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DEVELOPMENT OF AUTOMATIC DESCRIPTION DEVICE WITH RUNNING TEXT FOR WAYANG COLLECTIONS AT SENDANG MAS BANYUMAS MUSEUM

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Abstract

The current technological advancements have rapidly evolved various aspects of life, including disseminating information and education through Augmented Reality (AR). In Kabupaten Banyumas, there are numerous museums, one of which is the Sendang Mas Banyumas Puppet Museum. This museum already has a device for automatic puppet descriptions. However, the issue is that only one puppet is currently described using a speaker. This research aims to enhance the previous puppet description tool by adding descriptions for three puppets and an LCD. The objective is to assist museum staff and make the museum more appealing. The research employs the prototype method because it allows for rapid development and practical testing to ensure the device's proper functioning. In this study, an Arduino Uno is used as the microcontroller to operate various components, Arduino IDE is utilized for programming commands, three ultrasonic sensors are employed for three puppets, an LCD is incorporated for viewing the core descriptions, and a speaker is used to provide audio descriptions. This proposed automated description system will be implemented at the Sendang Mas Banyumas Puppet Museum as the research site. The development of this automated description system will aid staff in explaining the origins of the puppets, ensuring that visitors receive comprehensive and engaging information.

Keywords: Automated Puppet Museum Description, Prototype, Ultrasonic Sensors, Arduino Uno, DFPlayer

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I. INTRODUCTION

Technology and electronics have been rapidly advancing in recent times. Almost every aspect of human daily life has been encompassed by equipment utilizing both analog and digital control systems[1]. The latest technology used in information delivery is AR (Augmented Reality). In education, AR is employed as a medium to introduce historically significant objects which constitute cultural heritage. Historical objects as part of cultural heritage fall under the category of cultural heritage preservation[2].

The existence of museums in Indonesia plays a crucial role in preserving, advancing, and fostering cultural and historical awareness among the populace. Museum visitors can benefit from tangible and intangible cultural heritage. According to Government Regulation No. 19 of 1995, a museum is an institution and a repository that safeguards, preserves, protects, and exhibits objects as evidence of

human, natural, and ecological cultural wealth, supporting and protecting them to preserve national cultural wealth [3].

A tool already exists to automatically describe puppet collections by utilizing an ultrasonic sensor, which emits a description of the puppet when an object is brought close to it. However, the tool is limited to audio output and only describes a single puppet automatically. To address the shortcomings of the previous research, the present research aims to formulate "How to develop and design a device capable of displaying descriptions of puppet collections automatically using an ultrasonic sensor as input and a speaker and LCD with Running Text as output?" The objective of this study, stemming from the existing problems, is to develop and design a tool that can automatically display descriptions of puppet collections using an ultrasonic sensor as input and a speaker and LCD with Running Text as output.

In this research, the investigator builds upon the previous study by incorporating an additional LCD and creating automatic descriptions for three puppets with audio output descriptions and LCD Running Text. In conclusion, the researcher created an embedded system titled "Development of an Automatic Description Tool with Running Text for Puppet Collections at the Sendang Mas Banyumas Puppet Museum," to ensure visitors receive comprehensive and accurate information or explanations.

II. RESEARCH METHOD

The research consists of several stages: interviews and observations, requirement gathering, prototype construction, prototype evaluation, system coding, system testing, system evaluation, and system implementation.

A. Interviews and Observations

During this phase, the researcher directly visited the Sendang Mas Banyumas Puppet Museum to conduct observations and interviews with several individuals regarding the existing system and the challenges faced by the museum staff regarding the decrease in museum visitors.

B. Requirement Gathering

The subsequent stage involves gathering the necessary tools and materials. The tools gathered are:

1. A laptop used for program development and uploading via the Arduino IDE application to the Arduino microcontroller.
2. A USB A to B cable connects the laptop to the Arduino Uno.

