IAS- Intelligent Attendance System based on Windows Image Acquisition(WIA) ,Optical Character Recognition(OCR) and Windows Communication Foundation(WCF) Service

3 authors, including:

Chirag Indravadanbhai Patel
Charotar University of Science and Technology
13 PUBLICATIONS   577 CITATIONS

SEE PROFILE

IAS- Intelligent Attendance System based on Windows Image Acquisition(WIA) ,Optical Character Recognition(OCR) and Windows Communication Foundation(WCF) Service

Chirag Patel, Maitri Chokshi, Dr. Atul Patel

Abstract— Taking student attendance in the class and then posting it in online attendance system is a quite time consuming process for the teachers. In this paper, we have presented a novel approach for posting the attendance in the online attendance system without user intervention. In the proposed work after taking the attendance manually in the attendance sheet, a teacher needs to put attendance sheet in front of camera. Then the camera can capture the image of attendance sheet. After capturing the image of attendance sheet by the Windows Image Acquisition (WIA) technique, the proposed work does the optical character recognition (OCR) of it to find out the lecture/ laboratory details and absent numbers. These details are sent to WCF service to store it in the online attendance system database. We used Tesseract OCR engine which is provided by Google to do OCR. The accuracy of OCR is not 100% so we have applied algorithm to auto correct the data after OCR.

Index Terms—   DLL, Online Attendance System, Open Source, Optical Character Recognition (OCR), Tesseract, WIA, WCF

———————————— ◆ ————————————

1   INTRODUCTION

In Indian education system, student attendance system plays major role in teaching and learning process. In most of the Universities student attendance is taken manually in attendance sheet and then after it is being processed by data entry operator or online attendance system. Both of these methods are time consuming and error prone as the attendance details are entered by human being. The model diagram of existing attendance system is shown in Fig. 1. The attendance of student is taken by the teacher at the end of lecture or laboratory session and then it is posted by the teacher through online system, if the university has its own online attendance system. If the university does not have online attendance sys-
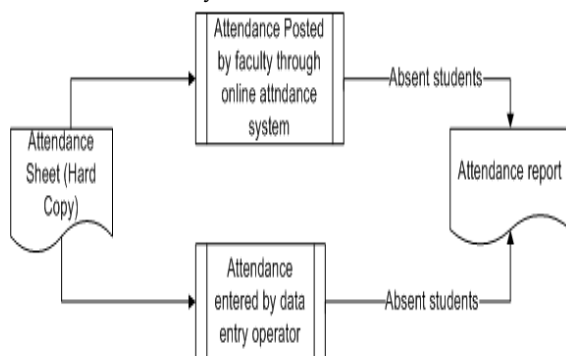

Fig. 1. Conventional attendance system

tem then generally attendance sheet is given to the data entry operator who enters details of attendance in the spreadsheet application. Then after the attendance report is generated by spreadsheet or by the online attendance system. In both methods, it requires user intervention to do the entry of absent number in particular session whether it is lecture or laborato-

ry. There are few problems in these approaches: First: As human does the entry of absent numbers so there can be typing mistake and there are the chances of making present student absent and absent student present. Second: A teacher or data entry operator needs to spend some time for doing entry of absent number so it is a time consuming process.

The remainder of this paper is structured as follows. Section 2 presents related work in existing student attendance systems. After learning precedent systems' pros and cons, Section 3 introduces the proposed system details with the architecture. The working model is system is described in section 4. Then, the results obtained by this proposed system are presented in Section 5, which is followed by conclusion presented in section 6.

2 RELATED WORK

There are many methods available for the student attendance management. Each of these methods is having different technologies and different type of algorithm. Some of the student attendance systems are based on Radio Frequency Identification (RFID) [1], [2], [3]. These systems require RFID devices/tag to be given to the students and faculties. Student details are extracted from the RFID tag and stored in the attendance system. In these systems, no human intervention or minimum human interaction is required. Another attendance system is based on mobile phone [7]. This system uses bluetooth connection in between student's mobile and teacher's mobile. The software installed in the teacher's mobile queries to student's mobile via Bluetooth connection and student attendance is confirmed. This system also does not require human intervention. A biometric attendance system [5] is used for recording employee and student attendance. This system takes

person's thumb impression as confirmation for attendance. The thumb impression must be registered against the person

tendance systems provide good accuracy and less human interaction but in all the systems from [1] to [9] either installa-

