# Fingerprint Sensor Using NodeMCU For Individual Identification

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***Abstract:*** One of the important and unique ways of identification for human beings is their fingerprint. This uniqueness can be used for identifying the human being automatically using the fingerprint sensor. In this paper, a system has been proposed for unique identification of students and marking their attendance accordingly using a fingerprint sensor mounted on NodeMCU.
In the proposed method, we have used an optical fingerprint sensor which is mounted on a NodeMCU microcontroller.

***IndexTerms- Fingerprint sensor, NodeMCU microcontroller, fingerprint image, fingerprint template, biometric.***

## I. INTRODUCTION

Fingerprint impression of a person is considered to be the most unique identity of the individual. A fingerprint being very unique cannot be forged easily and thus can be used for biometric identification of an individual.

Many of the educational institutes in the country still rely the traditional pen and paper method for attendance purposes. To digitize this archaic practice biometric impressions can be used to map and track attendance of students. By digitizing the attendance records the paper work needed is drastically reduced increasing the efficiency of managing the records and simultaneously making the management a paper free process.

By storing the fingerprint templates of the students, a database of all the students in the institution will be created which will be used while the authorization or attendance marking. This system of fingerprint identification can be also used in various surveillance systems such as unlocking personal mobile phones or also in systems where access is granted only to authorized people

The use of NodeMCU over Arduino will be beneficial here as the model ESP8266 is a WI-FI module which acts as a microcontroller, it is cost effective and the size of the final module will be relatively smaller to the size of the module using Arduino