The collected materials include:

1. Arduino Uno R3, a microcontroller board based on ATmega328, is the central control in this automatic description system[4].
2. DFPlayer is a sound player music module supporting audio file formats such as .mp3[5].
3. HC-SR04 Ultrasonic Sensor is used for detecting stationary objects and various distance measurement applications, particularly in acquiring traffic data[6].
4. Stereo Speakers were used as the primary output in this study, providing descriptions of selected puppets[7].
5. Micro SD FAT 32 is used for data storage[8].
6. LCD (Liquid Crystal Display) for visual information output[9].
7. Jumper Cables electrical cables interconnect components on a breadboard without requiring soldering[10].
8. Resistors are electronic components regulating and impeding electric current flow within a circuit[11].

C. Prototype Construction

In this phase, the design of the device to be built is carried out. The construction of the prototype involves several steps, including the design of a block diagram and the complete circuitry of the device.

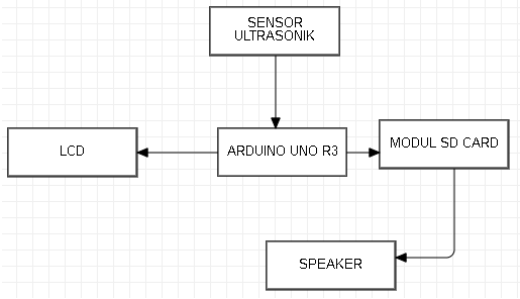

Fig. 1. Block Diagram

The design of a block diagram illustrates the operation of each circuit, and this diagram is crucial as one circuit's function interconnects and affects the performance of other components.

Based on the block diagram in Figure 1, it explains that the Arduino Uno R3 serves as the central control unit. The ultrasonic sensor provides input to the Arduino Uno R3. The Arduino Uno R3 commands the Micro SD Module to play the recordings stored in the micro SD and supplies power to the Speaker. The Micro SD Module then transmits data to the Speaker, converting it into sound, while the LCDs the text of the object's name in a scrolling manner.

The Circuit Scheme represents the design of the device components and the entire system, encompassing the design of the ultrasonic sensor component, the DFPlayer component, the speaker component, the LCD component, and the overall device design.

Designing the ultrasonic sensor component involves utilizing three ultrasonic sensors. This design depicts their placement and connection to the Arduino Uno. The ultrasonic sensor works by detecting stationary objects in front of it within a 2-5 cm range and then sending this data to the Arduino. This information is then displayed as a description on the LCD, and the Speaker will produce sound as puppet descriptions. The ultrasonic sensor circuitry can be observed in Figure 2.

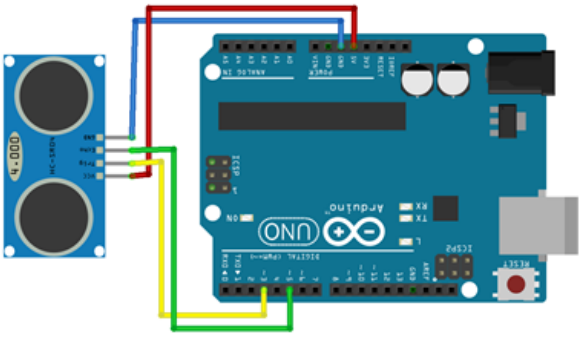

Fig. 2. Sensor Ultrasonic

The design of the LCD component is performed to illustrate the placement and the connection of the I2C 20x4 LCD to the Arduino Uno, as shown in Figure 3. The utilized LCD is an I2C 20x4 LCD, capable of displaying 40 characters across four rows.

