Article

Development of a Parking System Using the High Sensitive R503 Fingerprint Sensor for Sequential Search Algorithm Based Customer Detection

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Abstract:
Today's technological developments are very demanding. This can be seen in various innovations during this period, from simple innovations to trends worldwide. Parking is the state in which the driver parks his car in the parking lot. Parking systems that utilize RFID (Radio Frequency Identification) systems use RFID cards, a drawback of systems where everyone has an RFID. Still, there are several ways to facilitate customer parking and provide security. It has become a technology applied to parking systems. A card can issue another card to the owner's vehicle using the same RFID card. A solution to the lack of RFID-based parking systems is to use his R503 fingerprint sensor, which is highly sensitive. It applies a sequential search algorithm to recognize the customer in the fingerprint enrollment application and uses his R503 in fingerprint authentication, which provides much better security than RFID cards. The data verification speed sensor takes an average of 0.78 seconds to open the parking portal.

Keywords: Parking Portal, R503 Fingerprint Sensor, Sequential Search Algorithm, RFID cards, Smart Parking System

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1. INTRODUCTION

Current technology development is very tough. This can be seen in various innovations during this period, from simple innovations to trends worldwide. Many things are automated now, including parking lots, which makes human work more accessible. Parking lots in Indonesia, in particular, still use a manual parking system where the driver enters the parking lot with a ticket, which is a drawback. Apart from that, the security of manual parking systems is still highly questionable, as many drivers can get out of other vehicles with their tickets. I worry about using fingerprint sensors to solve the lack of RFID-based parking systems. It provides much better security than using RFID cards by applying a sequential search algorithm to recognize the customer's fingerprint ID. This research solution description uses a susceptible R503 fingerprint sensor, enrolls via an Android application, and uses Firebase as database storage. Using a fingerprint, the driver can open the parking portal without using her RFID card again. A sequential search algorithm can be used

to recognize a customer's fingerprint ID until the customer data is found in the database.

2. THEORY

A. Sequential Search Algorithm

It is the basic process of data processing. The search process consists of finding a specific (data) value within a data set of the same type (both primary and form types). Pseudocode for the sequential search algorithm is:

```
Declaration:
array type:array[1..100] of integer Procedure
read_array(output L : larik, input N : integer)Function
sequential_search1(input L : array, input N,X: integer)
-> integer N,X, idx: integer {N: amount of data, X: the number
to look for, idx: location index where it was found data}A:
array
Description:
Read(N)
Read_array (A,N)
Read(X)
ldx<- sequential_search(A,N,X)
If idx <= N then
Write ("data found in index",idx)
Else
Write ("data not found")
End if
```

A search algorithm is generally described as an algorithm that takes input from a problem and produces a solution to that problem. It is usually obtained by evaluating several possible explanations. A search algorithm is an algorithm that takes a critical argument and uses a particular technique to find a record with that key. You will be presented with one of two choices when a search is performed. Whether the searched data was found (success) or not (failure).

Smart parking generally means smart parking, and intelligent parking means a system designed to facilitate the parking process. As mentioned in smart parking, smarts can do things correctly, methodically, and neatly according to the rules and ethics in force, and as a result of learning, they can absorb information accurately and quickly. Yes, the current parking system is developing very rapidly, and the parking system in major cities in Indonesia is very efficient. Today's parking technology uses more advanced technology that allows semi-manual techniques to be fully automated.

A microcontroller is a computer without a human interface like a monitor, keyboard, or mouse. The essential parts of a microcontroller chip are the processor, memory (ROM and RAM), input/output units, and auxiliary units (internal and external), such as analog-to-digital converters (ADCs) and digital-to-analog converters. The ESP32 (M.Tiga, 2021) is a microcontroller introduced by Espressif System, the successor to the ESP8266 microcontroller (P.D.P.Adi, 2022). This microcontroller already has a WiFi module installed on the chip, which is very helpful for creating IoT application systems. Figure 2.5 shows the ESP32 pinout. This pin can be used as an input or output to turn on an LCD, turn on a light, or drive a DC motor. (Imran, 2020)

A fingerprint is a ridge-and-groove-like pattern on the edge of each finger. Fingerprints have been used for centuries to identify individuals and have a very high matching accuracy. (Dawley, 2019) A micro-servo is a motor with a closed feedback system that sends the motor's position to the servo control circuit (Prasetyo, 2017). This servo later drives the opening and closing of the parking portal. The Arduino IDE (Integrated Development Environment) is the software used to program the Arduino and upload it to the Arduino board. The Arduino IDE is also a text editor, allowing users to edit, create, and review program code. Source code files have the extension .ino. (Destiarini, 2019).