TABLE 1. PROS AND CONS OF DIFFERENT TYPES OF EXISTING ATTENDANCE SYSTEM AND PROPOSED SYSTEM

Ref	Technology	Pros	Cons
[1],[2],[3]	RFID	Human intervention is not required, Saves time	Costly, Chances of misuse of absent student RFID tag
[4]	Wireless sensor network	Human intervention is not required, Saves time	Complex to design, Costly
[5]	Biometric using thumb	Accurate, No chance of misuse	Human Intervention is required, Less accuracy in the case of cut in thumb
[6]	Biometric using ear	No chance of misuse	Less accurate as it is difficult to detect ear
[7]	Mobile and Bluetooth	Human intervention is not required	Mobile with Bluetooth is required for students and faculties
[8]	RFID and GSM network	Prompt availability	Difficult to deploy, costly
[9]	Face recognition with Fuzzy logic and content based image retrieval	Accurate, Human intervention is not required	Slow, Face recognition can fail in the case of injured face, Need for high resolution camera, Need for High speed computer, Need for good amount of memory
Proposed System	Optical Character Recognition(OCR)	Human intervention is not required, Accurate	Need for High resolution camera

detail in the database. Human intervention is required in this system. A system that uses wireless sensor network for monitoring attendance is presented in [4]. It uses ZigBee Sensor Network, Mobile Transfer, Middleware Web Server and Mobile Client. A different type of attendance system is based on ear [6]. This system uses ear as input for the attendance confirmation. It uses ear because no two person can have same kind of ears. In this system, human interaction is not required but human is needed for scanning the ears for the attendance. Another attendance system uses RFID and GSM network [8] to remotely monitor the attendance of students. In this system, attendance can be taken by RFID and sent over the GSM network. Therefore, attendance can be taken anywhere and anytime. An automated fuzzy logic based attendance system is presented in [9]. This system uses face recognition system along with content-based image retrieval and fuzzy logic. Human intervention is not required in this system. In Table 1, these methods are compared with pros and cons. Many at-

tion cost in higher or there can be chances of misuse. After doing this comparison, it is evident that none of the attendance system based on OCR exists today. In proposed system, human intervention is not required as attendance is captured by camera and then it is processed by the OCR engine. After taking attendance a teacher needs to put attendance sheet in front of camera and rest of the task is done by our proposed system. This system has one small problem: It requires high-resolution camera to capture the image of attendance sheet otherwise the image cannot be captured properly and OCR will not provide accuracy. The architecture of the proposed system is described in the following section.

3 ARCHITECTURE OF PROPOSED SYSTEM

This section describes the model for developing an intelligent attendance monitoring system using WIA, OCR and WCF services. The following sub-sections describe the different tech-

niques used in the system development.

3.1 WIA

The WIA is the platform for still image acquisition in the Windows operating systems family. This platform facilitates the im-

