windows

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mobile, Windows CE, .NET Framework, .NET Compact Framework and Microsoft Silverlight. It also includes a code editor supporting Intellisense as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger. Other built-in tools include forms designer for building GUI applications web designer,class designer, and database schema designer. It accepts plug-ins that enhance the functionality at almost every level—including adding support for source-control systems (like Subversion and Visual SourceSafe) and adding new toolsets like editors and visual designers fordomain-specific languages or toolsets for other aspects of the software development lifecycle (like the Team Foundation Server client: Team Explorer).Visual Studio supports different programming languages by means of language services, which allow the code editor and debugger to support (to varying degrees) nearly any programming language, provided a language-specific service exists. Built-in languages include C/C++[5] (via Visual C++), VB.NET (via Visual Basic .NET), C# (via Visual C#), and F# (as of Visual Studio 2010[6]). Support for other languages such as M, Python, and Ruby among others is available via language services installed separately. It also supports XML/XSLT, HTML/XHTML, JavaScript and CSS. Individual language-specific versions of Visual Studio also exist which provide more limited language services to the user: Microsoft Visual Basic, Visual J#, Visual C#, and Visual C++.

Microsoft SQL Server is a relational database management system developed by Microsoft. As a database, it is a software product whose primary function is to store and retrieve data as requested by other software applications, be it those on the same computer or those running on another computer across a network (including the Internet). There are at least a dozen different editions of Microsoft SQL Server aimed at different audiences and for workloads ranging from small single-machine applications to large Internet-facing applications with many concurrent users. Its primary query languages are T-SQL and ANSI SQL.

Emgu CV is a cross platform .NET wrapper to the OpenCV image processing library. Allowing OpenCVfunctions to be called from .NET compatible languages such as C#, VB, VC++, Iron Python etc.We are using in our application these third party libraries to run C# program into .NET. Essential library of EMGU:

using Emgu.CV;

using Emgu.Util;

using Emgu.CV.Structure;

using System.Drawing;

It is necessary to include all the above packages into the application to execute successfully. By installing the EMGU CV packages all the dll files are available to the application and calls the required dll files as needed.

RFID Step Up Process:

The system is set up with the following steps:

- Connecting the Male head of the RS232 serial cable to the Female DB9 port of the RFID reader.
- Connecting the USB end of the serial cable to one of the USB ports of the computer system being used.
- Connecting the 9V dc battery to the Adapter and then the adapter to the RFID reader's power jack.
- Determination of the appropriate COM port of the computer used, and ensure that it corresponds to the one used within the programming code written to control the system.

Eigen faces Algorithm:[2]

Stage 1: Subtract the Mean of the data from each variable.

Stage 2: Calculate and form a covariance Matrix.

Stage 3: Calculate Eigenvectors and Eigen values from the covariance Matrix.

Stage 4: Choose a Feature Vector (a fancy name for a matrix of vectors).

Stage 5: Multiply the transposed Feature Vectors by the transposed adjusted data.

The web camera is connected through the USB port of the working machine. The application is executed and is kept running.

Initially, the employee as to be registered with the attendance system. The administrator takes 10 images of the employee using the application and enters all the necessary details of the employee. The RFID Reader is used to read the RFID Tag value of the employee and all these details are inserted into the database.

The architecture diagram of the proposed system is as follows:

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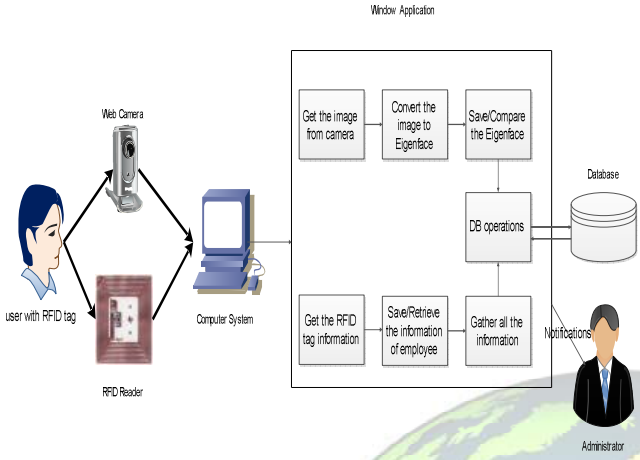

Figure 2 (Architecture Diagram)

The images are captured by the web camera and is sent to the application. The application uses the EMGU CV package to convert the images to Eigenfaces and stores those images in a working directory. Only the file names of the image is inserted into the database whereas the images are saved in an external path. The openCV package is used to process the images captured by the web camera.

