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# A Biometric-Based Model for Monitoring and Controlling Students and Lecturers' Attendance in Tertiary Institutions

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***Abstract:*** ***It has always been observed over the years, the bottleneck of managing people in most of the organizations. Therefore, maintaining the attendance record of both the students and the staff in academic institutions has always been an arduous task. It, therefore, calls for a system that automates the whole process of monitoring and controlling both students and Lecturers lectures' attendance and maintaining the records. In this research, an automated system that controls and monitors both students and staff attendance was developed. This system takes attendance electronically using fingerprint identification. Using a fingerprint sensor, all the records are saved on a computer server. Fingerprint sensors and Liquid Crystal Display (LCD) screens are placed at the entrance of each lecture room. In order to mark the attendance, lecturer has to place his/her finger on the fingerprint sensor in order to mark the commencement of lecture and invoke sign-in process for the students to mark their attendance. On identification, lecturers' and student's attendance records are updated in the database and he/she is notified through LCD screen. The developed system was tested for a class of 43 students and two lectures at Kwara State College of Education Oro. To evaluate the performance of the model, questionnaires were administered to the students and lecturers that were involved in the implementation. Likert scale method was used to analyze the response of the people. The analysis of the result revealed that the developed system generated accurate and reliable students' lectures' attendance. It monitored and controlled lecturers' conduct of lectures.***

***Keywords: Attendance, Biometric, Identification, enrollment, fingerprint, failure to enroll (FTE), Failure to Capture (FTC), verification, fingerprint templates***

## I. INTRODUCTION

Attendance taking is the recording of student' participation of class lectures with a view to collating the data that will be used as part of the continuous assessment or to know the number of students that attended a particular lecture. Every academic institute has its own lecture attendance policy for students and keeping the accurate record of attendance is very important. According to [5], presently, attendance is usually noted using paper sheets and the old file system, this approach has been in use for a very long time. It becomes difficult for the management to regularly update the record and manually calculate the percentage of classes attended. Investigation and research show that there is high correlation between lecture attendance and examination performance on the part of the students [1]. On the other hand, lecturers need to be more dedicated to their lectures makes sure they attended the number of lecture stated by the curriculum [7]. He suggested that each institution should look for a moderately better way to monitor lecturers lectures' attendance. Keeping these issues in mind, a system is designed to overcome the problems associated with attendance system. Biometric systems have been widely used for the purpose of recognition. These recognition methods refer to automatic recognition of people based on some specific physiological or behavioral features.

In computer technology, biometrics relates to identity - confirmation and security techniques that rely on measurable individual biological characteristics [4], [6]. For example, fingerprints, handprints or voice patterns might be used to enable access to a computer, to a room or to an electronic commerce account. In general, there are three levels of computer security schemes. Level 1 relies on something a person carries, such as ID card with a photograph. Level 2 relies on something a person knows such as a password or a code number (e.g. PIN). Level 3, the highest level, relies on something that is a part of a person's biological makeup or behaviour, such as a fingerprint, a facial image, or a signature. There are a number of simple, widely available means of personal identification, including Photo ID cards and Secret passwords or Personal Identification Number (PIN). While these simple means of identification work most of the time, they may be compromised easily. For example, ID cards may be lost, stolen, or copied. Similarly, passwords or personal identification numbers (PINs) may be forgotten or guessed by others. However, biometric systems provide automatic personal identification on the basis of a physical or behavioural feature that is distinctive to each individual. The concept of biometrics perhaps has its origin with the human use of facial features to identify other people. It can be said to have its link to the traditional method of human identification. Modern biometrics, however, started in the 1880s and has since been used and acceptable universally.

Biometric systems are basically used for one of the two objectives identification or verification [Identification means to find a match between the query biometric sample and the one that is already been stored in database [2]. For example to pass through a restricted area you may have to scan your fingerprint through a biometric device. A new template will be

 

generated that will be then compared with the previously stored templates in database. If match found, then the person will be allowed to pass through that area. On the other hand verification means the process of checking whether a query biometric sample belongs to the claimed identity or not.

