Male and Female Papaya Seed Selector Using Fuzzy Logic

Annisa Alma Sofianti[1], Hadiwiyatno[2*], Abdul Rasyid[3]

[1]Digital Telecommunication Network Study Program, Department of Electrical Engineering, State Polytechnic of Malang, 65141, Indonesia.

[2,3]Telecommunication Engineering Study Program, Department of Electrical Engineering, State Polytechnic of Malang, 65141, Indonesia.

[1]annisaalma3003@gmail.com, [2]hadiwiyatno@polinema.ac.id, [3]abdul.rasyid@polinema.ac.id

***Abstract*— To meet the needs of consumers, especially fruit harvesters, they must be able to manage their harvests efficiently and with quality. Papaya is a fruit that can be harvested at any time and the price is relatively cheap with all the vitamins in it. In order for papaya to produce fruit, the seeds planted must be female seeds. Based on these problems, a tool is needed for selecting seeds from papaya fruit to make it easier for producers to get maximum results. Fuzzy logic algorithms can represent every state or represent human thinking. In fuzzy logic, element membership is in the interval 0 to 1. This fuzzy system has several features, namely this system is suiTable for use in system modeling because the variables are real values. In this study it is possible to design a system for selecting male and female papaya seeds using fuzzy logic. From this design, it can display male and female Papaya Seed Selector data using Fuzzy Logic which is displayed in the form of an application so that it can make it easier for users to choose the right seeds so they can maximize crop yields. Based on the results of making the tool, it can be concluded that the color sensor has succeeded in detecting the color of papaya seeds so that it can facilitate the selection process.**

***Keywords*— Color Sensor, Fuzzy Logic, Papaya, Seed, Selector**

I. INTRODUCTION

Papaya plants are dioceous plants, but there are also gynodioceous, there are three types of plants based on the type of flowering, namely plants with male flowers, plants with female flowers and plants with perfect flowers (hermaphrodites) [1]. Selection of SCAR Markers for Early Sex Identification of Papaya Plants. Research explains the selection of SCAR-based markers for sex detection in papaya plants. The results showed that the five SCAR primers tested could only differentiate female plants from male plants and hermaphrodites but could not differentiate male plants from hermaphrodites. The consistency of the amplification pattern resulted from the SCAR W11, Napf2, and T12 primers located at 800 bp. The SCAR primers W11, Napf2, and T12 can then be used as sex identification markers between female and male plants as well as hermaphrodites [2]. The research is entitled "Arduino Based Colored Ball Sorter Using the Fuzzy Method". This research explains ball sorting using the TCS3200 color sensor which is used to detect 10 colors. The sorting process is carried out using fuzzy logic. Standard value The value used to determine color is RGB which is captured by the sensor and read on the motor serial. The actuator to place the ball into the shelter is a servo motor. In this research, 10 color components were produced that could be detected by sensors, this was used as a basis for sorting balls. So that the results obtained are more accurate, the light intensity in the room where the test is carried out can be minimized, especially sunlight [6].

The rapid development of technology, makes the need to receive information faster. Based on these problems, a tool is needed for seed selection from papaya to facilitate producers in time efficiency with tools that make work easier. Therefore, a study was conducted with the title "Male and Female Papaya Seed Selectors Using Fuzzy Logic". This research uses color recognition method to detect gender in papaya fruit using fuzzy logic as a method of decision making. The way this system works is that the papaya seeds that will be selected are input into a container which will be selected one by one using a color sensor which is run by a servo motor selector. After the selection results are obtained, the transfer servo motor will point to the male seed container if the selected seed is a male seed and the transfer servo motor will point to the female seed container if the selected seed is a female seed. This system is also equipped with NodeMCU which will process the data obtained from the TCS230 color sensor and then the data is stored in a database where the results will be displayed in an application. With this research is expected to help solve the existing problems.

II. METHOD

This section describes in detail the research carried out conducted.

A. System Block Diagram

In the block diagram of the system design, the color sensor will select the papaya fruit seeds, and there is an infrared sensor that is used to count how many seeds have been selected by counting the number of times the slide moves left and right, then the servo motor selector will move the selected seeds. is inputted into a container to the TCS230 color sensor, then the data or results that have been obtained will be processed on the

*Corresponding Author

NodeMCU and stored in the database. After the selection process, the NodeMCU drives the shifting servo motor to move the seeds according to the selection results. If the seed is male, it will go into the male seed container, while if the selection results show female seeds, it will go into the female seed container. The display of the number of seed selection will be displayed in an application that is connected to the database.