3. METHOD

A. System Design

The system architecture in Figure 1 describes the parking system we are designing. This parking system uses several technologies, including the ESP32 microcontroller and R503 fingerprint sensor. This parking system is online-based, sending real-time data to a database. This parking system is required by public and security personnel as park gate guards. The parking system uses the case-mounted R503 fingerprint sensor to provide additional protection when entering and exiting residential areas. At a public event hosted by a housing cooperative, the security service gives a guest card to anyone who has not registered their fingerprints so that the housing association can recognize it. Apart from that, the parking system also uses an Android application for fingerprint enrollment and shows the history of people who have entered the parking portal by indicating the hours and days they opened the parking portal.

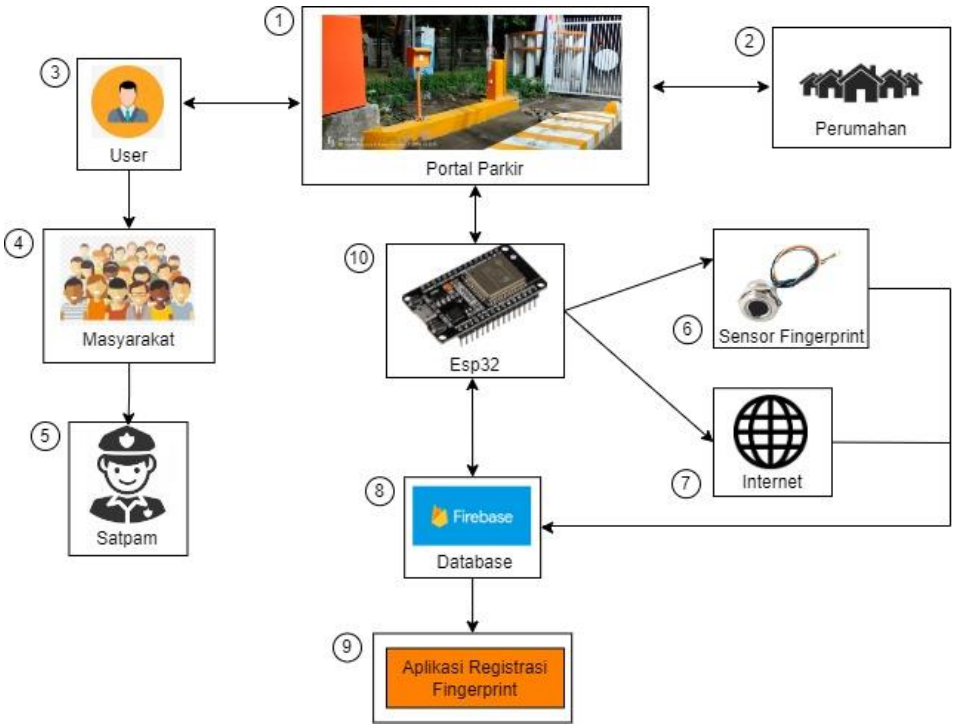

Figure 1. System Design

Furthermore, The steps for fingerprint registration in the application are as follows:

1. First, enter your name, email, NIM, and fingerprint id
2. If the fingerprint id is successfully obtained, it will continue on the next slide.
3. The following fall scans fingerprints on the susceptible fingerprint sensor R503
4. After that, press finish save the customer's fingerprint data
5. done