Some of the most commonly used biometric systems are (i) Iris recognition (ii) Facial recognition (iii) Fingerprint identification (iv) Voice identification (v) DNA identification (vi) Hand geometry recognition (vii) Gait recognition (viii) Signature verification. Previously the biometrics techniques were used in many areas such as building security, ATM, credit cards, criminal investigations passport control. The developed system uses fingerprint recognition technique for obtaining student's attendance. Human beings have been using fingerprints for recognition purposes for a very long time, because of the simplicity and accuracy of fingerprints. Fingerprint identification is based on two factors: (i) Persistence: the basic characteristics and features do not change with the time, (ii) Individuality: fingerprint of every person in this world is unique. Modern fingerprint matching techniques were initiated in the late 16th century and have added most in 20th century. Fingerprints are considered one of the most mature biometric technologies and have been widely used in forensic laboratories and identification units.

The developed system takes lectures attendance for both students and lecturers automatically using fingerprint verification technique. It has been proved over the years that fingerprints of each and every person are unique. So it helps to uniquely identify the students.

## II. RELATED WORKS

Most of the attendance systems use paper based methods for taking and calculating attendance and this manual method requires paper sheets and a lot of stationery material. Previously a very few work has been done relating to the academic attendance monitoring problem. Some software's have been designed previously to keep track of attendance. But few of them require manual entry of data by the staff workers. Others were centered on students' attendance only. So the problem remains unsolved.

Cheng, Xiang, Hirota and Ushijima (2005) developed the system to manage the context of the students for the classroom lecture by using note PCs for all the students. Because this system uses the note PC of each student, the attendance and the position of the students are obtained. However, it is difficult to know the detailed situation of the lecture. Kawaguchi, Shoji, lin, Kakusho, and Minoh, (2010) developed a model/system called Face Recognition-based Lecture Attendance". It is a system that takes the attendance of students for classroom lecture automatically using face recognition. However, it is difficult to estimate the attendance precisely using each result of face recognition independently because the face detection rate is not sufficiently high due to classroom environment which could either be dark or bright. In this system a method for estimating the attendance precisely using all the results of face recognition obtained by continuous observation was adopted. Continuous observation improves the performance for the estimation of the attendance. Lecture attendance system based on face recognition was developed, and applied the system to classroom lecture. Apart from environmental factor, each student must maintain a unique seat position and the uniform must not be the same colour as the seat which is not feasible in tertiary institutions. Furthermore idea of attendance tracking systems using facial recognition techniques have also been proposed but it requires expensive apparatus still not getting the required accuracy. Tabassam, Saim,, Arash, and Azhar-ud-din (2009), developed a system that takes students lectures attendance while entering the lecture rooms. It is a fingerprint based model. This was designed for student only. According to [3], a biometric-based model called "School Attendance Management System (SAMS)" was developed. SAMS is a biometrics and RFID(Radio Frequency identification) based comprehensive attendance management system for schools and colleges. SAMS was design by [3] in order to provide robust, secure and automatic attendance management system for both, students and staff. SAMS has an inbuilt facility of sending automatic SMS and Email alerts to the Parents/Guardians of the students. The fingerprint sensors are placed at strategies point in the school premises. Despite the fact that it takes the attendance, it does not guarantee lecture attendance since it is not lecture-based attendance system rather mere presence in the school premises. With all these, the expected system has not been developed i.e. a system that monitors and controls students and lecturers lectures' attendance.

## III. SYSTEM DESCRIPTION/ ARCHITECTURE

A fingerprint sensor device along with a Liquid Crystal Display (LCD) screen is placed at the entrance of each classroom as shown in the Figure 1. The fingerprint sensor is used to capture the fingerprints of the students and lecturers at the entrance of the lecture rooms while LCD screen notifies the each of them that his/her attendance has been marked.