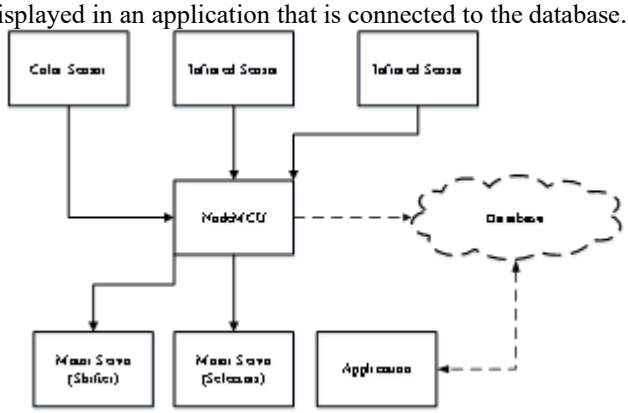


Figure 1. Block Diagram

B. System Design

1. The user enters the application page "Male and Female Papaya Seed Selectors Using Fuzzy Logic"
2. Enter Username and Password and click login
3. If the Username and Password are not registered, a notification will appear that your Username or Password is wrong
4. Register, enter the Name, Username and Password that has never been registered and click register
5. Go to the login page, enter the registered username and password and click login
6. After clicking login, a success notification will appear
7. The user will be redirected to the selector home page
8. The connection will be connected if the application or tool module is connected to the internet access network, if one is not connected then check the connection on the micro module
9. If everything is correct, the funds according to the application and the tools are ready to be used for selection
10. The user places the papaya seeds randomly in the storage container
11. The system starts running, the first servo (selector) will move the papaya seeds one by one on the color sensor, if the seeds are male then the 2nd servo (shifting servo) moves 111° so that it sends the seeds into the male container
12. If the seed is female then the 2nd servo (shifting servo) moves 160° thus sending the seed into the female container
13. The ir sensor calculates the number of seeds that have been selected, if servo 2 (shifting servo) moves to the right then the application display on the female papaya seed column will be worth 1, if the servo moves to the left then the male papaya seed column display will be worth 1, so on.
14. Press reset if it will start the papaya seed selector again

C. Hardware Planning

The following is a design tool to test the classification of male and female papaya seeds. With a diameter of 30cm high, 20cm wide and 25cm long, as shown in Fig. 2.