3.2 OCR

OCR is widely popular method used in conversion of printed, handwritten or typewritten text into editable alphanumeric text [11]. The character images may be scanned through scanner or digital images may be taken using web-cam or other hardware devices and these images are recognized by the OCR and trans-
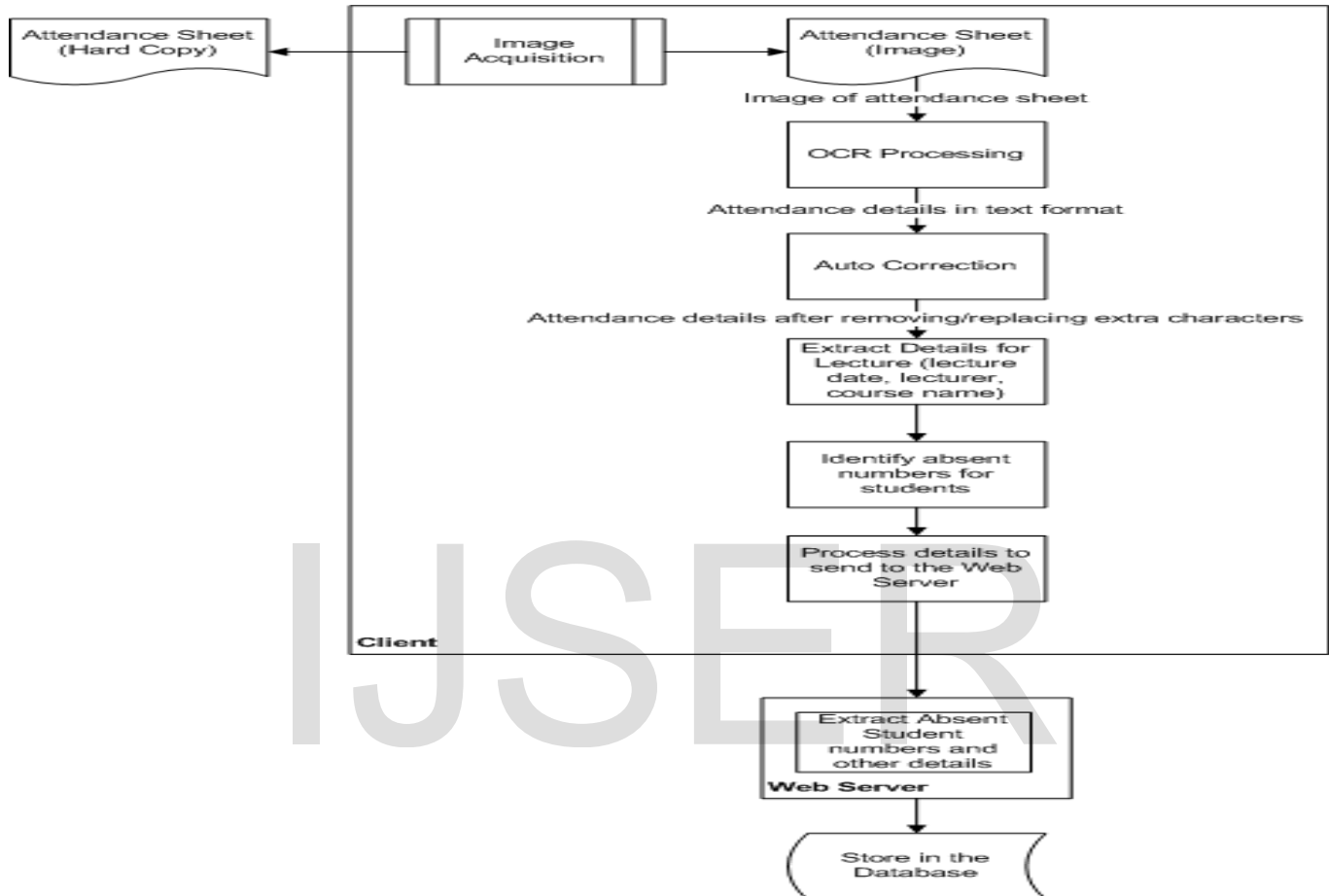
Fig. 2. Intelligent Attendance System using OCR and WCF services

age processing applications to interact with the hardware like scanners and cameras in a standardized approach. The platform comprises of data acquisition protocol, a Device Driver Model and Interface (DDI), API and a dedicated WIA service. The WIA API can be used in the imaging applications to support the simultaneous multiple device connections, to querying properties of devices, to acquire device data and maintain image properties. The WIA Automation Library was released in 2002 with the main functionality of providing end-to-end image acquisition capabilities to automate the application development environments and programming languages such as Microsoft Visual Basic 6.0, Active Server Pages (ASP) and VBScript and C# [10]. This library is used in our application that is developed using C# and .NET to capture image from web cameras.

lated into text that might be processed later on. Tesseract [12], [13] is one of the few OCR engines that are available as free and open source. It is available as a Dynamic Link Library (DLL) so that it can be easily plugged in the other applications, to use the functionalities provided by Tesseract. Moreover, Tesseract provides support for different languages and is portable.

3.3 WCF

Windows communication Foundation (WCF) is a framework or platform for developing distributed systems, service oriented architecture (SOA) etc. It is provided by Microsoft in the .Net Framework 3.0 onwards. The advantage of using this framework is that a WCF service can be hosted by different ways like: Internet Information Services(IIS) hosting, Self hosting, Windows Activation Service and Windows Service. In this proposed system our purpose is to provide the functionalities through service and to make these facilities available to

any client i.e. web application, windows forms, console application etc. Therefore, WCF is more suitable for our proposed work. More details about WCF can be available at [14], [15].

The system architecture is shown in Fig. 2. The model comprises of two main components: the client side and the server side.

