

## Conference Paper

# The Use of Biometric Technology for Effective Personnel Management System in Organization

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### Abstract

Although the concept of attendance systems has been carried over the years, in recent times the forms of its application has changed. Companies being aware of the importance of personnel attendance to overcome the problems raised from manual attendance systems have started to take advantage of biometric systems. Particularly, fingerprint and facial recognition are the two most used forms for biometric identification, since it is considered as the most reliable and secure method in terms of its uniqueness. Because manual attendance systems are time-consuming and ineffective, companies review their control mechanisms for personnel attendance to integrate new technologies in their operations. This article proposes a new generation technological structure used to get effective results in personnel attendance systems. There are plenty of personnel attendance control systems in the market both for multinational companies or small companies. However, the number of web-based form of these systems is limited. Web-based personnel attendance control systems is quickly becoming one of the fastest growing technologies that enables instant data flow and reporting. According to the literature reviewed, more and more companies in Turkey have benefited over the time from web-based personnel attendance control systems. Nevertheless, there are not enough researches about it. The aim of this article is to design and implement a web-based attendance system for personnel in an organization by using biometric system (fingerprints and facial recognition combining with RFID card and password authentication) and support managers to make effective and efficient decision-making process. The proposed system has been implemented by following the steps of Software Development Life Cycle (SDLC). In the process of software development, a waterfall model was chosen that was used in many software projects and that composed of analysis, design, coding, test, version and maintenance phases. Since it is a linear sequential, progress is seen as flowing steadily downward (like a waterfall) through the phases of software implementation. Even though the waterfall approach is the earliest approach, it is still most widely known for software development. This research is expected to help managers in educational institutions in terms of effective personnel management, especially for institutions that have large number of employees. In addition, the developed system can also help educational institutions for adopting their personnel attendance system to new technologies. It was also known that private organizations use this kind of systems. However, educational institutions can also take advantage of biometric data in the web-based personnel management system.

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## 1. Introduction

Personnel management is very significant in the administration and management of organizations. Lack of security and extensive paperwork in the traditional systems reveal that there is a need for new approach for personal verification and employee identification technologies. In recent times, organizations have started to benefit from fingerprints and facial recognition more than before for personnel attendance. Moreover, the fact that no two individuals have the same finger prints and face shape increases the system security. It can be also asserted that, since fingerprints and facial structure remains unchanged throughout lifetime, it remains unique and sustainable. All biometric devices take a number of measurements from an individual then digitally process the result of these measurements and save this representation of the individual's traits into a template. Templates are then stored in a database associated with the device or in a smartcard given to the individual [1].

According to [2], Business Communications Company producing reliable market research reports and forecasts for more than 45 years, the global market for biometric technologies, which totaled \$14.9 billion in 2015, is expected to reach \$41.5 billion by 2020, reflecting a five-year compound annual growth rate (CAGR) of 22.7%. Automated fingerprint identification systems (AFIS) and fingerprint technologies as a segment should reach \$24.4 billion 2020 from \$8.8 billion in 2015, demonstrating a five-year CAGR of 22.8%. The face, iris, vein, and voice technologies segment of this market should increase from \$4.2 billion in 2015 to \$11.9 billion by 2020, with a five-year CAGR of 22.9%.

Recently, educational institutions have also started to use these type of systems both for student attendance and personnel attendance. Due to these reasons, researchers have started to pay more attention to the use of biometric technology for attendance management systems.

[3] benefited from fingerprint biometric authentication for attendance systems and analyze the biometric technology according to affordability, acceptability and sustainability in an organization and find out that fingerprint is the best biometric technology system that can sustainably solve the lingering problem of staff attendance in the proposed organization.

[4] asserted that the implementation of an electronic biometric-based method of attendance management system for non-academic staffs in IBBU Lapai will greatly assist IBB University Lapai in improving the net productivity of the institution and there by prevents time-consuming processes in attendance registering.

[5] implemented the Biometric Attendance Monitoring System (BAMS) in The Cagayan State University – Lasam Campus, Philippines (CSU – Lasam). It is revealed that BAMS greatly contributes in providing employees' ease and improving work values. Likewise, it encourages personnel to pay more attention to in and out times.