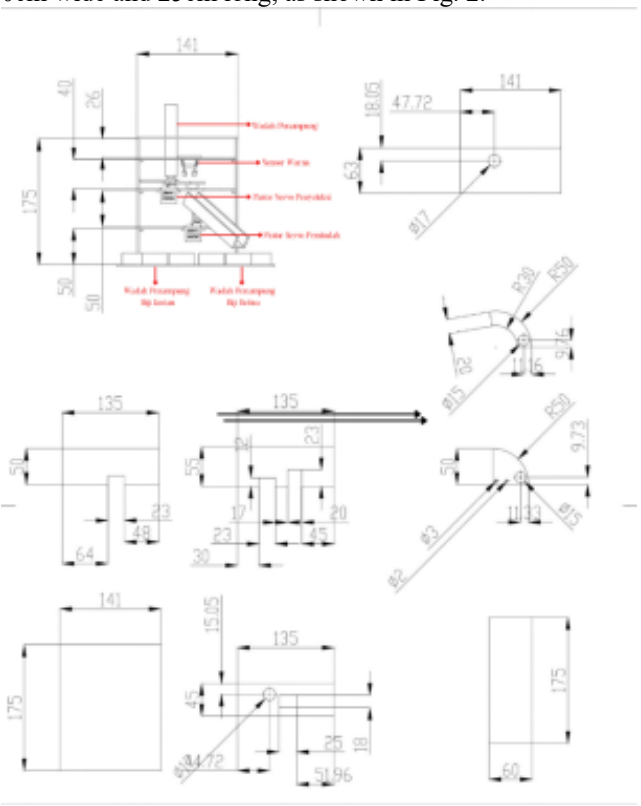


Figure 2. Hardware Design

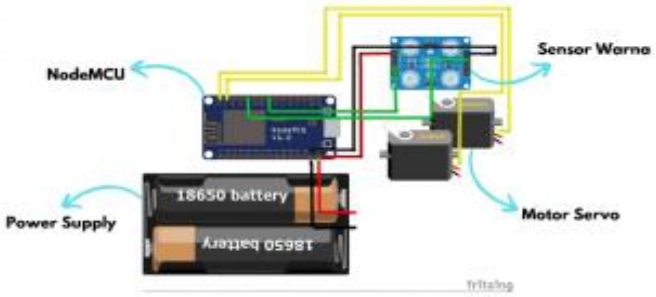


Figure 3. Wiring Hardware

Figure 3 shows components to support the formation of a male and female papaya seed selection tool. There is a Color Sensor to detect the color of the papaya seeds as a determinant of whether the seeds are male/female. Power supply as a voltage source used to activate the system. There are two servo motors used to control the selection of papaya seeds and the transfer process after being selected so that they enter the male/female seed container. While the NodeMCU functions as a microcontroller connected to Wi-Fi.

Figure 4. Infrared Sensor Schematic

Figure 4 shows schematic series of infrared sensors to detect papaya seeds that have been classified by detecting movement from an inclined plane that is run by servo 2 (servo drive). The infrared sensor is connected to the NodeMCU board which gets voltage from the power supply.

D. Software Planning

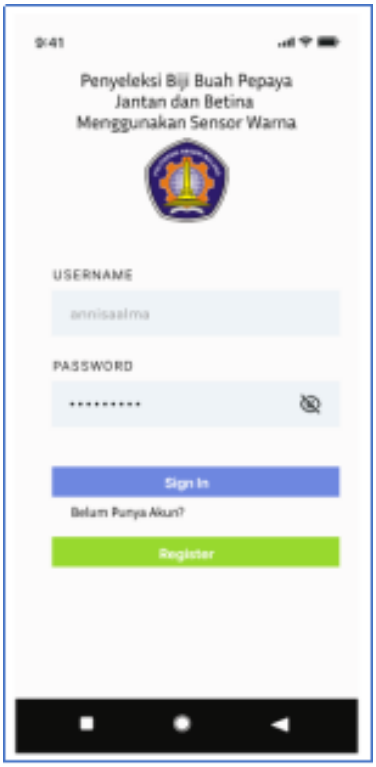


Figure 5. App Planning

Figure 5 shows an application design made for "Male and Female Papaya Seed Selectors Using Fuzzy Logic". Figure 5 is the login page. This application will be equipped with a register page to create a username and password that has not been registered.

E. Fuzzy Implementation

In system design, fuzzy variables will be created where this fuzzy is useful for decision making. This fuzzy control method has 3 inputs namely Red, Green, Blue and produces 2 outputs, namely male and female, as shown in Table 1.

TABLE I
FUZZY INPUT MEMBERSHIP FUNCTION

Input Function	Variabel	Universe of Conversations
Red	Low	0-70
	Currently	50-200
	High	70-255
Green	Low	0-70
	Currently	50-200
	High	70-255
Blue	Low	0-70
	Currently	50-200
	High	79-255

III. RESULTS AND DISCUSSION

A. Hardware Circuit Results

The design of the tool is then implemented in the form of a series of devices connected to the NodeMCU microcontroller. The results of the implementation will be shown in the Fig 6 and 7.