1. Client Application

The main responsibility of the client side component of the model is to process the image of the attendance sheet and to identify the student absent numbers and send these details to the server for further processing. The attendance sheet is developed in the pre-defined format as per the sample attendance sheet is shown in Fig. 3. It comprises of the details of the Semester, Subject Code, Current Year and the Faculty Code for the teacher who is responsible for delivering that lecture or conducting that laboratory. It has an n X m matrix for the student code/Student RollNo/Student ID and the date for attendance.For the present students, no manipulation shall be done on the attendance sheet, but to mark the absent students a cross (X), an asterisk (*) or a full block shading shall be done by a pen or pencil in the sheet. Precaution shold be taken that

high resolution camera, using a single click, the process using WIA API is invoked which would ensnare the image of the attendance sheet document in appropriate image file type. This converted image will act as the input for the OCR processing to recognize the data and thereby apply auto-correction mechanism. For instance, in the image processing, the image data is converted into the text data. Thereafter, the text is processed to identify the lecture details and the student attendance details. As OCR is not 100% accurate, while identifying the student attendance, if character 'u' or 'U' is encountered, it is replaced with 0, since the student code comprises of numbers only. After processing all the image information, the lecture details and the student absent numbers along with the respective dates would be transformed into the format which is used by the WCF services executing on the web-server.

2. Server Side Component

The WCF service is published on the web-server, ready to serve the client request. This service would extract the lecture details and the student absent numbers on each date. The component is not only responsible of extracting the details but also interacts with the database to store the information permanently. To

Fig. 3. Sample Attendance Sheet

the number is not fully readable while striking it off to mark the student absent numbers. The teacher may take the attendance in the classroom/laboratory and the hard copy shall be used as the input to the system. The WIA API used in the system would capture the image of the attendance sheet and will be used to initiate the OCR processing. The hard copy of attendance sheet is placed before the system which is having

achieve this objective, the extracted information from the client request by the WCF service, will be handled by the server process and will be inserted into the database.

4 WORKING OF SYSTEM

We tested this system by supplying various attendance sheets for different subjects. One of the sample attendance sheet for the

not retrieved properly. A student number can have only numbers so if any other characters are found in it, then it is corrected to

Fig. 4. Attendance Sheet with absent numbers

subject code CA705, semester 2 and Faculty code CIP is shown in Fig. 4. The user interface of client application of IAS is shown in Fig. 5. By clicking on the Take attendance button, the WIA is activated and hardcopy of the attendance sheet shown in Fig. 4, is

Fig. 5 .Interface of IAS

keyed to the Intelligent Attendance System. The first sub-component of the client component i.e. WIA captured the image of the same and it is shown in Fig. 6. The image is stored in the particular location in the system specified by the user. Then another sub component of client application – i.e. OCR engine,
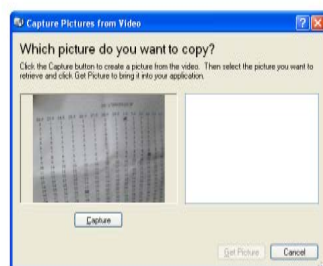

Fig. 6. Image capture of attendance sheet by webcam using WIA

which is formed by using Tesseract, has extracted the text from the images. As accuracy of OCR is not 100%, some of the text is

nearest number. For example, exclamation (!) is converted to 1, U or u is converted to 0 etc. After this auto correction process the text is divided in into various sections like subject code, semester, faculty code, lecture date with absent numbers in that date by appropriate data structures for each of these fields. Then client application sends these details to the WCF service for further processing. It is shown in Fig. 7. After receiving the details from client application the WCF, service stores the attendance details in the attendance database.

Intelligent Student Attendance based on OCR
Following details are sent to online attendance system database
Semester: 2
Subject Code: CA705
Faculty: CIP

Date	Absent Number
22-5-2012	11MCA018
23-5-2012	11MCA020
23-5-2012	11MCA030
24-5-2012	11MCA030
25-5-2012	11MCA032
26-5-2012	11MCA016
26-5-2012	11MCA034
27-5-2012	11MCA028
27-5-2012	11MCA040
28-5-2012	11MCA044
29-5-2012	11MCA048
29-5-2012	11MCA050
1-6-2012	11MCA001
1-6-2012	11MCA028
2-6-2012	11MCA021
3-6-2012	11MCA009
4-6-2012	11MCA026
5-6-2012	11MCA026
6-6-2012	11MCA040
6-6-2012	11MCA050
7-6-2012	11MCA030
8-6-2012	11MCA049
8-6-2012	11MCA005
9-6-2012	11MCA001
9-6-2012	11MCA008
9-6-2012	11MCA014
9-6-2012	11MCA021
9-6-2012	11MCA030