The purpose of this article is to present a new technological framework for non-academic personnel attendance in Dokuz Eylul University Faculty of Economics and Administrative Sciences by using biometric systems. Besides that, it is also aimed at how these systems support decision-making for executive management with analytical reports like daily, monthly and annual reports. In the scope of the research, a Web-based personnel attendance control system is developed and implemented within the organization.

It is expected to encourage educational institutions to benefit from biometric technology for their personnel management process.

## 2. Literature Review

A Personnel Management System (also called Human Resource Management System), refers to the systems and processes at the intersection between personnel management and information technology [6]. The most effective personnel management and the fullest realization of its goals are largely dependent on the composition of the personnel management system. Moreover, it is very important to understand the mechanism of its functioning and the most appropriate choices of technologies and methods of working with people [7].

Attendance management is an indispensable part of today's contemporary personnel management systems. It can be defined as the act of managing attendance or presence in a work setting to minimize loss due to employee downtime. Attendance control has traditionally been approached using time clocks and timesheets, but attendance management goes beyond this to provide a working environment which maximizes and motivates employee attendance [8]. It is used in different institutions for different purposes.

Personnel attendance control system is a computer based electronic system that records the entry and exit times of company personnel and provides daily and monthly

reports on these records. In addition attendance management systems divided into two groups, that is, conventional and automated methods. Conventional methods include timesheets, attendance management system and time clock. It requires a lot of paperwork and it is considered as time-consuming. Automated systems include Barcode, RFID or Biometric systems.

However, Barcode or RFID-based systems has some disadvantages in terms of personnel attendance control. In barcode based or RFID-based systems, every employee must have a badge or card and carry them to authenticate themselves. It involves several problems associating with cards. It means that there is always a risk about forgotten or damaged cards. In order to eliminate these problems, biometric systems have started to use in many organizations and also in academic institutions. Biometric systems are systems that enable verifying the identity of individual according to their unique characteristics.

The term biometrics comes from the Greek words bios, meaning life, and metrics, meaning measure. Biometrics can be defined as measurable physiological and/or behavioral characteristics that can be utilized to verify the identity of an individual [9].

Several biometric technologies are used, especially in authentication. There are many biometric recognition systems in existence today and the main ones are listed as Fingerprint, Retina, DNA, Face, Hand Geometry, Sound, Face Thermogram and Iris. In recent times, fingerprint has become the most mature and popular biometrics technology used in automatic personnel identification. The reason for the popularity of fingerprint verification is that fingerprints satisfy uniqueness, stability, permanency and easily taking [10].

In terms of technological applications, biometric systems usage is increasing day by day. Each biometric system has its own strengths and weaknesses. It is also impossible that finding a best practice for all applications. It may differ from its own usage purposes. [11] asserted that the fingerprint and iris-based technique have more accuracy compare to the voice-based technique. Due to the fact that biometric usage is increasing in applications for several sectors, biometric market size has started to grow.

In Figure 1, one of the method that is used in the research 'Automated Fingerprint Identification Systems (AFIS)' is growing. For all this reasons, biometric systems are considered that it can be bring a new perspective to the traditional personnel attendance management systems.

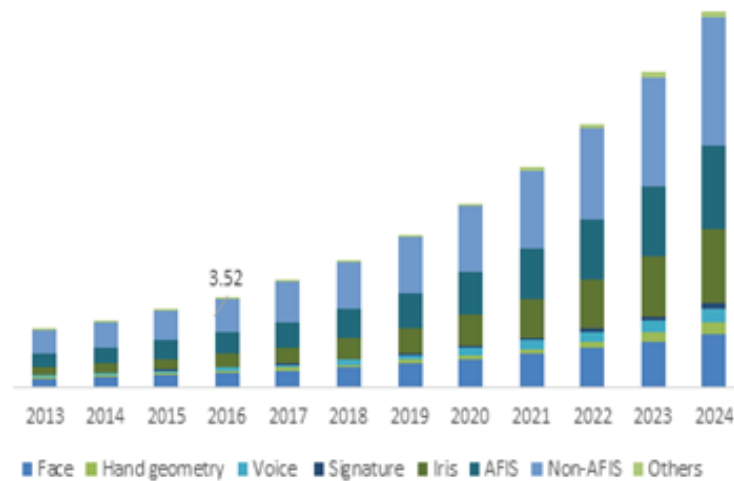


Figure 1: U.S. biometrics market size, by product, 2013–2024 (USD billion). Source: [12].