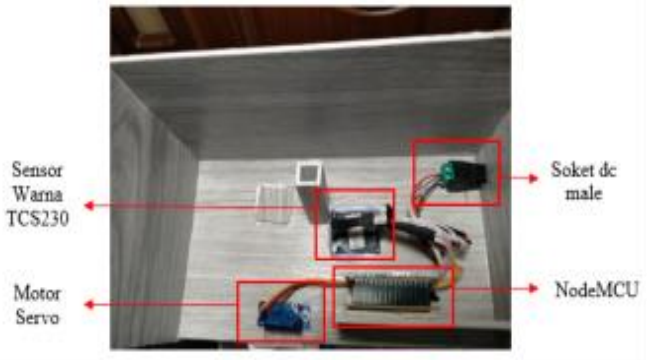


Figure 6. Hardware Results Top View

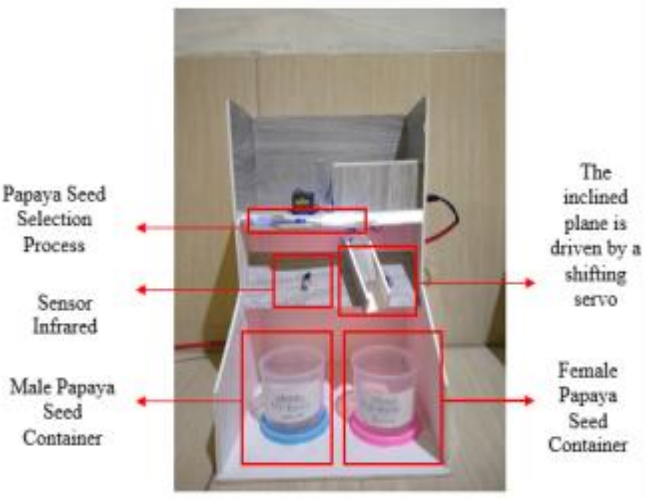


Figure 7. Hardware Results Front View

There are 2 levels in this tool, namely up and down. On the top level there is a servo selector which functions to regulate the transfer of the grain process from the holding container. The TCS230 color sensor functions as a sorter, the TCS230 sensor

can capture all colors through the reflection of the LED light and is captured by the color sensor through frequency waves. Microcontroller Board that will perform the sorting process. Socket jack for power which functions as a distributor of the 5V dc adapter voltage which is channeled to the microcontroller board. At level 2 there is a shifting servo that functions to continue from the movement that has been carried out by the color sensor classification process. The infrared sensor functions to calculate the number of seeds that have been selected, if servo 2 (shifting servo) moves to the right then the application display on the female papaya seed column will be worth 1, if the servo moves to the left then the display of the male papaya seed column will be worth 1, so on. There are 2 containers, namely the male papaya seed container and the female papaya seed container to accommodate the selected papaya seeds.

B. Software Result

From the results of the software in the form of an application there is a page for registration. on the registration page enter the Name, Username and Password. If the username is already registered then go to the login page to be able to access the dashboard page. On the dashboard page displays the number of papaya seeds that have been classified. If it produces male papaya seeds, the calculation column for male papaya seeds is increased by 1, the rule is also for female papaya seeds, as shown in Fig 8 and 9.

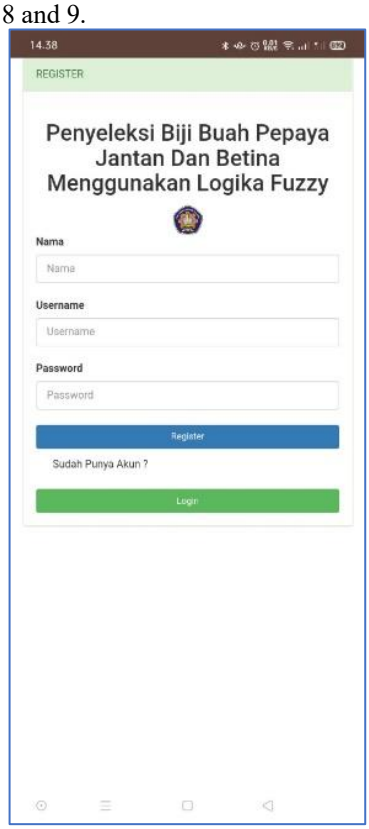


Figure 8. Register Page

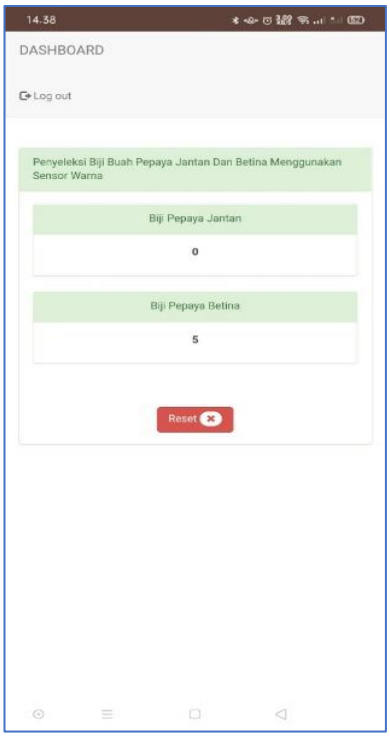


Figure 9. Dashboard Page

C. Testing the Success Rate of Data Delivery On System

QOS (Quality of service)

Parameters for testing the success rate of data transmission used are Qos (Quality Of Service), including Packet Loss and Delay. The test results in each QOS will be displayed in the Table.

