Vision Tracking and Optical Character Recognition for Augmented Reality based Attendance System

D P Kaur¹ and A Mantri²
¹ Assistant Professor, Chitkara University Institute of Engineering and Technology, Chitkara University, Punjab, India
² Professor, Chitkara University Institute of Engineering and Technology, Chitkara University, Punjab, India
E-mail: deepkriti.kaur@chitkara.edu.in

Abstract. This paper presents a system for smart portable electronic device which is based on computer vision-based techniques for scanning the manually entered data by the user for automatic update on a central database and augmented reality is used for automatic display of updated data to the user. The developed application is in the form of an Android app which is installed in compatible smart portable electronic device. The system for providing an interactive augmented reality-based attendance uses image processing for optical character recognition to identify the characters in the register marked as ‘x’ for absence and any numeric data for presence of the student. For capturing the images, an AR enabled device can be used which is connected to a central database through the internet and the user is made to visualize the augmented information in the form of overlaid virtual content on the real scene.

1. Introduction
Amalgamation of Real and Virtual Worlds that aims to enhance the physical information by exact super-imposition of Computer-generated content on it is called Augmented Reality [1]. In this technology, user’s current perception of reality is enhanced with the help of interactive and digitally manipulable information. The basic components that are integrated in augmented reality systems are Hardware, Software and Algorithms [2]. Hardware comprises of processor, display and interaction devices, sensors and input devices. Smart phones, Tablets and Head Mounted Displays come under this category. The software derives real world coordinates, independent from the camera, from camera images and augments them. The process consists of tracking of identifiable targets and their registration in the 3D environment. In present work, vision-based technique for image identification and tracking is used for updating the attendance information of the students on a central repository accessible by the teachers as well as the students [3]. The use of optical character recognition is done to ensure identification of particular character used to mark the student ‘present’ or ‘absent’ in the attendance register. Furthermore, vision based augmented reality is used for marking and displaying student attendance that is user friendly and less time consuming for classroom in which the human errors are reduced. Thus, the whole idea of converting a manually entered attendance in a register by the teacher into uploading to a central database, available for students as well as teachers in their respective accounts, and in the form of augmented data to the teachers physically in the classroom is presented in this paper.
2. Related Work

For attendance systems, the augmented reality system is used to create virtual seats to increase attendance at a live performance [4]. Apart from this augmented reality system is used to mark the attendance of students using a portable electronic device, which is able to capture images of the audience and identify them based on facial feature detection [7]. Solutions based on biometrics are also available where one of the identifiable features like face/ fingerprint/ retina is scanned and matched with the database to mark student’s attendance. This kind of system requires smart classrooms equipped with scanning devices at a central location. Therefore, currently no solution exists which can update attendance of students on a central database by processing the images from manually marked attendance and also display this updated database using augmented reality. This is in context with schools and colleges in the developing countries, where teachers have to mark the attendance in a register and also get that attendance updated manually in the central database of that school/college. Drawbacks of existing systems are:

i. In developing countries, teachers usually mark the attendance in a register and get that attendance updated manually in the central database for their organization. This process is time consuming and may consume the productive time of a teacher.

ii. Existing solutions based on biometrics are very cumbersome and require many equipments to be installed at the site where attendance has to be taken for students, adding to the cost and maintenance for system.

iii. Also, the image processing algorithms used for recognition of biometric features like face, retina, fingerprints etc. are complex and require proper training for usage.

iv. Separate database for information storage is required for biometric based attendance systems, therefore updation of central database is either done manually, or updated data is taken from system database as such.

Therefore, a need was felt to develop a user-friendly attendance system which can use image processing along with augmented reality so that the student database is updated and displayed immediately using some electronic portable device which is easily available with attendance taking persons and does not require extra maintenance. The present work develops an augmented reality Android application. The system is based on vision techniques of image processing to identify optical characters in the register marked as ‘X’ for absent and alphanumeric characters for the roll number of the student for whom ‘X’ is marked.

