

# Design and Implementation of an Automated Library System using Biometric Technology

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**Abstract**—The aim of this paper is the design and realisation of an automated library system using biometric technology. The personnel at the circulation desk (entrance) of the library desires to either confirm or ascertain the identity of the person requesting service in the library. Currently, most libraries use identity cards, including photo-based, smart card based for this purpose. With the proposed authentication scheme it is possible to confirm or establish an individual's identity based on the fingerprint rather than by what one remembers (e.g., a password); hence, the authentication system is able to ensure that the rendered services are accessed only by a valid user, and not by any other person. The automated library system is designed based on the client/server architecture with the web structured as a 3-tier application. The front end aspect (first tier) of the automated library system was developed using Microsoft Visual Studio. The middleware engine uses dynamic web content technology (hypertext preprocessor, Java Server Page, Active Server Page) while the backend was designed using MySQL server application, thus all the data for the user authentication software are stored in the MySQL database. The performance under test was found to be satisfactory when compared with the traditional verification/authentication technique.

**Keywords**—automated library system; biometric technology; fingerprint.

## I. INTRODUCTION

The traditional library system utilises the accession numbering system for the distinctive documentation. The drawbacks of such system are either not noticed or are certainly not taken into consideration until there is an alternative solution. Some of the related difficulties are trained personnel needed to maintain information system, space constraint, manual computation of over dues on late returns; reminder system and follow up activities as well as the non-provision of instant status on the availability or queries [1].

There are several factors that obliged shifting from a manually operated to an automated library system. These include the need for an improved record keeping of library activities, improved security, cost effectiveness, efficient management of a large amount of scholarly literatures as well as online public access catalogue. The fundamental requirements for library automation are finance, manpower, hardware and software [2]. The realisation of library automation mainly depends on the software utilised. On the

other hand, hardware configuration mainly depends on the software. In addition, the library professionals needs the requisite technical knowledge for making the automation successful.

The biometric technology can be utilised in several applications and fields all over the globe today. This technology can help in the library automation to ensure safety of its invaluable collections, infrastructure and human resources [3]. Biometrics is the measure of the distinctive physical features of an individual in order to verify the identity. The noticeable characteristic of the biometric can be physical (facial characteristics, eye, finger image, voice) or behavioural (signature and typing rhythm); hence, it can be used for authentication [4].

The overall aim of this study is the design and implementation of an automated library system using biometric technology. The fingerprint technique is chosen due to its comparative ease of access, low cost of sensors, non-intrusive scanning, and relatively good performance.

## II. MATERIALS AND METHODS

### A. Materials

The materials required in order to experiment the developed application are wireless access point, network switch, CAT 5e / 6 unshielded twisted pair network cable, RJ-45 clips, LAN/cable tester, computers and a biometric fingerprint reader.

### B. Data Collection

Data was collected about the existing library system and the automated library system to be developed from archival records, observations and interviews. In addition, a comprehensive review of related literatures and semi-structured interviews conducted with library professionals and scholars to explore their views, opinions and observation regarding the problems faced by the librarians due to changing information setting. Available information on the Internet was also explored.

### C. Methods

The development of the automated library information system application begins with the design of the software and the network deployment architectures as well as the selection of the web programming languages for the software prototype development. The library authentication software was designed with Visual Studio. This is a complete software development suite, which provides a platform for developing both desktop and web applications.

Visual Studio is based on the dot net framework which is a massive set of classes and their properties which can be implemented as objects in the software being developed. Visual studio also supports various languages (e.g., Visual Basic.NET, C# and F#). Conversely, Visual Basic.NET was used to develop the software. This language develops from the very archaic basic which metamorphosed to classic visual basic [5]. Today, Visual Basic.Net has become very popular as it allows programmers to easily write code in an easy to understand format. Using Visual Basic.Net in Visual Studio makes programming faster as it gives software design a visual experience while the software is being developed.

The backend was designed with My SQL, which is very light and easy to install on computers. It is fast and makes data management and administration to be less stressful and easy to access and display on the interface. Fig. 1 illustrates the biometric finger print design schematics.