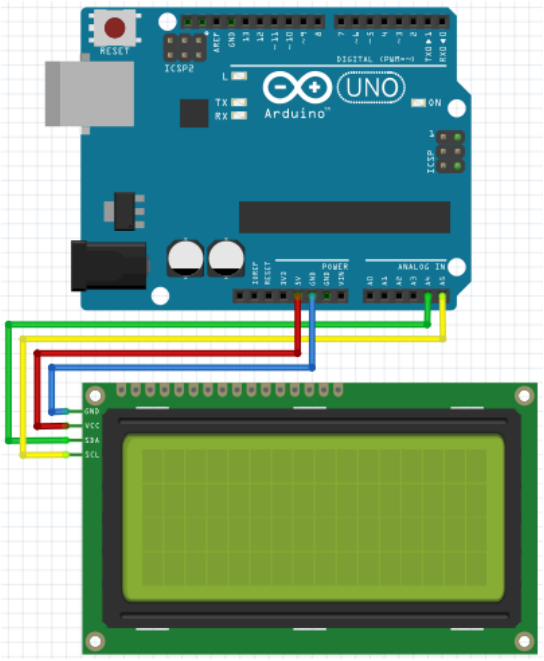

Fig. 3. LCD

The design of the DFPlayer component is performed to illustrate the placement and the connection of the DFPlayer to the Arduino Uno, as shown in Figure 4. The DFPlayer includes a micro SD card that contains .mp3 files of puppet descriptions.

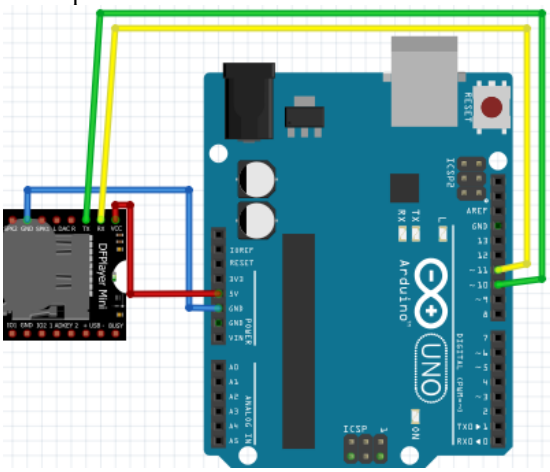

Fig. 4. DF Player

The design of the speaker component is carried out to illustrate the placement and the connection of the Speaker to the DFPlayer, as shown in Figure 5. The Speaker serves as the primary output of this research.

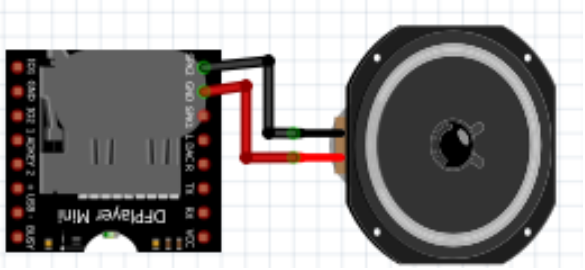

Fig. 5. Speaker

The overall device design constitutes a complete circuit comprising four crucial integrated elements: input circuitry, control circuitry, output circuitry, and software programs. The circuit comprises electronic

components in both input and output forms required by the microcontroller to function correctly. The complete circuitry of the device can be seen in Figure 8.

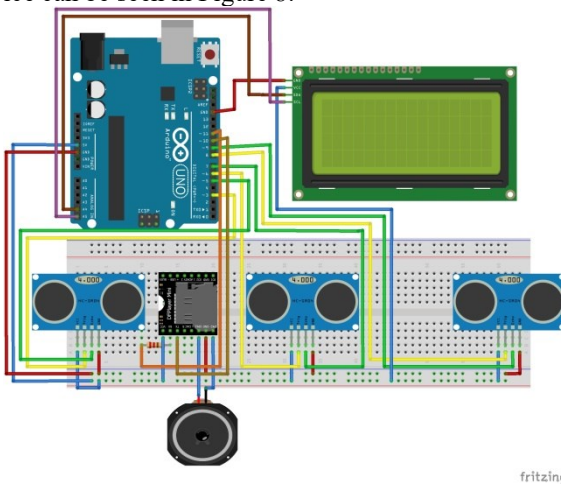

Fig. 6. Schematic System

From the overall device design in Figure 6, the following can be explained:

- For Ultrasonic Sensor 1: Connect the VCC pin to the Arduino's 5V pin, the trigger pin to pin 3, the echo pin to pin 5, and the GND pin to the ground (GND).
- For Ultrasonic Sensor 2: Connect the VCC pin to the Arduino's 5V pin, the trigger pin to pin 6, the echo pin to pin 7, and the GND pin to the ground (GND).
- For Ultrasonic Sensor 3: Connect the VCC pin to the Arduino's 5V pin, the trigger pin to pin 8, the echo pin to pin 9, and the GND pin to the ground (GND).
- For the LCD: Connect the SCL pin to pin A5 on the Arduino, the SDA pin to pin A4, the VCC pin to the 5V pin, and the GND pin to the ground (GND).
- For the DFPlayer: Connect the GND pin to the Arduino's GND, the VCC pin to the 5V pin, the RX pin to pin 11, and the TX pin to pin 12.
- For the Speaker: Connect the red pin to the SPK1 pin on the DFPlayer and the black pin to the SPK2 on the DFPlayer.