Latency or delay is the time it takes for data to travel the distance between the source/sender and the destination or receiver. Delays can be affected by distance, physical media, and long processing times or congestion, as shown in Table II.

TABLE II
DELAY CALCULATION

No.	Source	Destination	Delay(s)
1.	192.168.1.76	139.162.44.72	0,198454
2.	192.168.1.76	139.162.44.72	0,191817
3.	192.168.1.76	139.162.44.72	0,194032
4.	192.168.1.76	139.162.44.72	0,197921
5.	192.168.1.76	139.162.44.72	0,196246
6.	192.168.1.76	139.162.44.72	0,188201
7.	192.168.1.76	139.162.44.72	0,186254
8.	192.168.1.76	139.162.44.72	0,183719
9.	192.168.1.76	139.162.44.72	0,174272
10.	192.168.1.76	139.162.44.72	0,192517
	Rata-rata		0.190343

Delay is the time it takes for a packet to reach its destination. Using wireshark software. The sample is taken 10 packets and will find the average of the delay, the packet is taken on wireshark which consists of several packets when doing livestreaming. From the calculation of the resulting packet - the average delay obtained is 0.190343 seconds or 190ms and is included in the good category according to ITU-T G.114. The smaller the delay, the better the quality of data transmission because there will be no information delay, as shown in Fig 10.

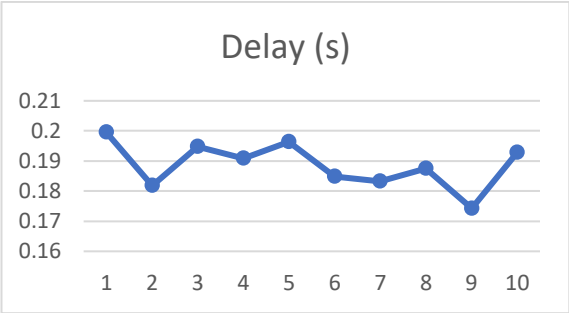


Figure 10. Delay Graphics

Packet Loss is a parameter to describe lost packets, this can be affected by congestion on the network. The Table II is a brief procedure for calculating packet loss.

TABLE III
PACKET LOSS CRITERIA

Packet Loss Category	Packet Loss (%)	Indeks
Very good	0	4
Good	3	3
Currently	15	2
Bad	25	1

The test results obtained that the number of packets that were successfully sent was 528748 and the packets that were not successfully received were 3110. To calculate the packet loss value, use the following formula 1.

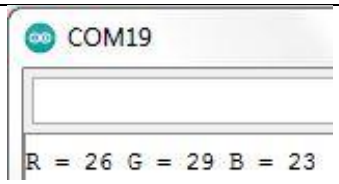
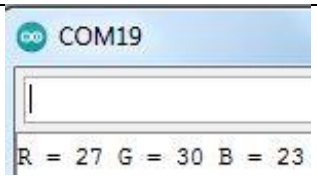
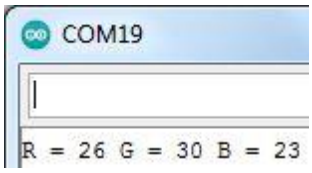
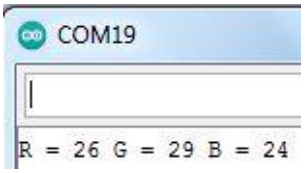
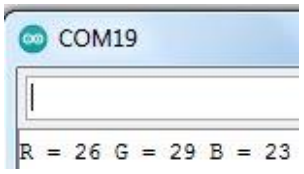
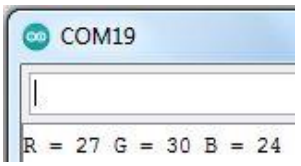
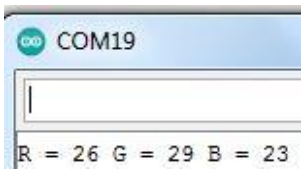
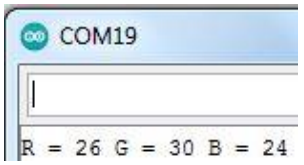
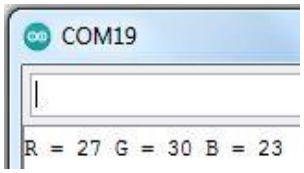
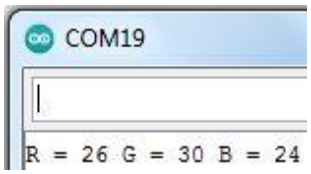
$$Packet\ loss = \frac{\text{data is sent} - \text{data received}}{data\ packet\ is\ sent}\ x\ 100\% \quad \text{.....(1)}$$