## II. PROPOSED METHODOLOGY

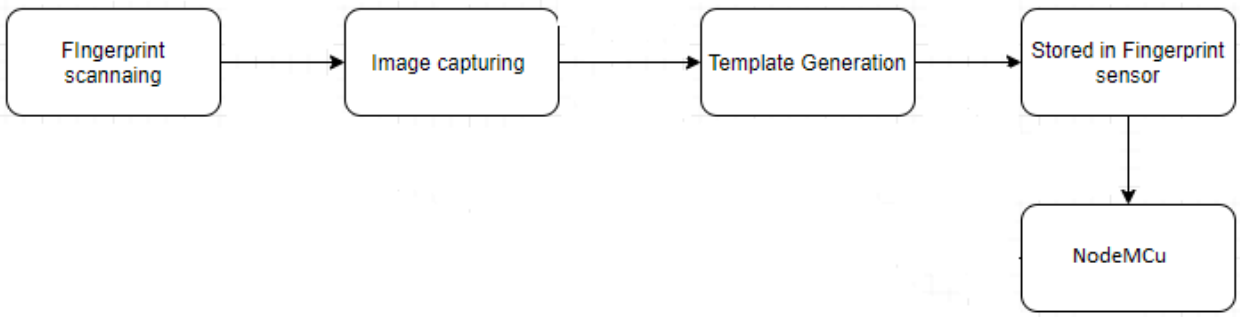


**Figure 1: System Architecture (Enrollment)**

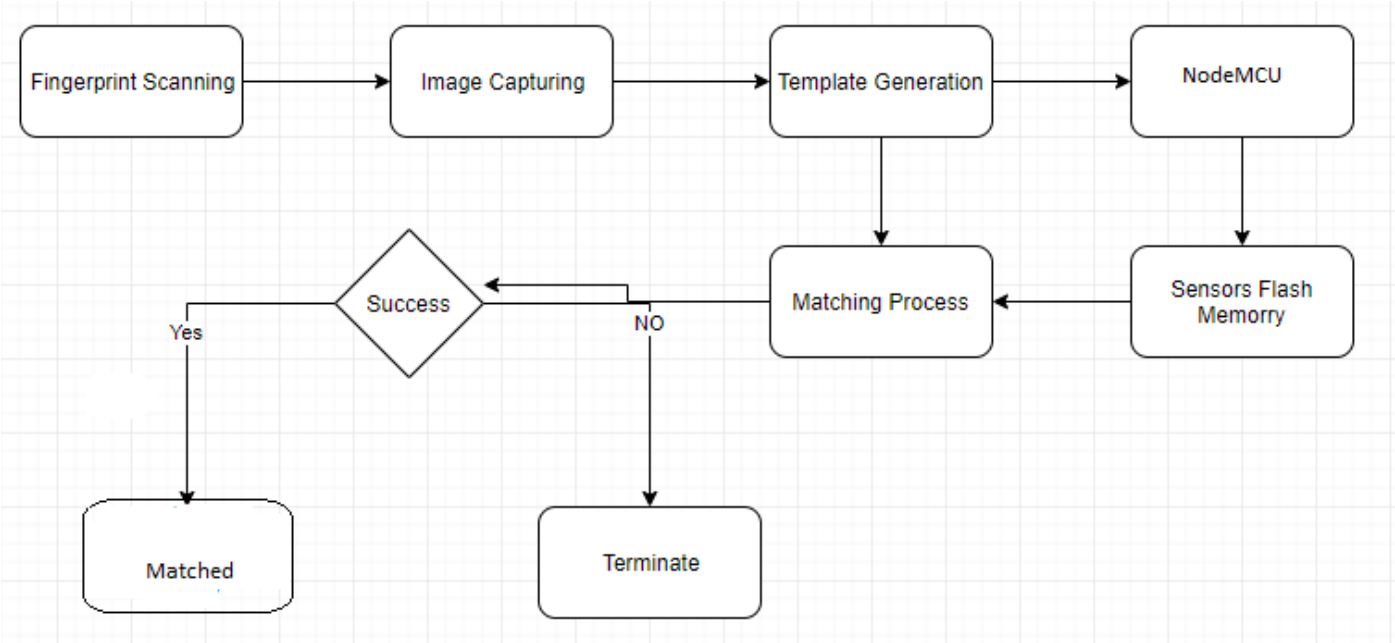


**Figure 2: System Architecture (Verification)**

A fingerprint sensor mounted on NodeMCU microcontroller will be used in this system to enroll or recognize the fingerprint impression provided. Depending upon the option selected either enrollment, verification, or deletion of the fingerprint templates will be done.

This system has three steps:

Step 1: Create Connections.

The first step in the system will be creation of connections between the NodeMCU and the fingerprint sensor. The connection and working of the fingerprint sensor will be done as per the following steps:

a) Connect VCC and GND of the sensor to the VCC and GND of the microcontroller and then connect the TX and RX pins of the sensor to the 2nd and 3rd pin of the microcontroller.
b) After all the connections are made, provide the microcontroller with power supply

Step 2: Selection of operation.

a) In this step the user has to select the operation that he/she wants to perform. If selected enrollment, then the fingerprint impression will be stored in the local database.
b) If selected verification, then the verification of the current fingerprint impression will be done by matching it to those stored in the local database.
c) If selected delete operation then the selected id's fingerprint templated will be erased form the local database.

Step 3: Conversion of Fingerprint image to template.

After capturing the image, the image has to be converted into a template for storing. This conversion of images to templates is done using a conversion algorithm. The Minutiae based extraction is one such algorithm, in this the minutiae points are used. The minutiae points are calculated based on the formation of ridges and valleys on the fingerprint image. Using this method, the image will be extracted into a template which will then be stored in the local database or will be used to match with the pre-stored templates for identification purposes.
Different SDK API's can be used having the extraction algorithms inbuilt.