A. Implementation

The design generated in the previous stage is physically combined with electronic components to form a single mechanical circuit. Subsequently, control logic is implemented into the system through programming in the Arduino IDE software. Arduino IDE is the software used to write programs containing commands uploaded to the microcontroller for execution. Writing the program code is done to provide instructions using the C programming language to run the system as per the code entered into an Arduino. Without the program code, the system cannot function because the code is the most crucial part of constructing a device.

B. Testing

The testing of this device includes both block-level testing and overall testing. Block-level testing identifies errors and simplifies microcontroller analysis when the device does not perform as intended.

III. RESULTS AND DISCUSSION

This chapter explains the operation of the automatic description system with Running Text. By placing a stationary object within 2-5 cm in front of one of the sensors, the sensor will transmit a signal to the Arduino. Subsequently, the Arduino sends signals to both the LCD and the Speaker. The Speaker produces the puppet description in sound, while the LCDs the core description in text.

The device will be housed in an enclosure to enhance its appearance, concealing the jumper cables, Arduino Uno, breadboard, DFPlayer, and SD Card. This can be observed in Figure 4.1, where the miniature automatic description device is encased in a trapezium-shaped acrylic enclosure, and the miniature elements are made from cardboard.

Fig. 7. Miniature Automatic Description Device for Puppet Collections

The system built in Figure 7 follows the following process flow:

1. Initially, the three ultrasonic sensors detect if there is a stationary object within the range of 2-5 cm.
2. When one of the ultrasonic sensors detects a stationary object, it sends a signal to the Arduino Uno, which then forwards the signal to both the LCD and the Speaker.
3. After sending the signal to the LCD and Speaker, the LCD outputs in the form of running text, while the Speaker emits the puppet description corresponding to the ultrasonic sensor detecting the stationary object in front of it.
4. If the ultrasonic sensor does not detect any object in front of it, it continues to scan for stationary objects.

Several tests were conducted in this study to support the success of this process flow. Initially, separate tests were conducted for individual components (20x4 character LCD, DFPlayer, Speaker, and ultrasonic sensor) used in designing the device to ensure that the desired results were obtained. Subsequently, testing progressed to examining the entire microcontroller component circuit that had been installed.

A. Ultrasonic Sensor Testing

In this phase, ultrasonic sensor testing was conducted to serve as monitoring to facilitate easier monitoring of the monitoring system. The sensor test involved comparing when the ultrasonic sensor reads a stationary object from 1-5 cm, triggering the puppet description audio's emission and the LCD's activation.

1. Use the formula below to determine the percentage of conformity and non-conformity.

$$\text{Success rate} = \frac{Jumlah\ keberhasilan\ uji\ alat}{Jumlah\ pengujian\ yang\ dilakukan} \text{ x } 100\% \qquad (1)$$

The formula presented can be utilized to determine the success and failure percentages[12].

Table 1 Ultrasonic Sensor Testing

NO	Day and date of testing	tools				Description
		Ultrasonic Sensor Number -	Distance (cm)	LCD	*Speaker*	
1	Sunday / 17 September 2023	1	1	✓	✓	Not suitable
		2	1	✓	✓	Not suitable
		3	1	✓	✓	Not suitable
2	Sunday / 17 September 2023	1	2	✓	✓	suitable
		2	2	✓	✓	suitable
		3	2	✓	✓	suitable
3	Sunday / 17 September 2023	1	3	✓	✓	suitable
		2	3	✓	✓	suitable
		3	3	✓	✓	suitable
4	Sunday / 17 September 2023	1	4	✓	✓	suitable
		2	4	✓	✓	suitable