$$Packet\ Loss\ (\%) = \frac{9}{108} x 100\% = 2.208\ \%$$

In the calculation, the packet loss value is 2.208%. This value is included in the range of good category values according to ITU-T G.114.

Calibration Test on Color Sensor

TABLE IV
RGB NILAI VALUE CALIBRATION RESULTS

No.	Sample Experiment	Serial Monitor
1.		
2.		
3.		
4.	Male and Female Seeds	
5.		
6.		
7.		
8.		
9.		
10.		

The Table V is the result of color sensor calibration using 10 samples of papaya seeds.

Papaya Seed Selector Measurement Results

TABLE V
FUZZY MEASUREMENT RESULTS

Experiment	R	G	B	Results	Information
1	25	26	19	Male Papaya	Succeed
2	24	26	22	Male Papaya	Succeed
3	24	23	20	Male Papaya	Succeed
4	27	22	23	Male Papaya	Succeed
5	24	23	25	Male Papaya	Succeed
6	36	28	19	Female Papaya	Succeed
7	38	27	18	Female Papaya	Succeed
8	38	29	19	Female Papaya	Succeed
9	39	29	19	Female Papaya	Succeed
10	40	28	18	Female Papaya	Succeed

Based on the results of the fuzzy measurements, the results of the fuzzy logic of male fruit selectors with fuzzy conditions are obtained

R = has a range of values between 18 to 28
G = has a value range between 19 to 29
B = has a range of values between 15 to 25

IV. CONCLUSION

Based on testing and discussion, it can be concluded that based on the results of color sensor measurements, the frequency value obtained from the comparison of a standard reference between male and female papaya seeds using fuzzy logic is the range for male papaya seeds = 142-209, female papaya seeds = 5-17. Based on the results of testing 10 random samples of papaya seeds, it was concluded that 5 tests of female papaya seed samples had 100% correct results, and 5 tests of male papaya seed samples had 100% correct results. The best distance for measuring a color sensor to an object is 0.5cm–1cm. The average calculation for delay measurements from IP address 192.168.1.76 to IP destination 139.162.44.72 is 0.190343 (s). The packet loss calculation from the IP address to the IP destination is 2,208%, this value is in the good range value category. In future research, it is hoped that methods of increasing color brightness can be developed so that the results of increasing color brightness values can be known for better quality. Can also use different fuzzy methods to improve results closer to perfect value.

REFERENCES

[1] Noflindawati, A. Anwar , Yusniwati and A. Sutanto, "Karakter Morfologi dan Sitologi Bunga Pepaya Merah Delima," Jurnal Biologi Universitas Andalas (J. Bio. UA.), vol. 7(1), pp. 21-26, Maret 2019.

[2] Noflindawati, A. Anwar, A. Sutanto and Yusniwati, "Seleksi Marka SCAR untuk Identifikasi Dini Jenis Kelamin Tanaman Pepaya (The Selection of SCAR Markers for Early Sex Identification of Papaya)," J. Hort. , vol. Vol. 30 No. 1, pp. 1-8, Juni 2020 .

[3] M. I. Sari, R. Handayani, S. Siregar and B. Isnu, "Pemilah Benda Berdasarkan Warna Menggunakan Sensor Warna TCS3200," TELKA: Jurnal Telekomunikasi, Elektronika, Komputasi, dan Kontrol , Vols. Vol.4, No.2, p. 85~90, November 2018.