Take attendance

Fig. 7. Result of OCR processing with date and absent numbers

5 EXPERIMENT RESULTS

We have tested this system on 31 attendance sheets of different

based application so that image capture can be possible from any of the client terminal.
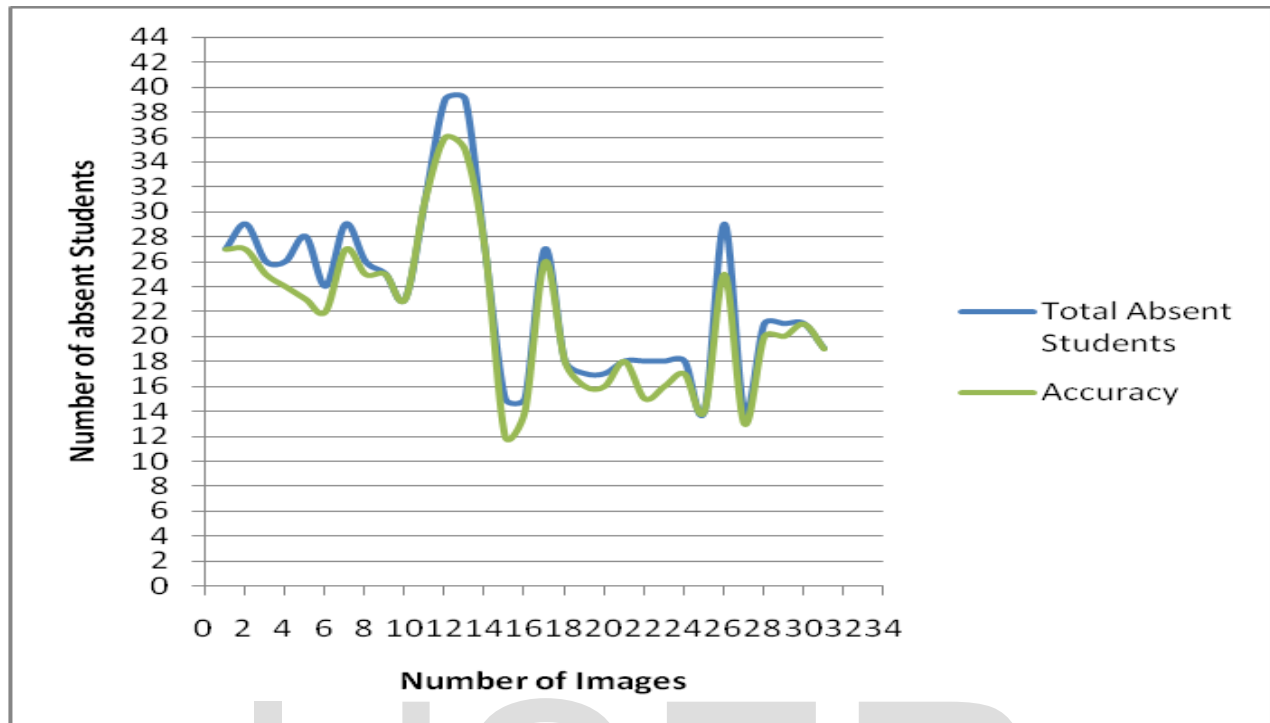

Fig. 8. Graph of attendance sheet images with accuracy

subjects and achieved average of 94.22% accuracy that is shown in the form of graph in Fig. 8. This test was carried out by 5 mega pixel HD camera of Samsung Galaxy ACE 2 mobile with computer having Pentium IV processor, 1 GB RAM and windows XP operating system. Some of the images are not captured properly due to lights or wrong alignment of the attendance sheet. Because of these factors, average accuracy is not 100%. From the graph, it can be observed that there is no significant difference between total absent students and average accuracy retrieved by the system. So IAS tends to provide 100% accuracy in extracting absent student details from the attendance sheet. The system can also work in offline mode i.e. if camera is not available then attendance sheet can be scanned by the scanner and in this method, IAS provides 100% accuracy.

6 CONCLUSION

The novel system presented in this paper can be useful in various academic institutes where student attendance is taken on paper and then posted online. It can be very useful and time saving, as a teacher does not need to enter attendance details, instead he/she just has to input the attendance sheet into camera or scanner.