NO	Day and date of testing	tools				Description
		Ultrasonic Sensor Number -	Distance (cm)	LCD	*Speaker*	
		3	4	✓	✓	suitable
5	Sunday / 17 September 2023	1	5	✓	✓	suitable
		2	5	✓	✓	suitable
		3	5	✓	✓	suitable
6	Sunday / 17 September 2023	1	1	✗	✗	suitable
		2	1	✓	✓	Not suitable
		3	1	✗	✗	suitable
7	Sunday / 17 September 2023	1	2	✓	✓	suitable
		2	2	✓	✓	suitable
		3	2	✓	✓	suitable
8	Sunday / 17 September 2023	1	3	✓	✓	suitable
		2	3	✓	✓	suitable
		3	3	✓	✓	suitable
9	Sunday / 17 September 2023	1	4	✓	✓	suitable
		2	4	✓	✓	suitable
		3	4	✓	✓	suitable
10	Sunday / 17 September 2023	1	5	✓	✓	suitable
		2	5	✓	✓	suitable
		3	5	✓	✓	suitable
The total number of experiments					Sensor 1	10
					Sensor 2	10
					Sensor 3	10
		The total overall				30
		Not suitable				4
Description :		✓ = ON				
Description :		✗ =OFF				

1. Based on the test results conducted to detect the stationary object from 1 cm to 5 cm, it can be concluded that the device operates properly. Out of 30 test instances, an average non-conformity rate of 13.33% and a success rate of 86.66% were observed.

B. LCD I2C Testing

The LCD I2C 20x4 module was tested to verify the functionality of the designed circuitry in displaying the core description in text on the LCD in response to commands. The LCD testing was conducted based on whether the LCD operates when ultrasonic sensors 1, 2, and 3 detect a stationary object in front of them.

Table 2 LCD I2C Testing

NO	Day / Date	Ultrasonic Sensor Number -	LCD	Description
1	Monday / 18 September 2023	1	✓	suitable
		2	✓	suitable
		3	✓	suitable
2	Monday / 18 September 2023	1	✓	suitable
		2	✓	suitable
		3	✓	suitable
3	Monday / 18 September 2023	1	✓	suitable
		2	✓	suitable
		3	✓	suitable
4	Tuesday / 19 September 2023	1	✓	suitable

NO	Day / Date	Ultrasonic Sensor Number -	LCD	Description
		2	✓	suitable
		3	✓	suitable
		1	✓	suitable
5	Tuesday / 19 September 2023	2	✓	suitable
		3	✓	suitable
		1	✓	suitable
6	Tuesday / 19 September 2023	2	✓	suitable
		3	✓	suitable
		1	✓	suitable
7	Tuesday / 19 September 2023	2	✓	suitable
		3	✓	suitable

Description : ✓ = ON

Description : ✗ =OFF

From Table 2, it is evident that during the LCD test, the display operates appropriately. The LCD presents the description corresponding to the selected sensor, aligning perfectly with the Speaker outputting the puppet description, achieving a success rate of 100%.

C. Speaker Testing

Speaker testing aims to determine whether the sound emitted by the Speaker matches the description or not. As the primary output in this system, the Speaker must accurately and clearly articulate the puppet description from start to finish. This speaker test assesses the alignment and operation of the Speaker when ultrasonic sensors 1, 2, or 3 detect a stationary object in front of them.

Table 3: Speaker Testing

Table 3 Speaker Testing

NO	Day / Date	Ultrasonic Sensor Number -	*Speaker*	Description
		1	✓	suitable
1	Wednesday / 20 September 2023	2	✓	suitable
		3	✓	suitable
		1	✓	suitable
2	Wednesday / 20 September 2023	2	✓	suitable
		3	✓	suitable
		1	✓	suitable
3	Wednesday / 20 September 2023	2	✓	suitable
		3	✓	suitable
		1	✓	suitable
4	Thursday / 21 September 2023	2	✓	suitable
		3	✓	suitable
		1	✓	suitable
5	Thursday / 21 September 2023	2	✓	suitable
		3	✓	suitable
		1	✓	suitable
6	Thursday / 21 September 2023	2	✓	suitable
		3	✓	suitable
		1	✓	suitable
7	Thursday / 21 September 2023	2	✓	suitable
		3	✓	suitable