[4] T. W. Wisjhnuadji , A. Narendro and P. Wicaksono, "Sistem Sortir Barang Otomatis Berbasis Arduino dengan Sensor Warna dan Monitoring via Android," Journal homepage: http://journal.lppmunindra.ac.id/index.php/Faktor_Exacta, Vols. Vol. 13, No. 2, pp. 106-112, June 2020.

[5] A. Safaris and H. Effendi, "Rancang Bangun Alat Kendali Sortir Barang Berdasarkan Empat Kode Warna," JTEV (JURNAL TEKNIK ELEKTRO DAN VOKASIONAL), vol. Volume 06 Number 02, pp. 399-410, 2020.

[6] Z. Budiarso, R. A. Saputro, H. Listiyono and H. Februariyanti, "Penyortir Bola Berwarna Berbasis Arduino Menggunakan Metode Fuzzy," Jurnal Teknik Komputer AMIK BSI, Vols. Volume 8, No.1, pp. 1-6, Januari 2022.

[7] S. NURJANA, "EFEKTIFITAS FRAKSI ETIL ASETAT EKSTRAK DAUN PEPAYA (Carica Papaya L.) SEBAGAI ANTIMALARIA TERHADAP PLASMODIUM FALCIPARUM: NARRATIVE REVIEW," https://www.google.com/url?sa=t&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwj6pYiuobL5AhWMTmwGHfCHAHcQFnoECA8QAQ&url=http%3A%2F%2Feprintslib.ummgl.ac.id%2F2640%2F&usg=AOvVaw28SYCkvAsloob_ahqz6UkG, Magelang, 2020.

[8] D. M. Putri, "PENGEMBANGAN PROJECT MICROCONTROLLER DENGAN ARDUINO IDE," ilmuti.org, 2008-2017.

[9] P. H. Duha, "RANCANG BANGUN SISTEM PENGGERAK PANEL SURYA MENGGUNAKAN SENSOR LDR DAN MOTOR SERVO BERBASIS MIKROKONTROLER," https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiWjJWPo7L5AhU8DrcAHfgSBHsQFnoECAkQAQ&url=https%3A%2F%2Fjurnal.pancabudi.ac.id%2Findex.php%2Ffastek%2Farticle%2Fview%2F1867&usg=AOvVaw13UfGgOknsF-2oyjFuVMSI, Medan, 2019.

[10] S. H. Pratama, "RFID Sebagai Pengaman Pintu Laboratorium Jurusan Teknik Elektro Fakultas Teknik Universitas Negeri Semarang," https://www.google.com/url?sa=t&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwis8-DYo7L5AhV6BbcAHS_ZAgAQFnoECAoQAQ&url=http%3A%2F%2Flib.unnes.ac.id%2F21850%2F&usg=AOvVaw2CZvxBc-Uxy34gFEdYXuVL, Semarang, 2015.

[11] A. R. Hakim and R. Romiyadi, "STUDI LITERATUR : PEMANFAATAN SENSOR TCS 230 UNTUK MEMBEDAKAN WARNA SUATU OBYEK," JUST

TI: (Jurnal Sains Terapan Teknologi Informasi) , vol. Volume 12 Nomor 1, pp. 22-26, Januari, 2020.

[12] J. W. Situngkir, A. Setiadi, N. Yunita and S. Marlina, "Sistem Informasi Penerimaan Siswa Baru Berbasis Web Pada Sekolah Dasar Ichtus Jakarta," Jurnal Teknik Komputer AMIK BSI, Vols. Volume VI, No.2, pp. 200-206, Juli 2020.

[13] Caroline, R. Thayeb, Hermawati and W. D. Harsanto, "Pemanfaatan Logika Fuzzy sebagai Pengendali Steering pada Hardware In the Loop Mobil Listrik Otomatis," Jurnal ECOTIPE, Vols. Vol. 8, No.1, pp. 39-46, April 2021.

[14] G. Selvachandran et al., "A New Design of Mamdani Complex Fuzzy Inference System for Multiattribute Decision Making Problems," in IEEE Transactions on Fuzzy Systems, vol. 29, no. 4, pp. 716-730, April 2021, doi: 10.1109/TFUZZ.2019.2961350.

[15] L. T. Hong Lan et al., "A New Complex Fuzzy Inference System With Fuzzy Knowledge Graph and Extensions in Decision Making," in IEEE Access, vol. 8, pp. 164899-164921, 2020, doi: 10.1109/ACCESS.2020.3021097.