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Design of Portable Fingerprint System Prototype for Student Presence Integrated with Academic Information System at the Universitas Sumatera Utara

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Abstract. University Sumatra Utara (USU) has an Academic Information System to record all academic transactions from students digitally including student attendance data. Attendance recording is still entered manually into the system from the presence system that uses paper media. In this research a prototype attendance system is carried out that can be directly entered into the system without using paper media. Attendance system is built by using Arduino to read and collect attendance data from the fingerprint sensor. Furthermore, an application is developed to synchronize the data from Arduino to the Academic Information System of USU. From the test result, it is obtained that the accuracy and the sensitivity of the sensor is 90%.

Keyword: Arduino, Fingerprint, Integrated System, Presence System, RTC

Abstrak. *Universitas Sumatera Utara (USU) telah memiliki Sistem Informasi Akademik untuk mencatat seluruh transaksi akademik dari mahasiswa secara digital diantaranya data kehadiran mahasiswa. Pencatatan kehadiran masih di masukkan secara manual kedalam sistem dari sistem kehadiran yang menggunakan media kertas. Pada penelitian ini dilakukan perangan prototip sistem kehadiran yang bisa langsung dimasukkan kedalam sistem tanpa menggunakan media kertas. Sistem dibangun dengan menggunakan Arduino untuk membaca data dari sensor sidik jari dan mengumpulkan data presensi. Selanjutnya dirancang aplikasi di komputer untuk melakukan sinkonisasi data dari perangkat Arduino ke Sistem Informasi Akademik USU. Dari hasil pengujian diperoleh akurasi dan sensitifitas sensor sebesar 99 %.*

Kata Kunci: *Arduino, RTC, Sidik Jari, Sistem Terintegrasi, Sistem Kehadiran*

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1 Introduction

Universitas Sumatera Utara (USU) has an Academic Information System to digitally record all academic transactions from students. One that is recorded in the system is data on student attendance at each lecture meeting. Attendance is recorded into the system based on data obtained

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from attendance recording through paper media. Recording attendance using paper media can cause recording errors because the data must be entered manually again into the system. Furthermore, USU wants to record attendance directly to the Academic Information System without using paper media to reduce existing errors.

There are various means that can be carried out to record the student attendance data, starting from the conventional way of signing a paper manually, or the modern method of utilizing the fingerprint sensor. Previously, there had been plentiful of systems that utilize fingerprint sensor to record the attendance [1]-[3], however the shortcoming was the device is static or cannot be moved for the needs of the student attendance who move between classes. Therefore, in this study the author is designing a portable fingerprint attendance system that is integrated with the academic information system of USU.

2 Methods

2.1 System Design

In general, this system is designed to carry out the attendance in the time of attending a certain course. The obtained data will then be sent to the academic information system database of USU. Therefore, with this system the attendance process is no longer carried out conventionally and reduces the error rate due to human error. In general, the system diagram can be seen in Figure 1.

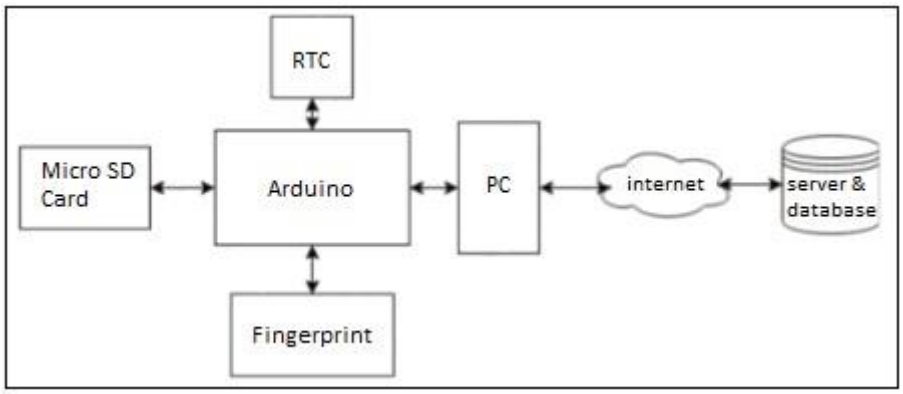

Figure 1 System Block Diagram

For the first time, the registration stage is carried out by the administrator, which is the data of each of the student's fingerprint is being scanned first to be stored in the portable attendance device as a comparison later. The data of the students' fingerprints is drawn by using the fingerprint sensor connected to Arduino.