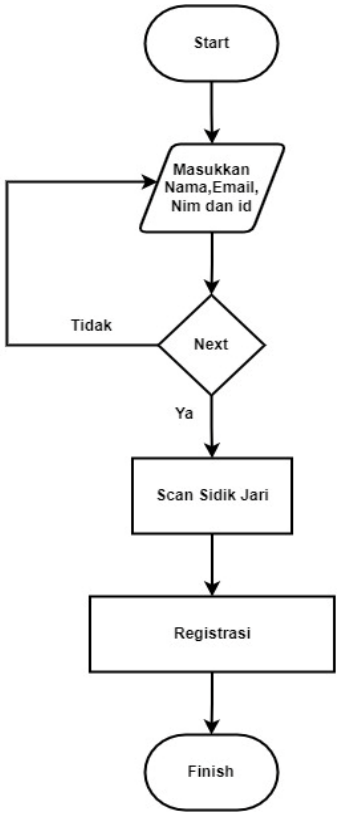

Figure 2. Fingerprint registration system flowchart

The steps for how the portal parking system works are as follows:

1. First, scan the fingerprint registered on the highly sensitive fingerprint sensor R503.
2. Then the ESP32 microcontroller checks the fingerprint data on the Firebase database.
3. If fingerprint data is not found, the portal does not open and returns to the first condition.
4. If fingerprint data is found, the parking portal verifies the fingerprint data that has been input.
5. The data is successfully verified, and the parking portal opens.
6. Done.

Based on the created design of the parking system tool, algorithm tests are performed, customer and non-customer fingerprint ID recognition are tested, the sensor access speed is tested, and the parking portal is tested. This is done by

direct observation when testing and testing system devices. The trial scheme for the intelligent parking system