### *3.1 Guidelines for Marking Attendance*

i. The lecturer selects the course to be taught
ii. The lecturer places his/her finger on the sensor of the fingerprint reader.
iii. The lecture click the start class indicator on the settings interface so that the system will mark the exact time of class commencement and assign it to "Start Time". This is to invoke the sign-in interface for the students lecture attendance taking.
iv. The lecturer will then click on attendance interface for every student to stripe their finger on the fingerprint reader as he/she enters the class/lecture room; also their time of attendance is also noted.
v. At the termination of the class/lecture, the lecturer clicks stop class. This will mark the end of the class and click attendance interface to invoke the sign-out process for the students.
v. The students stripe their fingerprint on the fingerprint reader to mark the end of the class and the time is slso recorded and assign to "End Time"

 

Note that update is made only for student whose the total time spent is up to 60% of the total lecture time.

### *3.2 Precautions*

Lecturers and students should scan his/her fingers correctly on the fingerprint sensor (see Figure 2)

If fingerprint is not enrolled correctly on reader as shown in Figure 3, it could lead to biometric error i.e. biometric device does not make perfect match decision.

There are two reasons for error Failure to enroll rate (FTE) and Failure to capture (FTC) rate of biometric device. FTC rate depends on functionality of the system and FTE occur due to poor quality inputs.

### *3.3 Scenario of Marking the Attendance*

Figure 4 shows the scenario of automatic attendance system attached to a class room. Database storage contains the fingerprint templates of lecturers and students along with their information (names, registration numbers and Subjects/lectures). When a lecturers or student enrolls his/her finger on the scanner his/her fingerprint is matched with database to mark the attendance

### *3.4 Implementation*

Hardware equipment is placed at the door of classroom (see Figure 1). Before entering the classroom, lecturers and students are identified through fingerprint scanner as shown in the Figure 5. On identification of a lecturer or student his/her attendance is marked.

The following sequence of steps summarize the system internal operational process of marking the attendance.

Step 1: Capture the student's fingerprint sample and create a feature set. A set of unique features created to match fingerprint is called feature set.

Step 2: Retrieve the stored templates from the repository (database).

Step 3: Perform a one-to-n comparison between the fingerprint feature set and the fingerprint templates stored in database, make a decision of match or non-match. Figure 6 describes the process of identification (fig. 6).

Step 4: If match is found retrieve student's information (Registration number, Department, Subjects) from the database.

Step 5: Obtain the scheduled lecture from the database and mark attendance if student is within the specified time i.e. 60 % of lecturer's lecture time (see rules for detail). If verification is not done or there is error in enrollment of fingerprint, system goes back to its initial state without marking the attendance as shown in Figure 7 .

## IV. RESULTS AND DISCUSSION

The developed system was tested for a class of 43 students of 200 level computer science department, Kwara State College of Education Oro and two lectures. The results revealed that two of the students did not spend up to 60% of the lecture time and their attendance was not updated. Out of other 41 students, 40 were properly identified and thus their attendance record was updated. 1unsuccessful identification occurred because student did not properly place his finger on the sensor (see rules for detail).

In order to collect user's assessement of the developed model, questionnaire were administered to the students and staff that were involved in the process. The Likert items (i.e each question asked in the questionnaires) provided metrics on which the performance parameters for the evaluation of this model were formulated. Survey targets were set for each evaluation parameter of the developed model. Although three of the Likert items were the same for the two categories. The respodents gave objective measure of the adequacy of the model based on the parameters

Out of forty five(45) qestionnaire that were administered, forty two (42) responses were received from the respodents and data from the dully filled questionaiare were captured, compiled and analysed using Microsoft Excel. The result of data analysis of individual Likert items is as presented in Tables 1. The first column of each table represents the question number of an item on the questionnaire. For exmple, Q1 and Q4 represent questions one and four respectively. While data in the split cells represent the frequency of the responses in number and its equivalent percentage.

The response mean and response mode depicts the overall user's satisfaction with most of the features of the develped model. The mean and modal value of response are in the upper classes of the rating scale except for item 9 (Q9) which is a reversal item.