The attendance process can only be done at the time of the course is in progress. The course choices are on the attendance device which will automatically be displayed when the device is active and the button is pressed. As for the time reference, a real time clock (RTC) module is used. RTC is a module/kit which function is to run the time and calendar in real time based on

DS1307 by using battery as the backup supply [4]. Furthermore, the data result of the attendance will be stored in a micro SD card.

The data in the attendance device then can be stored by the administrator in the local database using the desktop application that will be designed by utilizing the Software Developer Visual Studio, which is a complete software (suite) that can be used to develop application, be it business application, personal application, or the component of the application, in the form of console application, Windows application, or Web application [5]. Through this application, the administrator can download the attendance data to the academic information system server.

2.2 Hardware Design

For the hardware, a fingerprint sensor module is used as the fingerprint scanner and to process the data into template data which is then stored in a memory contained in the sensor. As for the course selection, a select button on the attendance device is used.

For the processor, an Arduino Uno module is utilized to process the data received from the fingerprint sensor and the RTC. Arduino is an open-sourced single-board micro controller, derived from the Wiring platform, designed to facilitate electronic use in various fields. The hardware has an Atmel AVR processor and the software has its own programming language [6]-[8]. The result will be stored in a micro SD car and displayed on a liquid crystal display (LCD) 2 x 16. The schematic diagram of the circuit can be seen in Figure 2 and the prototype of the hardware can be seen in Figure 3.