#### 1) Setup and execution of the automated library management application from the client system

Figure 2 shows the automated library management application setup from the client system. In order to complete the setup the following steps were taken:

- (a) ensured that the LAN settings has been configured;

- (b) ensure the CAT 6 unshielded twisted pair network cable is connected and both the server and client systems can ping each other;
- (c) be very sure by executing the ping command from the command prompt of both systems; i.e., from Client computer type “C:\>ping 199.169.10.115” press the enter button, and from the server computer type “C:\>ping 199.169.10.120” then press the enter button;
- (d) double click the **LIS ICON** on the desktop of the client computer and a dialog box will be displayed asking user to choose a scanner module to load; and
- (e) use the scrollbar to navigate downward in order to tick and select the scanner option and click the OK button to invoke the finger print scanner interface for enrolling and verifying users.

**Note:** the above process is based on the fingerprint scanner installed that you intend to run. In this study, the U are U finger print scanner was installed.

#### 2) Enrolment and verification of users fingerprint biometric features

The implementation/enrolment of the biometric fingerprint system are illustrated in Fig. 3 and Fig. 4. Click on the Enrol button in the menu, it will popup admin login as shown in Fig. 5. Then, enter the admin login password “**admin123**”. This will automatically call up the enrol interface to capture information about the new user. Complete the information and select the correct access right (**Staff/Student/Admin**) for authentication. Click on the create button to capture new user biometric fingerprint feature by placing your thumb on the fingerprint reader machine. Click on the verify button to validate the fingerprint pattern captured for a match, by placing the same thumb on the reader again. The above procedure is illustrated in Fig. 5. It is important to note that the person to be authenticated is required to be present at the time of authentication.

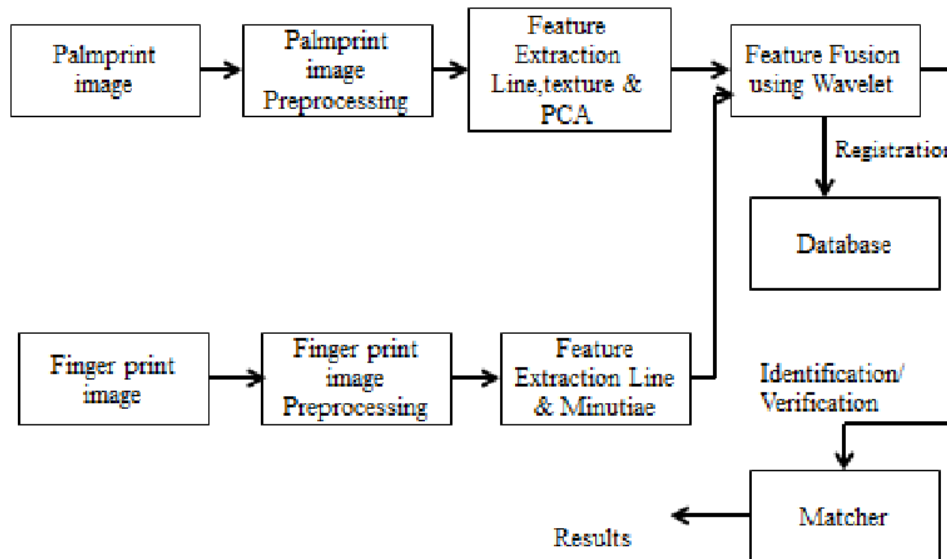


Fig. 1. Block diagram of biometric finger print design

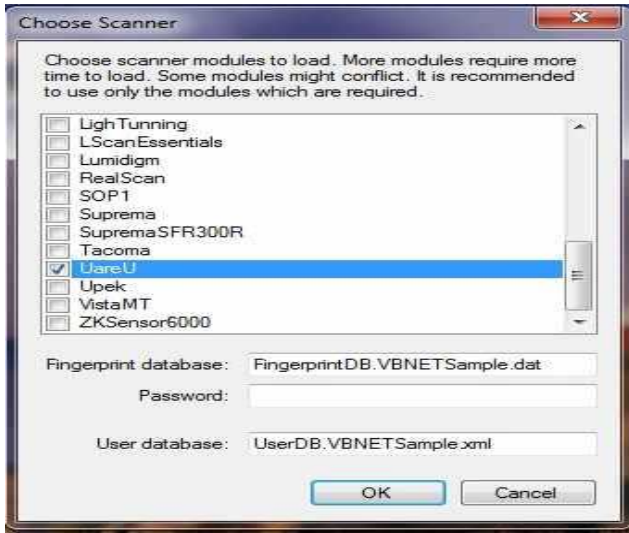


Fig. 2. Setup and execution of the automated library management application from the client system