As some of the images are not captured properly the system was not able to do OCR property and 100% accuracy is not achieved. The distance between camera and the attendance sheet should be in the range of 15 cm to 20 cm to capture image with good clarity. The 5 Mega pixel HD camera could be replaced with High-resolution HD web camera to take attendance in real time. Further WIA can be replaced with flash-

REFERENCES

[1] Qaiser, A, *"Automation of Time and Attendance using RFID Systems" International Conference on Emerging Technologies*, pp. 60-63,2006.

[2] Chiagozie, Ononiwu G. and Nwaji, Okorafor G, **"**Radio frequency identification (RFID) based attendance system with automatic door unit.**"***Academic Research International*, pp. 163-182, 2012.

[3] Wahab, M.H.A., et al. "Design and development of portable RFID for attendance system.". *Information Retrieval & Knowledge Management, (CAMP)*. pp. 173-178, 2010.

[4] Hsu, I-Ching "Mobile ubiquitous attendance monitoring system using wireless sensor networks.". *2nd International Conference on Education Technology and Computer (ICETC)*. pp. V4-533-V4-537, 2010.

[5] Ujan, I.A. and Ismaili, I.A. "Biometric attendance system.". *IEEE/ICME International Conference on Complex Medical Engineering (CME)*. pp. 499-501, 2011.

[6]   Jawale, J.B. and Bhalchandra, A.S. "Ear based attendance monitoring system" *International*

Conference on Emerging Trends in Electrical and Computer Technology (ICETECT). pp. 724-727, 2011.

[7] Jamil, T. "Automatic attendance recording system using mobile telephone." *19th Telecommunications Forum TELFOR.* pp. 1297-1299, 2011..

[8] Singhalm, Zatin and Gujral, Rajneesh Kumar. "Any Time Any Where- Remote Monitoring of Attendance System based on RFID using GSM Network." *International Journal of Computer Applications*, pp. 37-41, 2012.

[9] Salian, Neelesh S., et al "Automated Attendance System using Fuzzy Logic and Content based Image Retrieval" *International Journal of Computer Applications,* pp. 17-24, 2012.

[10] Windows Image Acquisition. *MSDN.* [Online] http://msdn.microsoft.com/enus/library/windows/desktop/ms630368%28v=vs.85%29.aspx.

[11] SHINDE, ARCHANA A. and D.G.Chougule. "Text Pre-processing and Text Segmentation for OCR." *International Journal of Computer Science Engineering and Technology*, pp. 810-812, 2012.

[12] SMITH, R. "An Overview of the Tesseract OCR Engine.". *IEEE Ninth International Conference analysis and Recognition*, ICDAR, 2007.

[13] Patel, Chirag, Patel, Atul and Patel, Dharmendra. "Optical Character Recognition by Open source OCR Tool Tesseract: A Case Study.", *International Journal of Computer Applications*, pp. 50-56, October 2012.

[14] Windows Communication Foundation Framework. *MSDN.* [Online] http://msdn.microsoft.com/en-us/library/ms731082.aspx.

[15] Windows Communication Foundation Framework. *MSDN.*[Online]http://msdn.microsoft.com/enus/library/vstudio/ms735119%28v=vs.90%29.aspx.

Chirag Patel received Bachelor degree in computer application (B.C.A) from Dharmsinh Desai University Nadiad, Gujarat, India in 2002 and Masters Degree in Computer Applications (M.C.A) from Gujarat University, Gujarat, India in 2005. He is pursuing Ph.D in Computer Science and Applications from Charotar University of Science and Technology (CHARUSAT). He is with MCA Department at Smt Chandaben Mohanbhai Patel Institute of Computer Applications, Charotar University of Science and Technology (CHARUSAT), Changa, Gujarat, India. His research interests include Information Retrieval from image/video, Image Processing and Service Oriented Architecture.

Maitri Chokshi received B.Sc degree in Electronics from S.P. University in 2001 and Masters Degree in Computer Applications (M.C.A) Degree from S.P. University- Gujarat, India in 2004. She with MCA Department at Smt Chandaben Mohanbhai Patel Institute of Computer Applications, Charotar University of Science and Technology (CHARUSAT), Changa, Gujarat, India.

Dr. Atul Patel received Bachelor in Science B.Sc (Electronics), M.C.A. Degree from Gujarat University, India. M.Phil. (Computer Science) Degree from Madurai Kamraj University, India. He has received his Ph.D degree from S. P. University. Now he is working as Professor and Principal, Smt Chandaben Mohanbhai Patel Institute of Computer Applications – Changa, India. His main research areas are wireless communication and Network Security.