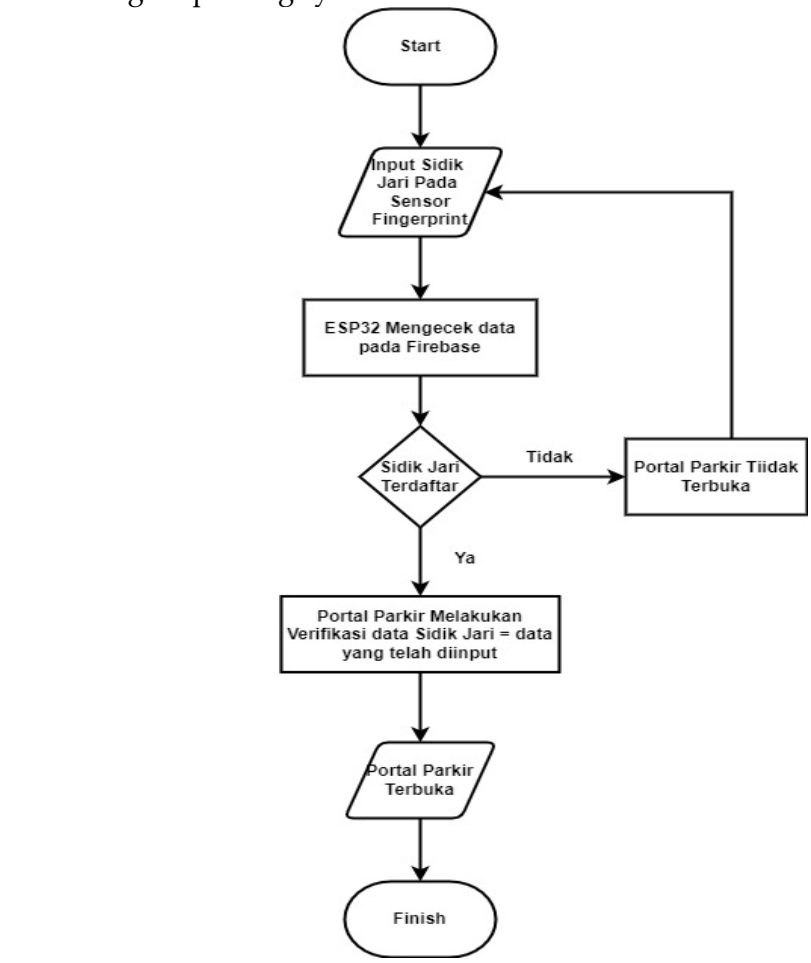

Figure 3. Parking System Work Flowchart

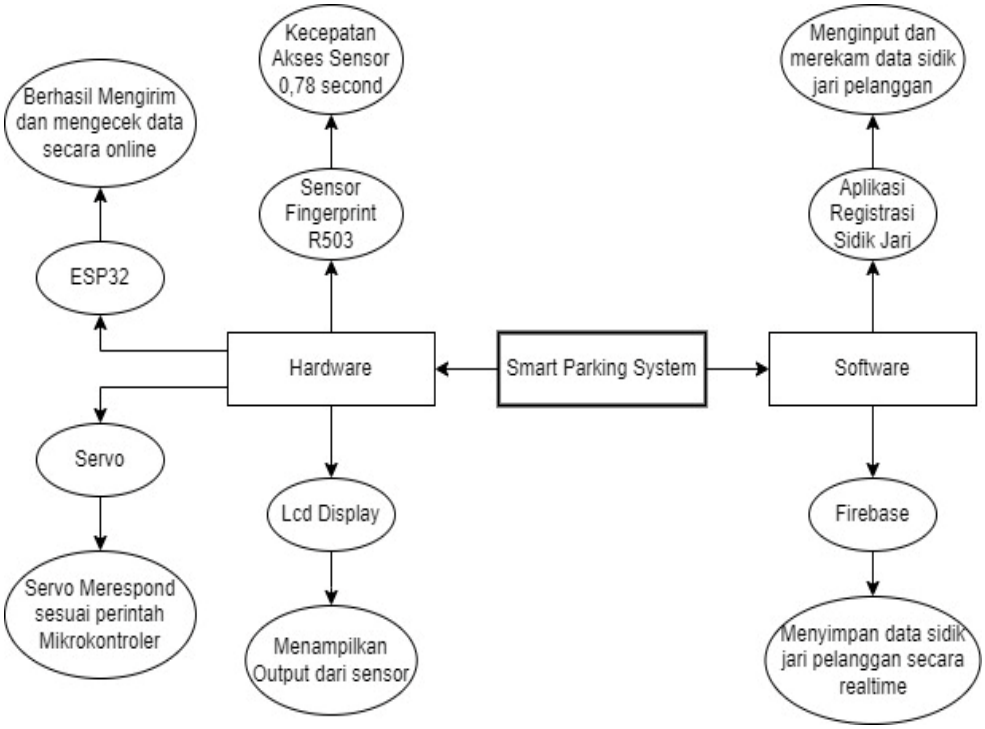

Figure 4. Scheme of testing the intelligent parking system

4. RESULT AND DISCUSSION

Based on the experimental scheme in Figure 4, we have successfully performed a holistic test from hardware to software. From the test results, the intelligent parking system produced can be directly used by customers.

Figure 5. Prototype Results

When testing a sequential search algorithm, test the algorithm against the algorithm. Without using the algorithm in the fingerprint enrollment application, the algorithm can show the fingerprint ID used, so the fingerprint id can not be displayed. The same ID exists when you enroll your fingerprints in the application. If your application doesn't use the algorithm, everyone can use the same ID, overriding the fingerprint ID. The overwritten fingerprint ID is read most predominantly.

Recognition of customer and non-customer fingerprint IDs by the highly sensitive R503 fingerprint sensor was tested 30 times in 30 trials with different users who could distinguish between customers and non-customers. All tests use fingerprint sensors to identify customers and non-customers. By comparing the verification speed of the two sensors in 10 trials, we tested the read speed for accessing the customer ID verification to open the portal with the fingerprint sensor and RFID sensor, 0.78 seconds for the fingerprint sensor and 0.20 seconds for RFID An average value for the sensor was obtained. Obtained ID access speed The speed of fingerprint sensors is slower than that of RFID sensors, which are even faster. Our testing of the parking portal with the fingerprint sensor is going as expected. By making ten attempts to open a parking portal that has enrolled or enrolled a customer's fingerprint, he can be considered successful, as there are no errors or issues with the sensor and microcontroller during the ten attempts. The resulting prototype is well underway.