Generally, responses showed that the model is acceptable by both staff and students because of its efficiency, ease of use, ability to enforce both students and lecturers to attend lecture regulary at approriate time and its capabilities to reduce impersonation during lectures by the response of item 1, 2, 3, and 5 respectively. Item 4 ensures that all students are registered from the commencement of semester. The acceptability of the system is shown by the response of item 7 that both the students and the staff prefer the system to the traditional method and therefore must be encouraged in all tertiary institutions (see item 10). The inclusion of items 8 and 9 was to test for the False Acceptance Rate and False Rejection rate of the developed system and the responses showed that both rates are bearable. The data of the likert item of table 1 was subjected to statistical analysis using colunm chart as shown in figure 8.

## V. CONCLUSION

In a nutshell, it can be inferred that a reliable, secure, fast and an efficient system has been successfully developed. This system would effectively monitor and control both lecturers and students' lecture attendance in tertiary institutions. It is a

 

system that could replace the present manual and unreliable system. Results show that this system can be implemented in tertiary institution for better management of students' attendance. This system will save time, encourage the disposition towards automated attendance taking to monitor and control lecture attendance in our schools.

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Fig. 1: Hardware Equipment of the System at the Entrance of the Lecture Room

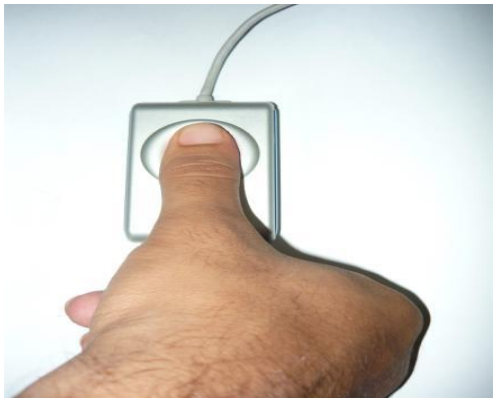

Figure 2: The correct method to place a finger on the device.

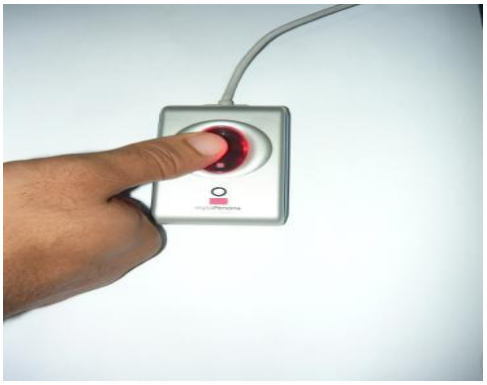

Figure 3: The wrong method to place a finger on the device.

 

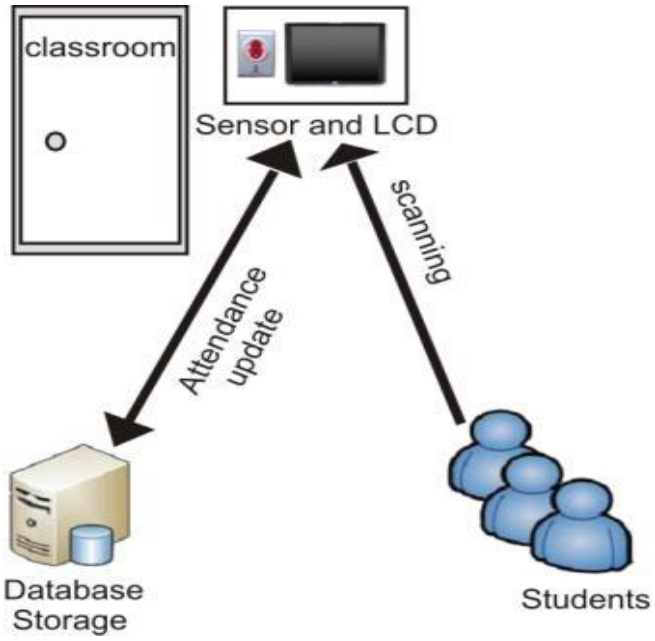


Figure 4: Scenario of Automatic Attendance system.