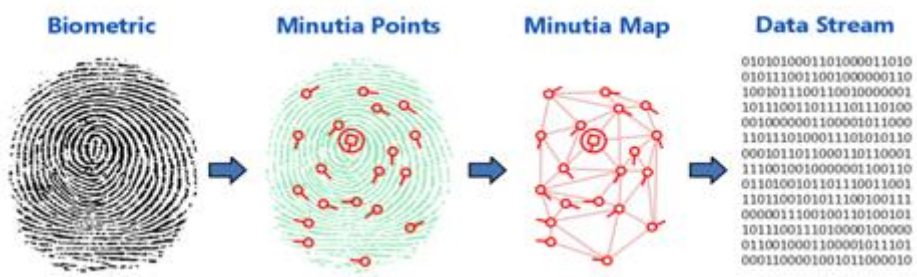


**Figure 3: Conversion of fingerprint image into template based on minutiae points**

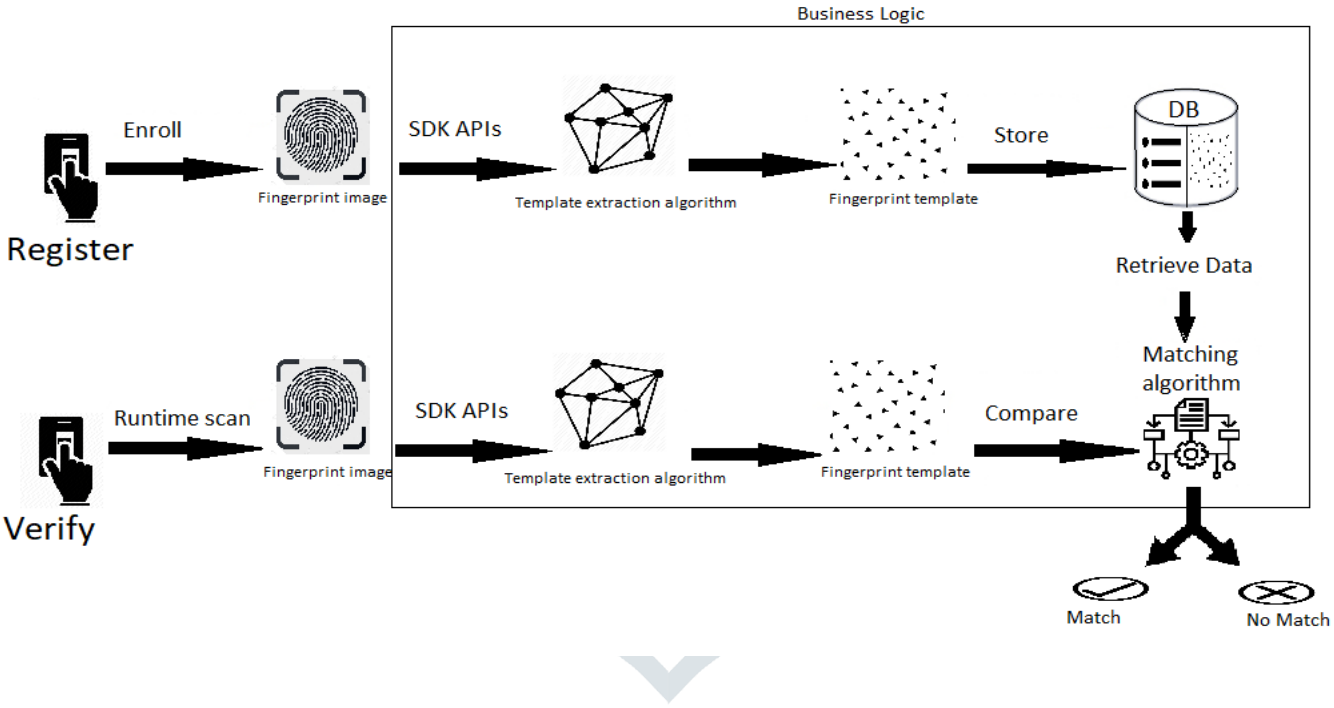


**Figure 4: Template Extraction Process Flow**

Step 4: Enrollment /Matching

This is the last step of the system. In this step, the application of the Step 2 will take place. Dependent upon the operation selected the fingerprint will either be stored in template format or will be matched with other stored templates for identification.

## III. RESULTS

COM3

```
Registering id =1
registering getting started for id :1
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
Image taken
Image converted
Remove finger
ID 1
Place same finger again
.....Image taken
Image converted
model for id :1
Prints matched!
id :1
Stored!

 **************************MENU****************
 1.Register
 2.mark your attendance
 3.Delete
```

**Figure 5: Register Fingerprint**

COM3

```
id found :1 Confidence :156
1

-1
-1
-1
-1
-1
-1
-1
-1
-1
```

**Figure 6: Verify Fingerprint**

```
 **************************MENU********************
 1.Register
 2.mark your attendance
 3.Delete

Enter id to be deleted ...
Deleted! ID2
```

**Figure 7: Delete Fingerprint**

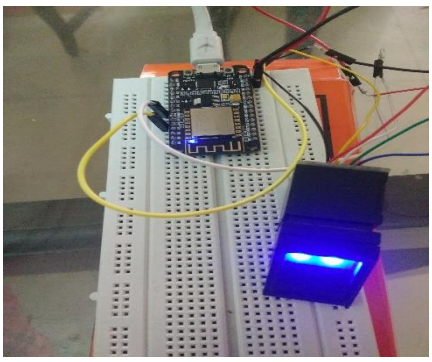

**Figure 8: Actual connections.**

Thus, this module has been successfully implemented using a fingerprint sensor mounted on a NodeMCU. This is quite accurate module and does not accept fake entries at all. For further modification and improvement in this module, we can consider of adding more than 2 images per user thus making the module more accurate and more user friendly.

## IV. CONCLUSION

Fingerprint recognition is the one most powerful biometric identification system. This can be used to identify and map individuals accurately and efficiently. Using fingerprints, we can develop attendance systems to digitize the respective records. When we use efficient and cheap microcontrollers like NodeMCU and fingerprint sensor, this system can be deployed in areas where fake entries are prohibited. By implementing modern techniques like ANN's and CNN's the system can be enhanced by making it more robust and increasing the fault tolerance.

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