Table 1. Sequential Search Algorithm testing

Testing	ID	Fingerprint registration	
		Using Algorithms	**Not Using Algorithms**
1	46	Succeed	Succeed
2	18	Succeed	Succeed
3	46	Not successful	Succeed
4	14	Succeed	Succeed
5	14	Not successful	Succeed
6	96	Succeed	Succeed
7	19	Succeed	Succeed
8	46	Not successful	Succeed
9	18	Not successful	Succeed
10	19	Not successful	Succeed

Table 2. Reading speed of parking portal access

Testing	Sensor Reading Speed			
	RFID		**Fingerprint**	
	Time according to the serial monitor	**difference**	**Time according to the serial monitor**	**difference**
1	36.674 – 32.131	0,45 s	19.551– 18.848	0,7 s
2	11.681 – 10.978	0,07 s	07.384 – 06.634	0,7 s
3	54.869 – 54.732	0,01 s	52.998 – 52.155	0,84 s
4	35.474 – 34.034	0,14 s	22.650 – 21.713	0,93 s
5	49.250 – 48.970	0,02 s	18.761 – 18.058	0,70 s
6	05.373 – 03.428	0,19 s	15.246 – 14.449	0,79 s
7	14.750 – 10.433	0,43 s	03.729 – 02.791	0,93 s
8	20.280 – 19.350	0,09 s	49.994 – 49.337	0,65 s
9	40.448 – 36.833	0,36 s	08.120 – 07.276	0,84 s
10	46.942 – 43.743	0,31 s	04.605 – 03.855	0.75 s
Average		0,20 s	Average	0,78 s

Table 3. Testing on the parking portal

Testing	User	Id	The fingerprint scan opens the parking portal	
			Portal state	History of the application
1	Muh Yusril Adiyaksa	46	open	Sel, 8 Nov 2022 16:29:07
2	A.Fandi Akbar	75	open	Sel, 8 Nov 2022 21:52:58
3	Iin Rahmawati	65	open	Sel, 8 Nov 2022 22:09:50
4	Haslina	70	open	Sel, 8 Nov 2022 22:04:33
5	Syahrul	103	open	Sel, 8 Nov 2022 16:33:19
6	Arya kusuma	73	open	Sel, 8 Nov 2022 22:02:43
7	Andi Dhetryansah	78	open	Sel, 8 Nov 2022 21:09:52
8	Nurul Fauziah	77	open	Sel, 8 Nov 2022 21:18:08
9	Hayisra	74	open	Sel, 8 Nov 2022 21:59:35
10	Welli Chandra KK	96	open	Sel, 8 Nov 2022 16:06:28

Based on first-hand test results, developing a parking system with a susceptible R503 fingerprint sensor for customer recognition based on a sequential search algorithm is progressing as expected.

5. CONCLUSIONS

Algorithm implementations are done for fingerprint recognition customers, and the algorithms are applied to customer fingerprint enrollment applications. The Customer Fingerprint Enrollment application is intended to enroll the customer's fingerprint in the form of her ID. An ID is selected during fingerprint enrollment, and an algorithm is applied to recognize existing customer fingerprint IDs, so if you choose an ID during fingerprint enrollment, no two IDs will be the same. After using the customer recognition sequential search algorithm for the fingerprint enrollment application, it works as expected by the researchers based on the results of the fingerprint ID recognition test, and the customer can open the portal with the R503 fingerprint sensor.

AUTHOR CONTRIBUTIONS

Conceptualization; Suhartono [S.S], Jumadi.M.Parenreng [J.M.P], Satria Gunawan Zain [S.G.Z], Iwan Suhardi [I.S], Fahri Syafriandi.K [F.S.K], Methodology; [S.S],[J.M.P],[S.G.Z],[I.S],[F.S.K], validation; [S.S],[J.M.P],[S.G.Z],[I.S],[F.S.K], formal analysis; [S.S],[J.M.P],[S.G.Z],[I.S],[F.S.K], investigation; [S.S],[J.M.P],[S.G.Z],[I.S],[F.S.K], data curation; [S.S],[J.M.P],[S.G.Z],[I.S],[F.S.K], writing—original draft preparation; [S.S],[J.M.P],[S.G.Z],[I.S],[F.S.K], writing—review and editing; [S.S],[J.M.P],[S.G.Z],[I.S],[F.S.K], visualization; [S.S],[J.M.P],[S.G.Z],[I.S],[F.S.K], supervision project administration; [S.S],[J.M.P],[S.G.Z],[I.S],[F.S.K], funding acquisition; [S.S],[J.M.P],[S.G.Z],[I.S],[F.S.K], have read and agreed to the published version of the manuscript.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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