When an employee appears in the photo frame, the application captures the frame in which the human face is detected. The RFID reader tracks the RFID Tag value by using the passive mode in which the RFID Tag absorbs the electricity from the reader and transmits the RFID Tag value to the reader. The RFID Reader is connected with the computer system and this RFID Reader transmits the data read from the RFID Tag to the application. The application retrieves the employee details from the database using the RFID Tag information as the search key.

The image file names are fetched from the database, the application compares the captured frame with that of the images stored in the application working path. When the system detects the image and finds it to be matched with the registered candidate, then the attendance is marked for that employee and a notification message is send to the administrator containing the details of the employee like employee ID, image and arrival time of the employee.

The administrator is provided with the privilege to add, update, delete the employee details and also a report is generated daily containing the daily attendance details of the organisation. He is provided the facilities to create a backup of the database and also to restore the database.

In this proposed system, in order to overcome the effect of facial changes over the certain period of time, the application is to be developed with an automated script which is executed once in a certain period of time say in fifteen days. This script replaces the old image of the employee with the newly captured image by the camera at the time of facial comparison once after the attendance is marked after the successful verification process. This overcomes the drawback of facial changes over the time period. This script checks the last modified date of the image stored by the application during the training process and compares it with the present date, if the result is found to be equal to or greater than fifteen days then this script is executed else the same image is used until it becomes fifteen days old.

The training form of the application is as shown below and this form is just a sample for detecting and saving the image of the employee.

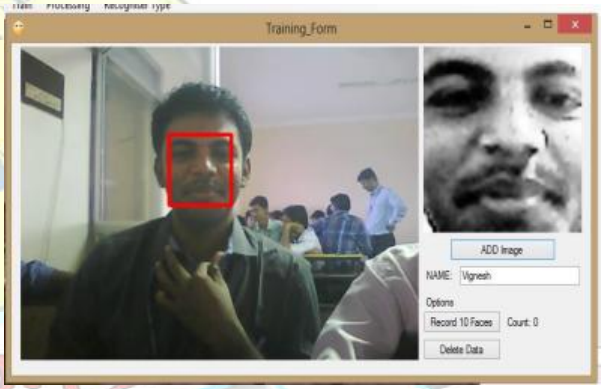

Figure 3 (Training Form)

The face detection form is as shown below:

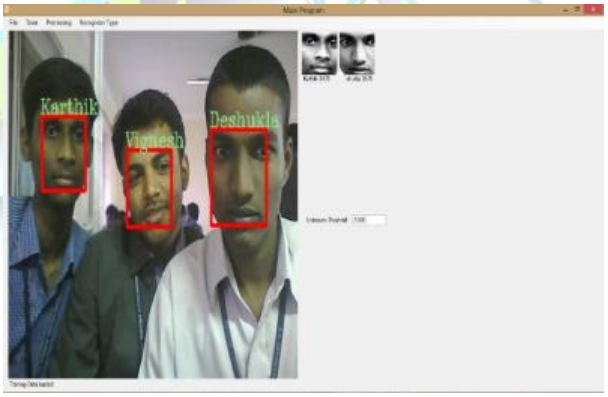

Figure 4 (Detection Form)

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V. CONCLUSION:

The proposed system is capable of successfully presenting the simplified, low cost solution to the listed problem of attendance maintaining system in an organization. The proposed system is capable of eliminating impersonation erring by the candidate. It is also capable of reducing the complexity involved in the attendance maintaining process. The strength of this system lies in its portability and high scalability. This system is capable of reducing the time it actually needs to maintain attendance in any other system.

VI. FUTURE ENHANCEMENT

The developed system have its own limitations. In order to overcome this limitations it is necessary to implement the following suggestion has to be employed as soon as possible.

1. In a distributed environment, the web cameras used should be replaced with IP camera to increase the efficiency and security of the system against impersonation in such an environment.
2. Employing active RFID reader for effective performance.
3. Introducing an alarm system to notify theuser about the presence of his identity.

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