Figure 5: Students mark their attendance before entering the classroom

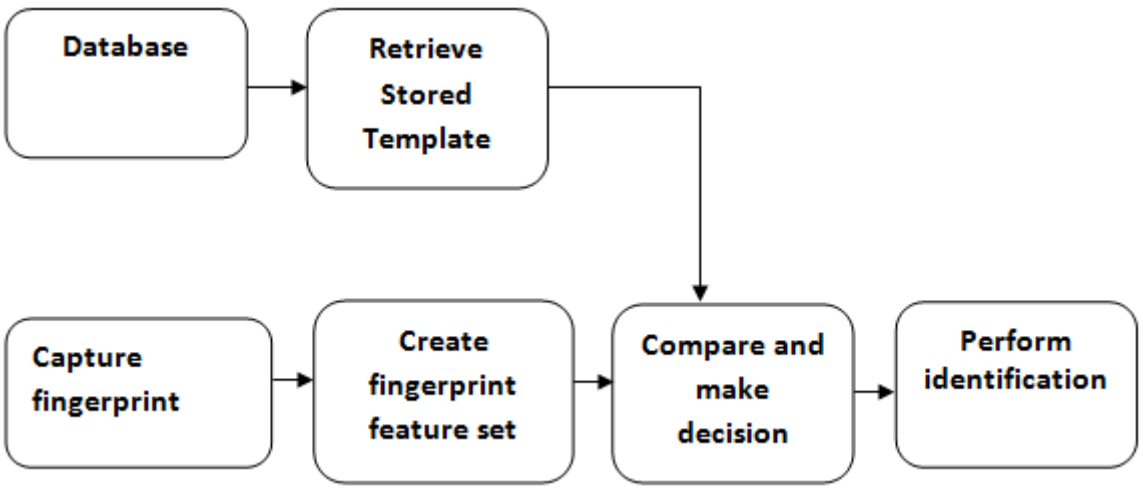


Figure 6: Identification Process: Perform a one-to-n comparison between the fingerprint feature set and the fingerprint templates stored in database, in order to make a decision of match or non-match

 