### 3. Methodology

In the scope of the research, each step of Software Development Lifecycle was implemented.



Figure 2: Software development lifecycle. Source: [13].

1. In the first and second phases, namely **planning and analysis**, firstly the operations in the institution should be examined and the problems analyzed. Within this framework, the way in which the personnel attendance control process works

within the scope of Dokuz Eylul University has been examined and the deficiencies have been documented accordingly. In the analysis phase of the system requirements, it is analyzed how the institution intends to reach which output. At this stage, the flow charts for Personnel Attendance Control System have been prepared and activities have been determined and the system design has been carried out accordingly

2. In the **design and implementation process**, the pre-collected data for the system has been set in a logical scheme. An error-free data-entry structure has been designed so that the system can produce meaningful results. In this process, user interfaces for the system have been created and the connection between user and system has been established. At the same time, the system database has been designed to hold all the data.
3. **Testing phase**, one of the most important steps in the system development life cycle, and it is vital that the software be tested with real users and data as soon as possible before implementation. If the problem is noticed and measures are taken before reaching the user, the business will be free of the cost of this error. The prototype developed at this stage was tested and systematic errors were documented and resolved before the system released.
4. **The maintenance stage** is still on-going. The system is still evaluating and monitoring before go-live.

In the process of software development, the technologies that could be the most effective solutions for user needs were selected. Users of the system have been identified and authorized. Because, different roles implement different operations in the system. At the same time, criteria such as software performance and productivity were taken into consideration.

Covering all of the processes, Waterfall model which has been used in many software projects and consists of analysis, design, coding, test, version and maintenance stages has been chosen. According to this model, every phase must be completed accurately. Since the condition for passing to the next step is completed previous phase, a linear software development process has been provided. In addition, Waterfall model is widely used when specific needs are determined in the beginning of the project. Therefore, when project structure and literature reviewed taken into account, Waterfall model best fits the system.

Besides that, there are several benefits of Waterfall model for software projects. These can be listed as follows:

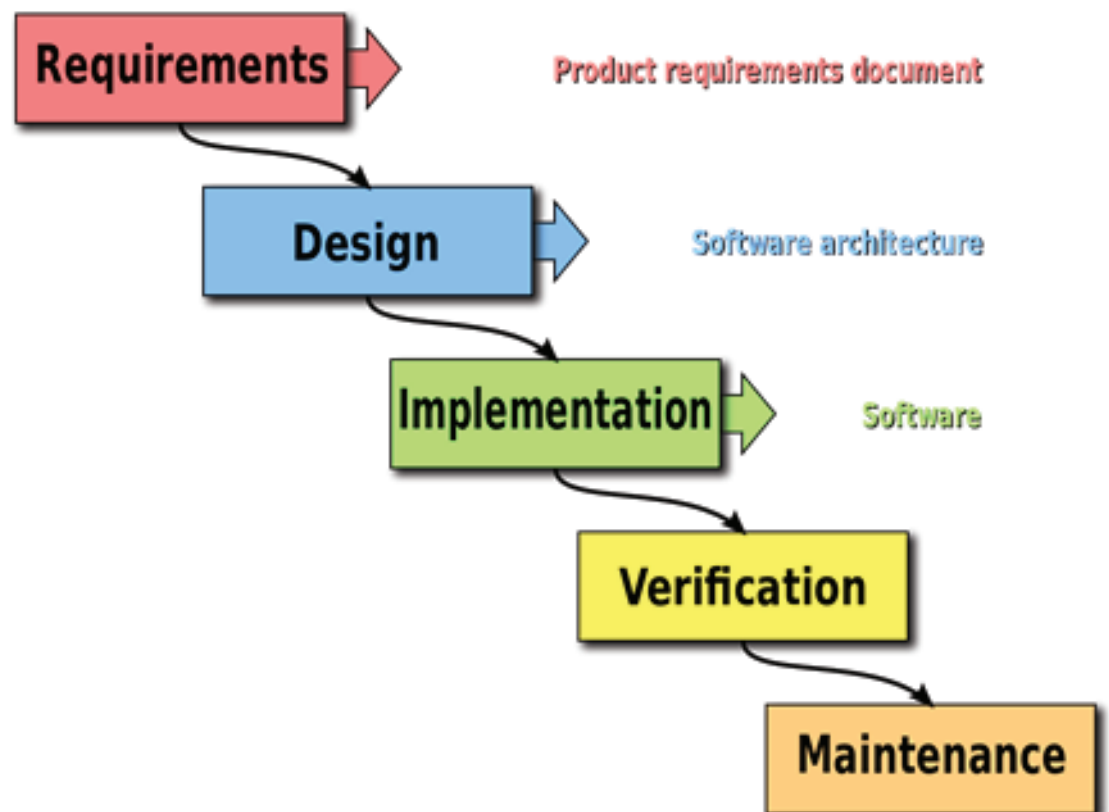


Figure 3: Waterfall model. Source: [14].

1. All of the requirements of end users, administrators and top management are clear before development process begin.
2. Each phase is completed in specified period of time after that it moves to next phase.
3. Because it is a linear model, it is easy to implement for the software project.
4. The amount of resources required to implement this model are minimal.
5. Each phase proper documentation is followed for the quality of the development [15].

#### 4. System Design and Application

As seen in Figure 4, the proposed system has 3 core modules, namely; personnel, manager and reporting module. In personnel and manager module only authorized people can execute aforementioned operations. For authorization, two types of users defined as admin and manager. Admin can execute all of the operations about personnel and manager like creating, listing, deleting personnel, password authentication, assigning

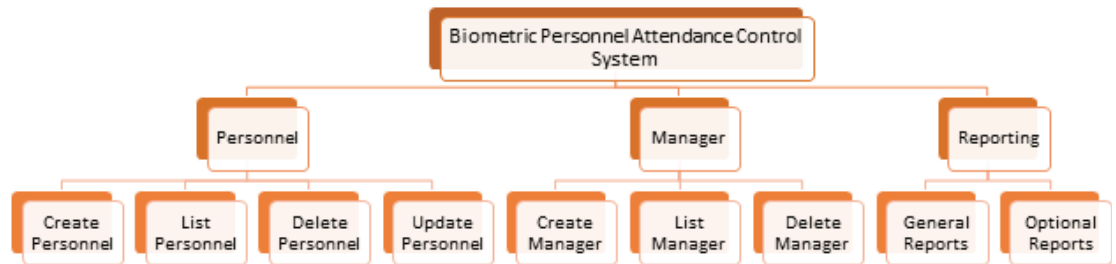


Figure 4: Core modules of the system. Source: Authors.

a personnel as manager, or viewing reports. However a manager can only view the reports.