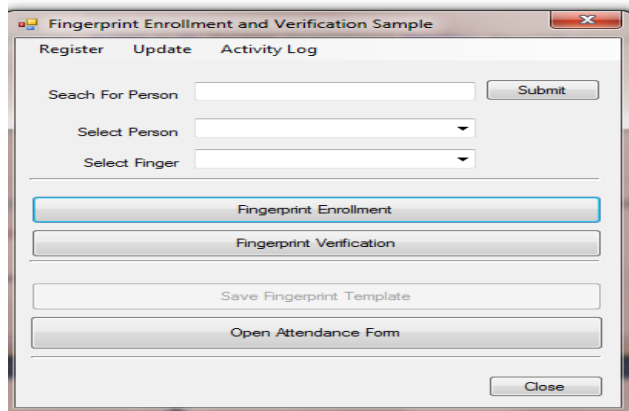


Fig. 3. Biometric fingerprint enrolment/verification sample

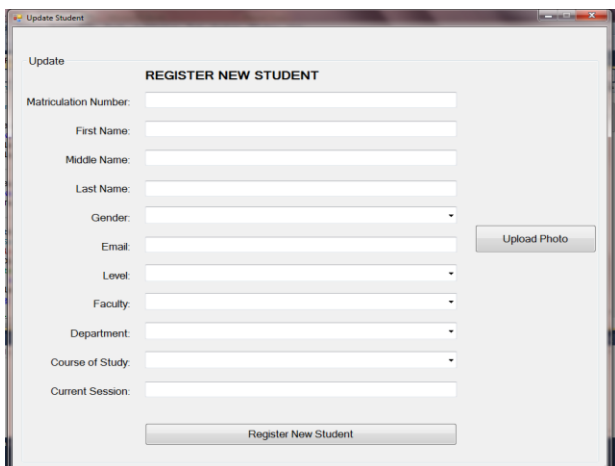


Fig. 4. Biometric fingerprint enrolment for new user sample

If the finger print match is verified ok, it will pop up a dialog box (Fig. 6). This process will automatically invoke the login interface for that user. Enter the username and password of the user to finally call up the user's profile, in order to perform various actions. Fig. 7 shows the system design of the fingerprint biometric interface.

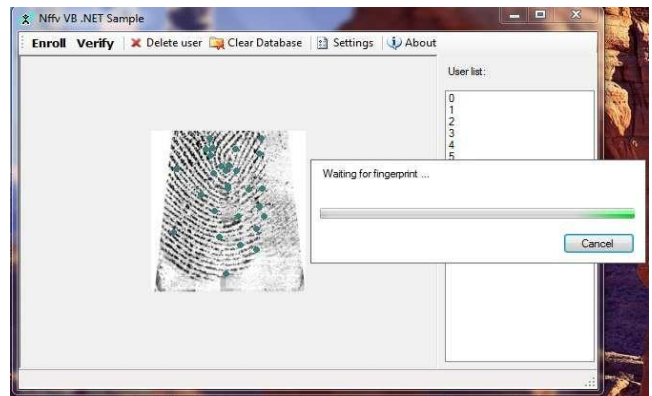
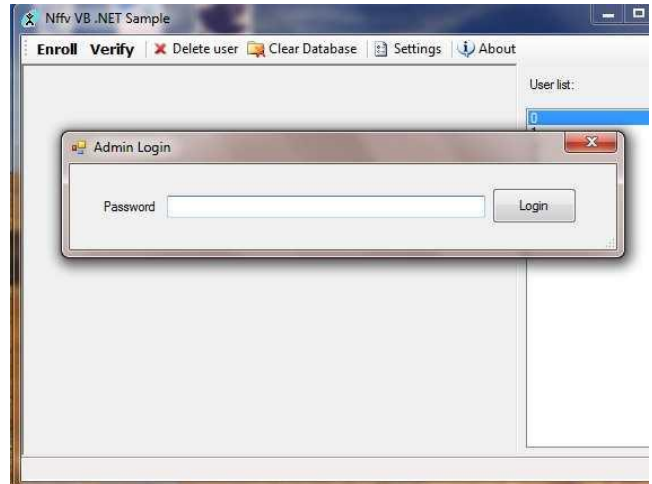