Description : ✓ = ON

Description : ✗ =OFF

From the speaker testing experiment, the Speaker functions well, clearly articulating the puppet descriptions and aligning accurately with the ultrasonic sensor, achieving a success rate of 100%. The descriptions for the emitted sound are as follows:

a. Wayang Bawor

Wayang Bawor is a character in Banyumasan puppetry. He is the eldest son of Semar, possessing a weapon named "Audi." His distinctive features include a concave head top, hair in a braid, a stout body, wide eyes, and wavy lips, symbolizing simplicity and honesty. The wayang measures 36 cm in length, 23 cm in width, and 0.3 cm in thickness, serving as a mascot in Banyumas Regency.

b. Wayang Sarkawi

Wayang Sarkawi is made of flattened leather. It measures 47 cm in length, 13 cm in width, and 0.2 cm in thickness. Its unique feature is using a "blangkon" or headgear, symbolizing loyalty. Sarkawi is a special punokawan following Pandhita Drona wherever he goes, but oddly, Sarkawi and Pandhita Drona never agree and constantly have disagreements.

c. Wayang Srenggini

Wayang Srenggini, the fourth child of the mighty Bima and the goddess Rekathawati from the crab tribe, possesses a giant claw as a weapon on his right shoulder. Additionally, he holds a martial art called "took sewu," symbolizing firmness. The Wayang Srenggini is made from leather and is 47 cm in length, 20 cm in width, and 0.2 cm in thickness.

A. DFPlayer Testing

The DFPlayer Mini is tested to ascertain whether it can record sound on the memory card. The recording is placed into an MP3 folder and labeled with codes like 001 or 002. The sound will be played according to the coding command. During the DFPlayer testing, observation was made to check whether, when ultrasonic sensors 1, 2, or 3 detect a stationary object, the DFPlayer accurately emits the corresponding puppet description sound.

Table 4 Pengujian DF*Player*

NO	Day / Date	Ultrasonic Sensor Number -	DF*Player*	*Speaker*	Description
1	Jum'ad / 22 September 2023	1	✓	✓	suitable
		2	✓	✓	suitable
		3	✓	✓	suitable
2	Jum'ad / 22 September 2023	1	✓	✓	suitable
		2	✓	✓	suitable
		3	✓	✓	suitable
3	Jum'ad / 22 September 2023	1	✓	✓	suitable
		2	✓	✓	suitable
		3	✓	✓	suitable
4	Sabtu / 23 September 2023	1	✓	✓	suitable
		2	✓	✓	suitable
		3	✓	✓	suitable
5	Sabtu / 23 September 2023	1	✓	✓	suitable
		2	✓	✓	suitable
		3	✓	✓	suitable
6	Sabtu / 23 September 2023	1	✓	✓	suitable
		2	✓	✓	suitable
		3	✓	✓	suitable
7	Sabtu / 23 September 2023	1	✓	✓	suitable
		2	✓	✓	suitable
		3	✓	✓	suitable

Description : ✓ = ON

Description : ✗ =OFF

The DFPlayer is crucial in this system as it commands the Speaker to emit sound descriptions corresponding to the ultrasonic sensor. From this test, it can be concluded that both the DFPlayer and the Speaker operate well and are in sync with the ultrasonic sensor, achieving a success rate of 100%.

IV. CONCLUSION

Based on the test results conducted by the researcher, the following conclusions can be drawn:

1. The prototype design of the automatic description system with running text, incorporating ultrasonic sensors, LCD, DFPlayer, and speakers, operates efficiently, achieving a 100% success rate.
2. Ultrasonic sensors effectively detect stationary objects within a 2-5 cm range in front of the sensor.
3. All three ultrasonic sensors work well and correspond accurately to the puppet names, with a success rate of 86.66% and a failure rate of 13.33%.
4. The DFPlayer operates effectively by detecting and playing the correct files on the Speaker, achieving a 100% success rate.
5. The Speaker delivers clear puppet descriptions, in line with the ultrasonic sensors detecting stationary objects in front of them, achieving a success rate of 100%.
6. The LCD functions well, displaying the core puppet descriptions following the ultrasonic sensors detecting stationary objects and the Speaker, achieving a 100% success rate.
7. The entire automated description system using Arduino Uno R3 functions effectively and aligns with the predetermined design, achieving a success rate of 100%.
8. The Wayang Sendang Mas Banyumas Museum can apply the development of the automatic description system. It has evolved from describing only one puppet to accommodating descriptions for three puppets and integrating an LCD.