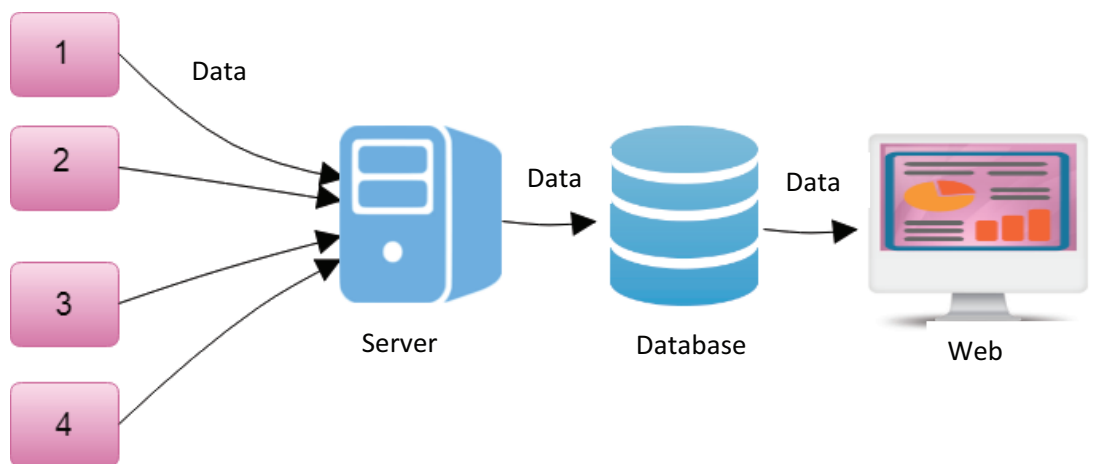


Figure 5: System structure. Source: Authors.

In addition, operating principle of the developed system can be seen in Figure 5. Every number used in first step represent a verification type. (1 = Facial Recognition, 2 = Fingerprint, 3 = RFID card, 4 = Password). The developed system was designed so that it can allow combination of minimum two verification types to increase accuracy. In order to do this, hardware allowing all of the operations was used.

After a personnel completes the verification process, the data obtained is sent to server. This data includes personal information, information about organization, verification mode, entrance and exit time. Following that, the data sent from server is stored on the database and using SQL(Structured Query Language) and PHP programming language, it can be viewed on the Web to top managers according to their purposive operations.

In the reports module, the system allows two types of reports, namely general reports and optional reports. In general reports, Entry and exit records for all personnel





**Figure 6:** The device used for verification. **Source:** [16].

is listed according to specified date range. If needed, late-in entry and early-out exit data can be viewed for all personnel based on the records by managers. In addition, in the optional reports, this data can be grouped by personnel, date or even hour. In this way, more specified and effective reports can be presented to managers. Moreover, in the dashboard page, the number of early-out exit, late in entry, both of them and absent staff can be viewed on a daily basis. If needed, this reports can be obtained on a monthly basis using some graphical features. This feature provides mangers with more transparent data in comparison with sophisticated Excel sheets. Considering the fact that, storing these reports for future use are beneficial, download different file types option is added such as.txt or.csv file types. While developing all modules, simple, user-friendly and responsive design was favored in terms of ease of use.

Figure 7 represents the number of monthly late check-in and early check-out. The purpose of using Figures 7 and 8 is to monitor in and out time effectively for each personnel. As seen in Figure 8, executive management can view the updated entry and exit hours for personnel in the organization benefiting from the bar chart. This type of report allows detailed information about overtime hours for each personnel. In this way, executive management can review their incentive policy for working overtime.