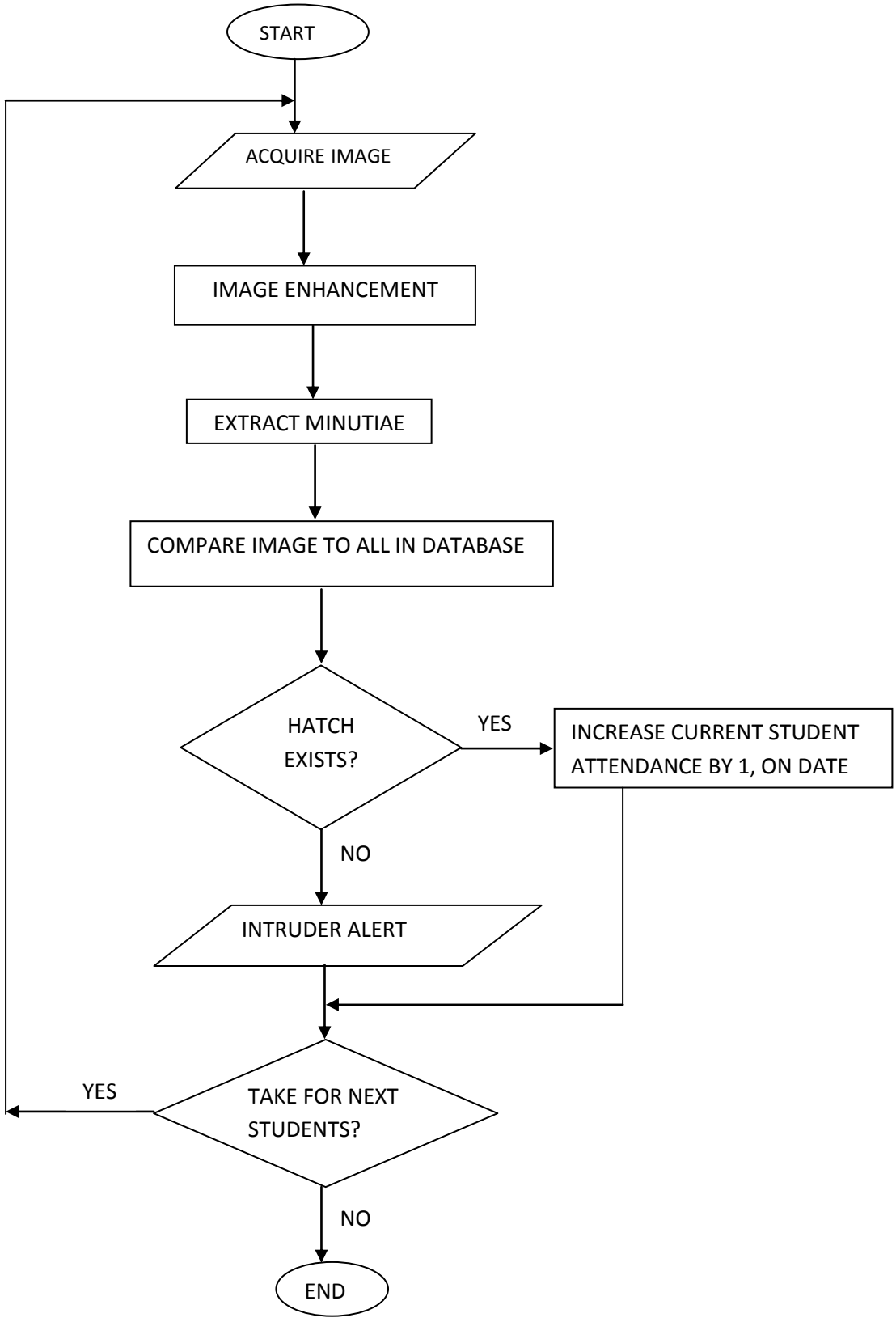


Figure 7: Attendance Taking Flowchart of the developed System

 

Table 1: Data Analysis of the Administered Questionnaire

| Q | Likert Items | Strongly Disagree (1) | Disagree (2) | Neutral (3) | Agree (4) | Strongly Agree (5) | Response Mean | Response Mode |
|---|---|---|---|---|---|---|---|---|
| Q1 | The developed system is easier to use than the conventional (traditional) method of attendance taking during lecture and examination | 2 | 3 | 4 | 10 | 23 | 4.16 | 5 |
| | | 4.76% | 7.14% | 9.52% | 23.81% | 54.76% | | |
| Q2 | The time it takes the developed system in attendance taking is faster the traditional method | 3 | 4 | 2 | 13 | 20 | 4.02 | 5 |
| | | 7.14% | 9.52% | 4.76% | 30.95% | 47.62% | | |
| Q3 | The developed system reinforces students and lecturers to attend lecture regularly and timely than the traditional method of attendance taking | 1 | 5 | 3 | 15 | 18 | 4.12 | 5 |
| | | 2.38% | 11.91% | 7.14% | 35.71% | 42.86% | | |
| Q4 | The number of registered students are known from the commencement of semester with the developed system | 2 | 1 | 5 | 13 | 21 | 4.19 | 5 |
| | | 4.76% | 2.38% | 11.91 | 30.95% | 50% | | |
| Q5 | The developed system helps to assert all the eligible students for a course during lectures than the conventional method of attendance taking | 2 | 1 | 5 | 13 | 21 | 4.19 | 5 |
| | | 4.76% | 2.38% | 11.91 | 30.95% | 50% | | |
| Q6 | The developed system ensures proper, accurate and reliable record keeping of the attendance than the conventional method of attendance taking | 1 | 4 | 5 | 12 | 20 | 4.09 | 5 |
| | | 2.38% | 9.52% | 11.91% | 28.57% | 47.62% | | |
| Q7 | Students and lecturers prefer the developed system to conventional (traditional) method of attendance taking | 5 | 6 | 5 | 12 | 14 | 5.57 | 5 |
| | | 11.91% | 14.29% | 11.91% | 28.57% | 33.33% | | |
| Q8 | The developed system do not rejects registered identity frequently | 1 | 1 | 1 | 15 | 24 | 4.43 | 5 |
| | | 2.38% | 2.38% | 2.38% | 35.71% | 57.14% | | |
| Q9 | The developed system accepts unregistered identity frequently | 24 | 15 | 1 | 1 | 1 | 1.57 | 1 |
| | | 57.14% | 35.71% | 2.38% | 2.38% | 2.38% | | |
| Q10 | The use of developed system should be encouraged in all tertiary institutions in Nigeria | 4 | 3 | 4 | 13 | 18 | 3.91 | 5 |
| | | 9.52% | 7.14% | 9.52% | 30.95% | 42.86% | | |