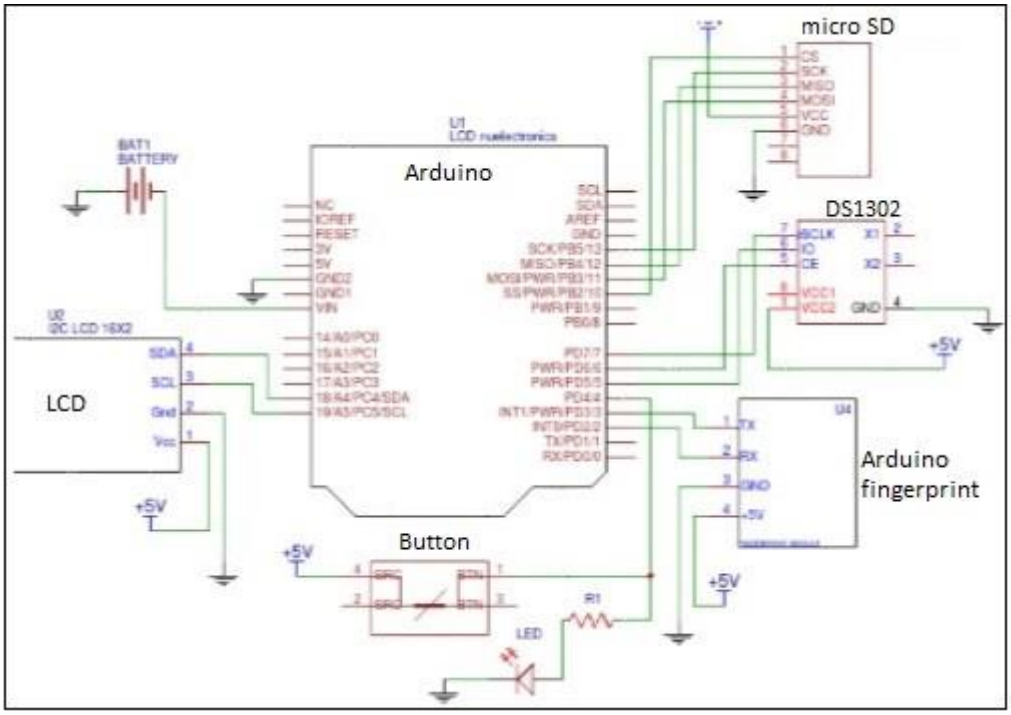

Figure 2 The Schematic Circuit

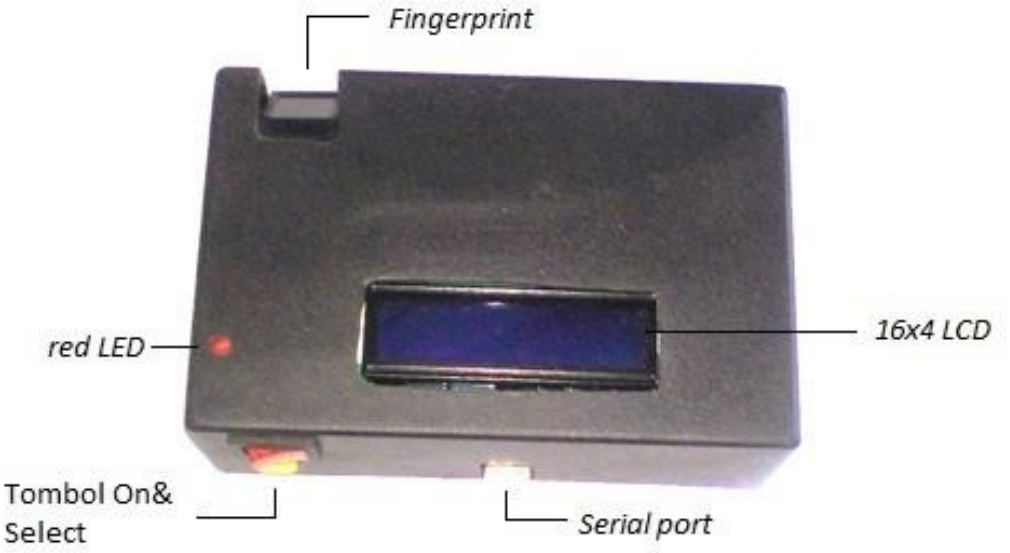

Figure 3 The Attendance Device (Hardware)

2.3 Software Design

The interface application is used as the user communication intermediary with the system. The designed application is also used to communicate with the attendance device and information system of USU. By utilizing this application, the user can perform several instructions as can be seen in the use case diagram in Figure 4. The data download instruction is a command to copy the attendance data in the attendance device (hardware). Next, the save instruction is to give command to the application to save the attendance data to the local database in the form of .xml file. As for the upload instruction, is a command to send the attendance data that has been copied to the information system server of USU.

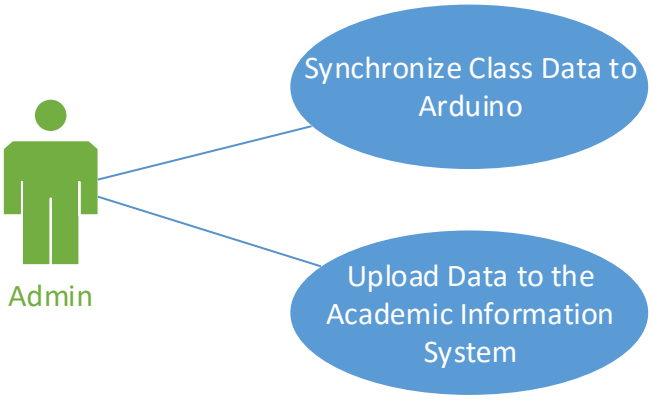

Figure 4 Figure 1 Use Case Diagram

3 Result and Discussion

3.1 The Result of Attendance Device Test

From the result of testing the attendance device (hardware) obtained the data as shown in Table 1. The retrieve of the data is done with the interval of 5 seconds from the previous data retrieval. From a hundred tests, it is obtained each test shows a correct and accurate reading data.

Table 1 Table of Testing Result of The Accuracy of The Attendance Device (Hardware)

No	Name	Finger ID	ID is Obtained on the Testing-									
			I	II	III	IV	V	VI	VII	VIII	IX	X
1	Reni E	0	-	0	0	0	0	0	0	0	0	0
2	Ermija	1	1	1	1	1	1	1	1	1	1	1
3	Siti May	2	2	2	2	2	2	2	2	2	2	2
4	Deby E	3	3	3	3	3	3	3	3	3	3	3
5	Yan Herni	4	4	4	4	4	4	4	4	4	4	4
6	Erlina	5	5	5	5	5	5	5	5	5	5	5
7	Desy H	6	6	6	6	6	6	6	6	6	6	6
8	Liza R	7	7	7	7	7	7	7	7	7	7	7
9	Firda N	8	8	8	8	8	8	8	8	8	8	8
10	Roita A	9	9	9	9	9	9	9	9	9	9	9
11	Hanafi	-	-	-	-	-	-	-	-	-	-	-
12	Esra	-	-	-	-	-	-	-	-	-	-	-

3.2 The Attendance Data Transfer Result with Desktop Application

After testing the transfer of the data from the attendance device with the application, then the result obtained as displayed in Figure 5. The data transferred is successfully received by the application and the data is also can be compared with the right database. As seen in the figure below, there were 5 students enrolled in the PFD_6_3 class.