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REFERENCES

[1] Lutfiyana, N. Hudallah, and A. Suryanto, "Rancang Bangun Alat Ukur Suhu Tanah , Kelembaban Tanah, dan Resistansi," *Tek. Elektro*, vol. 9, no. 2, pp. 80–86, 2017.

[2] P. Haryani and J. Triyono, "Augmented Reality (Ar) Sebagai Teknologi Interaktif," *J. Simetris*, vol. 8, no. 2, pp. 807–812, 2017.

[3] E. D. Saputra and R. Febryansyah, "Memperkenalkan Budaya Berwujud Di Museum Lampung Dengan Mengembangkan Aplikasi Augmented Reality Menggunakan Pengembangan Multimedia," *Portaldata*, vol. 2, no. 5, pp. 1–13, 2022.

[4] D. Fina Supegina, "Perancangan Robot Pencapit Untuk Penyotir Barang Berdasarkan Warna Led Rgb Dengan Display Lcd Berbasis Arduino Uno," *J. Tek. Elektro*, vol. 5, no. 1, pp. 9–17, 2016.

[5] V. Polly, S. Pandelaki, and K. Dame, "Alat Pendeteksi Suhu Tubuh Contactless Menggunakan Mlx90614 Berbasis Mikrokontroler Dengan Fitur Suara," *J. Ilm. Realt.*, vol. 16, no. 2, pp. 49–53, 2020, doi: 10.52159/realtech.v16i2.133.

[6] M. D. Prasetyo, A. R. Rachmansyah, and B. A. Dananjoyo, "DETEKTOR KESALAHAN PENGISIAN VOLUME BBM MENGGUNAKAN SENSOR ULTRASONIK DAN SMS GATEWAY," *J. Inform. dan Tek. Elektro Terap.*, vol. 10, no. 3, pp. 157–166, 2022, doi: 10.23960/jitet.v10i3.2703.

[7] Sunarwi, "Narasi Audio Tentang Objek Museum," pp. 28–29, 2020.

[8] U. Bedjo, R. Triana, and H. P. Ganjar, "Phototeraphy Radiometer Dengan Penyimpanan Data Pengukuran Pada SDCard," *Semin. Skripsi*, vol. 7, pp. 1–7, 2018.

[9] E. Orlando and Y. I. Chandra, "Penerapan Metode Prototype Dalam Membuat Alat Penyiraman Tanaman Otomatis Berbasis Mikrokontroler Arduino Uno," *Tekinfo J. Bid. Tek. Ind. dan Tek. Inform.*, vol. 23, no. 2, pp. 9–23, 2022, doi: 10.37817/tekinfo.v23i2.2593.

[10] S. Achmady, L. Qadriah, and A. Auzan, "Rancang Bangun Magnetic Solenoid Door Lock dengan Speech Recognition Menggunakan Nodemcu Berbasis Android," *JRR J. Real Ris.*, vol. 4, no. 2, pp. 79–91, 2022, doi: 10.47647/jrr.

[11] N. Nurhayati and B. Maisura, "Pengaruh Intensitas Cahaya Terhadap Nyala Lampu dengan Menggunakan Sensor Cahaya Light Dependent Resistor," *CIRCUIT J. Ilm. Pendidik. Tek. Elektro*, vol. 5, no. 2, p. 103, 2021, doi: 10.22373/crc.v5i2.9719.

[12] A. Kurniawan, "Alat Bantu Jalan Sensorik bagi Tunanetra," *Inklusi*, vol. 6, no. 2, p. 285, 2019, doi: 10.14421/ijds.060205.