 

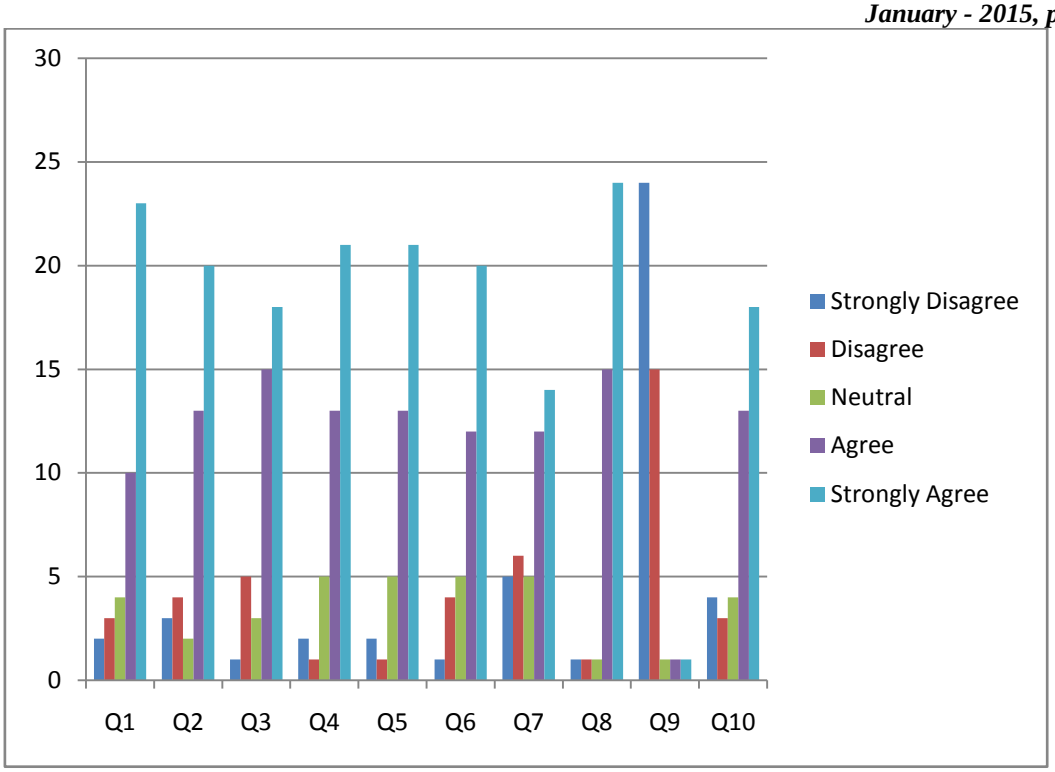


Fig. 8: Representation of Numeric Frequency of Response of Table 1

 