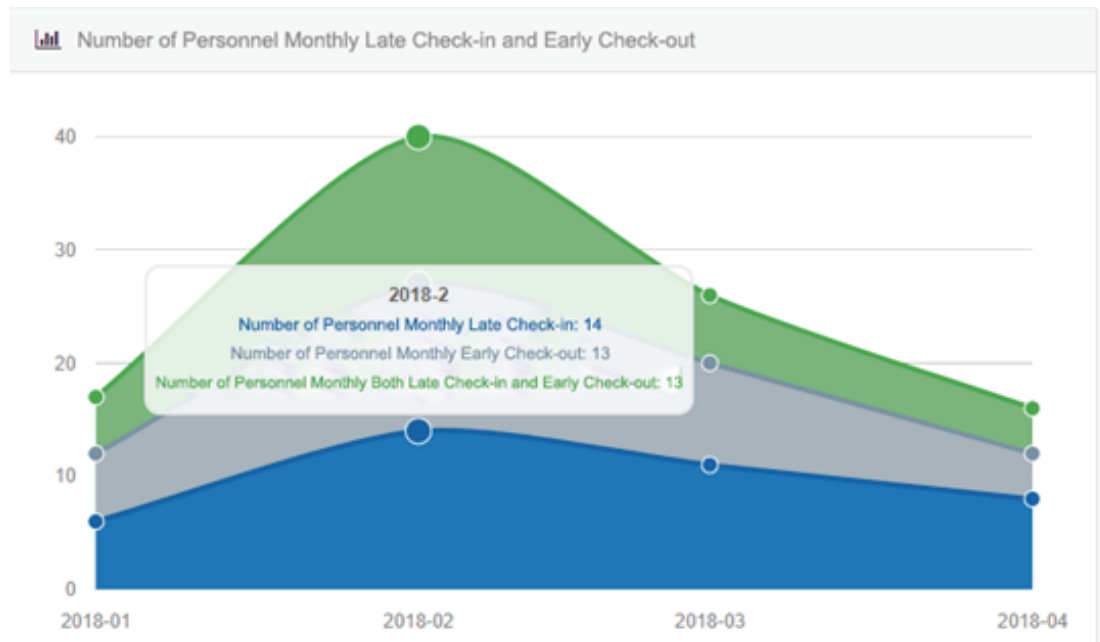


Figure 7: Number of monthly late check-in entry and early check-out personnel report. Source: Authors.

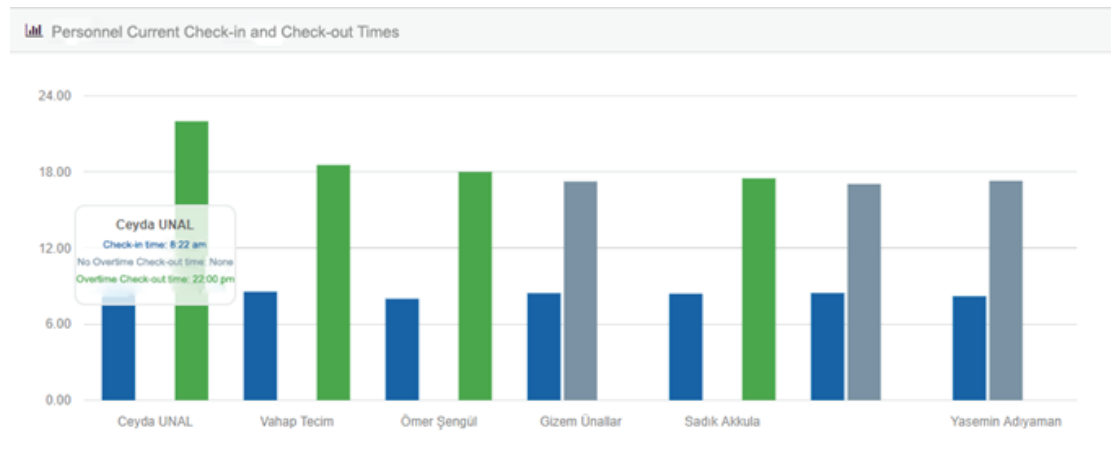


Figure 8: Updated entry and exit hours for personnel. Source: Authors.

## 5. Discussion and Conclusion

In conclusion, a biometric-based attendance management system is presented. This system mainly reviewed the personnel attendance mechanism in the organization. The system is developed using PHP, C# server-side scripting language and CSS, HTML, JavaScript for designing which is fully meet the system’s goals. In terms of effectiveness and efficiency, it saves valuable time, eliminates paperwork and provides instant reports in comparison to traditional attendance systems. This research has also presented a framework which provides an automated process for attendance management. Since biometric technology will involve the employees of the proposed

company using the behavioral or physiological part of their body for identification and verification, this however satisfies the fact that the system will be sustainable.

This system overcome many limitations. Since the developed system allows more than one verification mode alternatively, problems resulting from accuracy and security have been minimized. The system structure is dynamic and flexible in order to adapt new user requirements. It also shows that this type of systems are applicable not only for multinational companies, but also for educational institutions. In addition, it is observed that it enhances staff attendance and productivity.

In the future researches, the developed system can be improved through the integration of multimodal biometric technologies to provide more security for the personnel attendance management system. In addition, the system can be integrated to accounting information system like ETA or LOGO for salary calculation.

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