3. Comparison of available attendance systems with present work

The technologies discussed in the above-mentioned section have been compared in terms of development, implementation, learning, efficiency and ease of use with the present work and their advantages and disadvantages are presented in Table 1.

Therefore, it can be concluded from the Table 1 that in spite of all the efforts made, the solutions previously proposed and known do not meet all the essential requirements which have to be taken into consideration. Existing systems of student attendance updation and display are either not automatic, or if they are, then these systems require cost of installation and maintenance of equipments, proper training for their usage, complex image processing algorithms for recognition of biometric features like face, retina, fingerprints and separate database for information storage.
Table 1: Comparison of Technologies for attendance system

| Sr. no. | Significant observations                                                                 | Comparison with present work                                                                                                                                                                                                 |
|---------|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.      | The invention creates Virtual Seats to increase attendance at a live performance or event with the help of augmented reality [4]. | The present work does not create any virtual seat. Rather it enhances the real image of attendance register by overlaying computer-generated data on it and subsequently updating the central database of attendance. |
| 2.      | The invention enables a Mobile Device to deliver / customize messages to other mobile devices using a distributed Augmented Reality Software platform. Mobile device uses its camera to capture a real scene and identify some predefined marker in the image thus obtained. When the marker is recognized, the mobile device can send virtual messages to others, while in this shared physical space [5]. | In the present work, Image processing is used to identify an optical character in the image captured by the camera. When a particular character is recognized, information is updated on a central database system through internet connectivity. The updated web page is also displayed on the mobile device screen in the form of virtual content after the recognition of real-world elements. In comparison, the prior art patent cannot update the central database and can only send virtual messages through augmented reality. |
| 3.      | The images containing personal information of the users are generated in group activities. Through a user’s portfolio, which is based on receiving signals corresponding to the user’s movements in physical world, virtual tours can be provided [6]. | No virtual tours are provided in the present work. In Fact, a Recognition and database updation system is developed for large number of students using Image Processing for identifying optical character marked in the attendance register and using Augmented Reality to update the central database of attendance. |
| 4.      | Another system provides an augmented reality system using a portable electronic device, which is able to capture images of the audience and identify them based on facial feature detection. Also, their location mapping is done for inter-communication [7]. | The compared work [7] involves the detection of facial features for marking of attendance. In comparison the present work is a recognition and database updation system that uses Image Processing for identifying optical character marked in the attendance register and using augmented reality to update the central database of attendance. |
4. Framework of AR-OCR based automatic system for student’s attendance

The most important objective of the present work is to provide a method and system for automatic update of student attendance using image processing for optical character recognition from traditional attendance registers and its display using augmented reality to the electronic device users [8]. The updated data should be easily available with the attendance taking persons without requiring any extra cost of installation and maintenance of specific biometric devices. To implement this, figure 1 presents the framework of the system, consisting of application part (user-interface), image processing engine (vision based algorithms for identification of the characters, and a central database (where physically captured data is updated through the use of proposed application).

5. Development of AR based attendance marking system

The present system for providing augmented reality-based attendance marking system uses an android based portable electronic device (a smart-phone or a tablet). The method allows a user to capture an image of the attendance register or any character by virtue of camera present on the device. The characters and the rows/columns of the attendance register are
processed based on optical character recognition. Once the attendance of the particular student/date is recognized through image capturing of the alphanumeric character marked in the attendance register manually, corresponding information is updated on the list and data is transferred to central database. The updated attendance is then displayed to the user simultaneously on the screen of his/her device. Different teachers are provided with different login id to ensure data segregation. The device also utilizes an application of augmented reality. The major components of this application are: Device Camera, Eclipse IDE, Android Developer Toolkit & Eclipse plugins, Java JDK & JRE and Open source image processing libraries.