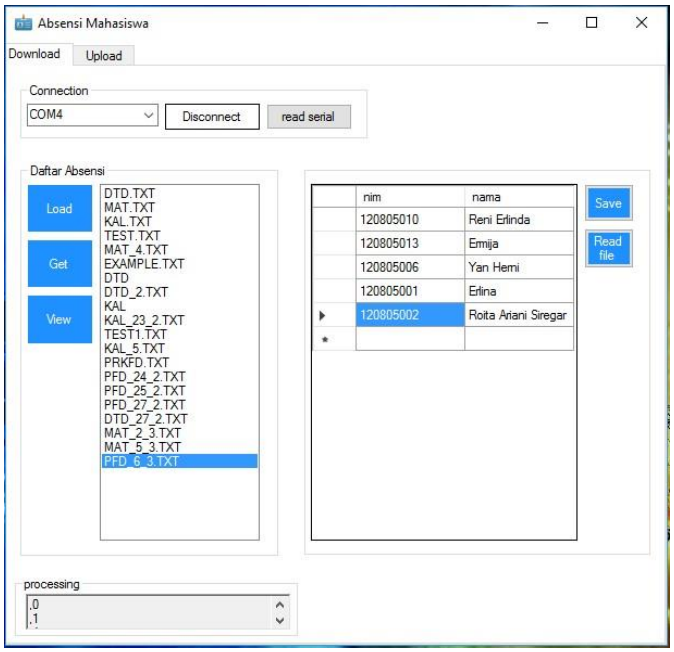

Figure 5 The Display of the Interface Application

3.3 The Result of the Attendance Data Transfer to the Server

The test is performed by uploading the student attendance data stored in the desktop application to the academic information system server of USU. The data to be sent is the data of each student of study plan card code, course code, attendance data, number of meeting and date sent as a package. If the package is successfully transferred, the data will be stored in the information system database of USU. Figure 6 shows the result of the data sent to the server.

id	nim	nama	krsdtid	klsid	absDetil	absJumlahHadir	absJumlahPertemuan	absDate
0	120805010	Reni Erlinda	8110030734	8110000893	|1|1|1	3	3	|6-3-2017|6-3-2017|27-2-2017
1	120805013	Ermija	8110030744	8110000893	|1|1|1	3	3	|6-3-2017|6-3-2017|27-2-2017
4	120805006	Yan Herni	8110030784	8110000893	|1|1|0	2	3	|6-3-2017|6-3-2017|27-2-2017
5	120805001	Erlina	8110030794	8110000893	|1|1|0	2	3	|6-3-2017|6-3-2017|27-2-2017
9	120805002	Roita Ariani Siregar	8110030834	8110000893	|1|1|0	2	3	|6-3-2017|6-3-2017|27-2-2017

Figure 6 The Result of Data Transfer to the Server

3.4 The Analysis of Test Result

From the test result, is obtained the level of sensitivity, specificity, and accuracy of the attendance device by comparing the test data with the actual data which is shown in Table 2 or the probability table.

Table 2 Test Result vs Actual Condition

		Hasil Pengujian		Total
		Positif	Negatif	
Kondisi Sebenarnya	Positif	TP 99	FN 1	100
	Negatif	FP 0	TN 20	20
Total		99	21	**120**

1. Sensitivity/True Positive Rate (TPR) of the Attendance Device

$$TPR = \frac{TP}{P} = \frac{TP}{TP+FN} \quad (1)$$

$$= \frac{99}{99+1} = 0.99 = 99\%$$

2. Specificity/True Negative Rate (TNR) of the Attendance Device

$$TNR = \frac{TN}{N} = \frac{TN}{FP+TN} \quad (2)$$

$$= \frac{20}{20} = 1 = 100\%$$

3. Accuracy (ACC)

$$ACC = \frac{TP+TN}{P+N} \quad (3)$$

$$= \frac{99+20}{120} = \frac{119}{120} = 0.9916 = 99\%$$

4 Conclusion

From the analysis result can be obtained conclusions as follows:

1. The specificity of the attendance is 100%.
2. The sensitivity of the attendance is 99%.
3. The accuracy of the attendance device is 99% and therefore, the attendance device works well.
4. The integration with the Academic Information System of USU is successful and the attendance data being sent can be received and store in the server database.

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