Fig. 5. Enrolment and verification of users using fingerprint biometric features

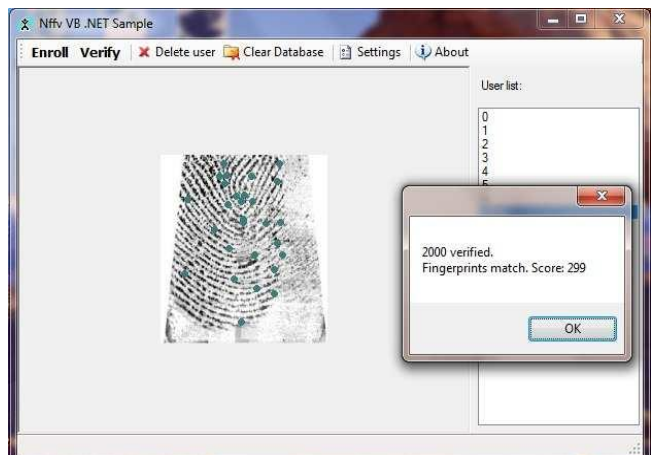


Fig. 6. Verification of users using fingerprint biometric features

### III. RESULTS AND DISCUSSION

Fig. 8 shows the system details of users' enrolment of the designed fingerprint biometric interface. As observed from the automated library system using biometric fingerprint, it is obvious that; after biometrics enrolment, the person can gain access through any of the library door when authenticated.

#### A. Main menu

1) *Add New Book(s) Option:* To add new book, click on the "add new book option" in the menu to invoke the interface to capture new book. From the add new book interface, select the faculty, department, and then enter the book title, author's name, edition, quantity ISBN and brief instruction about the book; then click on the post button to commit the information to the database at the server end.

2) *Approve Book(s) Option:* To approve any book for borrowing means a request of that particular book must have been made by a borrower e.g. student user in which the system

will then route the request within the internal mechanism to the staff user profile for awaiting approval before the staff user can click on the approval or decline button to execute request or deny request as the case may be.

3) *Receive Book(s) Return Option:* To receive book(s) for return the book(s) must have been due for return; the staff user must click on the receive book return option on the menu to call up a search word engine in order to fetch the borrowed book(s) information using any of the borrowers details i.e. students name, department or matriculation number on the database before finally clicking on the accept button to release the book back to the virtual shelf.

#### B. Report menu

1) *Borrowed Books Report:* This is a report of list of borrowed books from the library. To view the list of borrowed books; you click on the borrowed books report tab to display all books borrowed with its details.