The method comprises of a device having a suitable camera that can perform the function of scanning and optical character recognition. The device utilizes an application of augmented reality installed in the form of Android app based on JAVA coding. After marking the attendance manually as ‘X’ for absent and incrementing numeric characters for present, the teacher can scan the attendance register using the camera of the electronic device and this scanned image will be used for Image Processing with the help of Optical Character recognition algorithm present in the coding part of Android application installed in the electronic portable device. The data as read according to the absence and presence of the students is then transferred to the central database. The updated page or data will be displayed to the teacher on the screen of his electronic device by virtue of augmented reality till the time the device camera is projected on the attendance register. Steps for using the installed application are mentioned as follows, and are presented in Figure 2.

1. User launches android application installed in electronic portable device (smart-phone / tablet).
2. Device camera open up and starts capturing the real scene.
3. Attendance register cover page is scanned by the camera and user’s details are scanned for login/ User logs in manually to his/her account.
4. Error message is shown for invalid login.
5. For successful login, two options are provided: Daily attendance or Bulk attendance.
6. If user selects daily attendance; User has to provide date and lecture number. The device camera scans the attendance register column-wise and recognizes the details as provided by the user on top of the columns, scans the recognized and selected column and increments the last attendance by 1 for only those roll numbers for which other than ‘X’ is marked. Error message is shown for invalid date and/or lecture number.
7. If user selects bulk attendance; User has to provide the total number of lectures delivered and the roll number for which bulk attendance has to be entered. The device camera scans the attendance register row-wise and recognizes the details as provided by the user in left side of the rows, scans the recognized and selected row and counts the number of ‘X’s for that particular row. The algorithm then decrements the total lectures by count of ‘X’s for only that particular student whose roll number was provided by the application user and recognized by the application. Error message is shown for invalid roll number.
8. In this way, the attendance is updated on the central database using computer-vision (because only vision method; i.e. camera is used for image processing) using optical character recognition technique. It has to be ensured that the device has internet connectivity so that it is linked to the central database.
9. As long as the device camera focuses on the attendance register after scanning, updated attendance on database is displayed in the form of a webpage. This is done using augmented reality, where register’s attendance page serves as a marker and database webpage serves as virtual graphic data which is overlaid on the real scene.
10. There is an option for exit, and the user logs out from the central database account.
The augmented reality can be put to use in performing a number of tasks that people across educational institutes have to perform on a daily basis [9, 10]. The method and system of present invention provides an interactive platform to the user to easily interact and exchange digital information with other people. Also, it increases the productivity and once implemented would reduce chances of any human errors. The key features of the present invention are

- Based on image processing and augmented reality
- Optical character recognition is implemented
- In synchronism with traditional approach of marking attendance in registers in schools/colleges
- Data segregation
- Simple to use and robust

The novelty feature of the present work lies in disclosing a method and device based on
computer vision for automatic updating and augmented reality for display of student attendance. The user need not update the central database manually, rather the device possessing a camera will perform the job of image scanning and data will be updated directly on the central database and displayed using augmented reality. This database can be viewed anytime and manual error and effort is reduced.

6. Conclusion

The novelty for this proposed work has been achieved by using vision-based method for recognizing the optical character and their identification on an attendance sheet. A portable electronic device, capable of capturing images of handwritten characters is used. After marking the attendance manually as ‘X’ or any numeric character, the teacher can scan the attendance register using the camera of the electronic device and this scanned image will be used for Image Processing with the help of Optical Character recognition algorithm present in the coding part of Android application installed in the electronic portable device. The teacher will then enter the data according to the absence and presence of the students manually in the attendance register and this data is then transferred to the central database connected through the internet. The user of electronic device can also visualize the updated information in the form of overlaid virtual content on the real scene using Augmented Reality. Thus, the method and system presented here is simple, robust, and reliable to provide an intelligent and smart augmented reality-based attendance marking and display system. The method and system can be used to take attendance, interact, or perform any other activity inside a classroom, meeting room, or any other gathering. The present work would be applicable in any school/college where attendance needs to be updated to central database regularly after maintaining the manual copy in the traditional attendance registers.

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