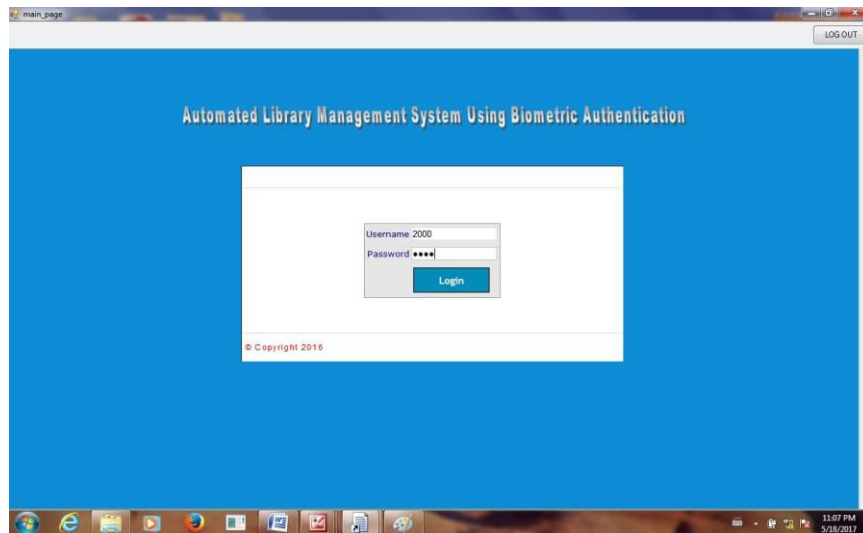


Fig. 7. Automated library management system interface

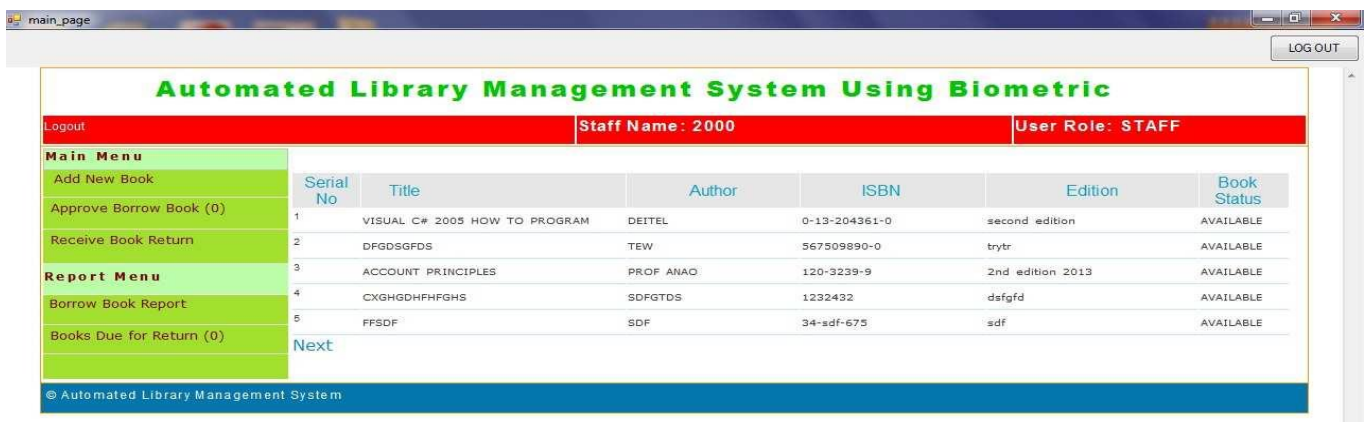


Fig. 8. Automated library management system users' enrolment details

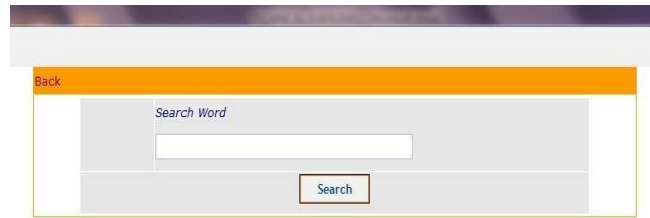


Fig. 9. Interface when Borrowing Book

Result of Search							
Back							
S/N	Book Title	Author	Edition	ISBN	Instruction		
1	VISUAL C# 2005 HOW TO PROGRAM	DEITEL	SECOND EDITION	0-13-204361-0	NOT FOR STUDENT BORROWING	Borrow Book	Read Book

Fig. 10. Result of Book(s) Searched

2) *Books due for Return Report*: This is a report of list of borrowed books due for return to the library after the expiry borrowed date. To view the list of books due for return; you click on the books due for return report tab to display all books due for return with its details.

#### C. How to Borrow Books

To borrow a book from the library; the user must have an idea of the particular book or books he or she wants to borrow from the library in terms of the book title or author's name. The user will then click the search for book option in the main menu. The user can then search for books he/she want to borrow by using the simple search word engine. Fig. 9 shows the interface when Borrowing Book. The result of the search will be displayed if found before user can actually borrow the book by clicking on the green borrow book tab as shown in Fig. 10. This shows that the implementation of an automated library system using biometric technology based on the design described in section II is perfectly working.

#### IV. CONCLUSION

The adoption of biometric systems has gained momentum and it continues to grow further as hardware costs reduce and easy integration solutions become available. The automated library system can eradicate the human errors made due to manual documentation by the circulation unit, the biometric program also prevents/rejects imposters by denying them

access and matching enrolled users by granting them access. Students can easily view available books, search for a particular book or even borrow books without much difficulty. An automated library can offer better services to the users and can suitably sustain the library more than the traditional system. The record keeping activities and the numerous report generation becomes easy to manage in an automated library system. Nonetheless, the success of any automation system depends largely on the proper planning and execution. Hence, professionals need to take accurate inventiveness in right direction.

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