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Detection Tool for Authenticity and Nominal of Banknotes for the Blind Using Arduino Based Scanning Sensor

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Abstract: *Money is a tool used to carry out buying and selling transactions and has been used by all humans in every corner of the world. This definitely makes money a basic commodity for everyone, even for people with disabilities such as the blind. The blind's limitations in seeing are a problem in terms of communication so they only rely on their sense of touch and hearing. The weakness of the blind in seeing and identifying money can cause money to be exchanged, taken wrongly, or even deceived by counterfeit money when buying and selling. Referring to this, it is necessary to have tools that can make it easier for the blind to identify the authenticity of money and the nominal value of money. The aim of this research is to design a tool that can be used to detect the authenticity of the nominal value of Rupiah banknotes. This tool uses a TCS3200-DB color sensor to detect the color of banknotes, then the microcontroller converts it into RGB data and outputs it in the form of sound output.and an ultraviolet sensor to detect the authenticity of money.The result of this research is that the system can recognize the authenticity and nominal value of moneypaper, especially rupiah. This makes it easier for users, especially the visually impaired, to carry out buying and selling transactions so they don't make mistakesto give or receive money.*

Keywords :*Arduino Uno, Ultraviolet Lamp,TCS3200-DB color sensor and DFPlayer.*

INTRODUCTION

Money is a tool used to carry out buying and selling transactions and has been used by all people in every corner of the world. This has definitely made money a basic commodity for everyone, even for the

people with disabilities such as the blind. The blind's limitations in seeing are a problem in terms of communication so they only rely on their sense of touch and hearing. The authenticity of Rupiah currency can be recognized through the characteristics contained in the material used to make the money (paper, plastic or metal), the design and color of each denomination of money and the printing technique. Some of the characteristics contained in Rupiah currency, apart from functioning as characteristics to differentiate one denomination from another denomination, can function as protection against the threat of criminal acts of money counterfeiting.

These safety devices consist of invisible, visible and tactile safety devices, and newly visible safety devices using tools in the form of ultra violet rays and infrared rays. In plain view, the way to differentiate genuine banknotes from fake banknotes is by looking, touching

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and looking at them. Genuine banknotes have security threads, watermarks, shiny printing, and embossed printing that feels rough when touched (Jalil, 2014).

However, this is not the case for blind people who have physical limitations in distinguishing real and fake banknotes. So far, the blind have used conventional methods such as arranging the nominal banknotes or making folds on the money to differentiate the nominal value of the money. However, it still has several weaknesses, namely in terms of the memory of the blind, the physical condition of the money and the absence of a determining factor for honesty, that when making transactions for buying and selling goods and services, the person with whom the transaction is made gives money according to the nominal value it should have and directs the blind Netra to arrange his money properly. According to the 1993 – 1996 Sense of Sight and Hearing survey, the blindness rate in Indonesia was 1.5%, the highest in Asia, compared to Bangladesh 1%, India 0.7% and Thailand 0.3%. This means that if there are 12 people in the world who are blind every 1 hour, four of them come from Southeast Asia and it is certain that 1 person is from Indonesia. (Porbadi, 2014).

The definition of money quoted from the opinions of several experts:

1. **According to AC Pigou in his book entitled The Veil of Money,** he said that money is anything that is commonly used as a medium of exchange.
2. **According to (Kuuswandhie, 2011)**Real money and fake money can be differentiated by the brightness level of the money which is indicated by the appearance of a green color which is a sign of the authenticity of the money. On real money, green will not appear, but only blue, which is the effect of ultraviolet light. Meanwhile, fake money will emit a level of brightness which is indicated by the appearance of a green color
3. **According to Law**, money is an object that is a legal means of payment. Functionally, money is an object that can be used as a means of payment. When viewed from its value, money is a unit of account to express nil.

Based on the understanding of the experts above, it is revealed that money is something that is very important and needed by humans as a means of exchange or payment for purchasing goods or services.

Referring to the problems above, tools are needed for blind people who can identify the authenticity and nominal value of banknotes by detecting the color of the banknotes. In this way, it is hoped that it will make it easier for blind people to carry out transaction activities of buying and selling goods and services. In accordance with developments, recently Bank Indonesia has been printing money using certain printing techniques which are more difficult to imitate. Because in its printing, Bank Indonesia embeds additional features as

characteristics of the authenticity of the money. So that people can recognize whether the money is real or fake using a tool called an ultra violet light, so that it can minimize criminal acts of circulating counterfeit money. To be able to find out the nominal value of money, a color sensor can be used. A color sensor is a tool that detects objects directly or indirectly and then processes them in the form of analog/digital signals (Shoppu, 2016). This final project will use one sensor implementation to detect the nominal value of rupiah banknotes. This implementation uses a color sensor, the data obtained from recognizing the color of banknotes by the color sensor is then entered into the microcontroller. The data on the microcontroller is still analog data. For this reason, a converter component is needed to convert analog data into digital data. After processing the data, a voice output is finally obtained which tells the nominal value of the banknote that you want to know.

The solution that is expected to be able to minimize acts of cheating and fraud against people with disabilities is none other than the use of technological developments. Therefore, this technological development is the background to the problem of this research, namely that it is hoped that the application of this technology will be able to help people with disabilities, in this case the blind, remain safe in carrying out their business in the field of buying and selling.

RESEARCH METHODS

1. Understanding Money

Money is something that is generally accepted as payment for purchasing goods and services and for paying debts. According to Budiono, 1990) money can function as a medium of exchange, a unit of account, a means of storing wealth, and a means of settling debts. (Porbadi, 2014) The authenticity of rupiah currency can be recognized through the characteristics contained in the materials used. to make money (paper, plastic, or metal). the design and color of each currency denomination as well as the printing technique. Some of the characteristics contained in rupiah currency, apart from functioning as characteristics to distinguish between one denomination and another, can function as protection against the threat of criminal acts of money counterfeiting.

Figure 1.1 Rupiah Banknotes

a. **Authenticity of money**

Real money and fake money can be distinguished by the brightness of the money which is indicated by the appearance of the blue color which is a sign of the authenticity of the money. On real money, green will not appear, but only blue, which is the effect of ultraviolet light. Meanwhile, fake money will emit a level of brightness which is indicated by the appearance of a green color (Kuuswandhie, 2011).

Table 2.1 Results of checking real money with a nominal value of 50,000 (Kuswandhie, 2011)

R	G	B
0	0	10320
0	0	10320
0	0	10320
0	0	10320
0	0	10320

Table 2.2 Results of checking counterfeit money with a nominal value of 50,000 (Kuswandhie, 2011)

R	G	B
14	301	9658
4	322	9683
24	312	9696
8	332	9719
9	312	9732

b. Amount of money

The data obtained will be used as a reference for the variable values used as boundaries to differentiate each banknote. The variables used are
The basic colors consist of red, green
and blue which is represented by the variables R,G and B and the size of the money which is defined by the edge variable. The following will show the limitations on each money used (Kuuswandhie, 2011).

Table 2.3 Value limits

variables R,G,B and the edge of each nominal amount of money (Kuswandhie, 2011)

Limitation	100				50				20			
	R	G	B	Edge	R	G	B	Edge	R	G	B	Edge
On	93	30	2		3	45	83		4	96	19	
Lower	67	5	0	160	0	13	50	150	0	77	0	145

b. Color sensor testing

This sensor has 4 color filter modes, namely clear mode, red filter mode, green filter mode, blue filter mode. Here the filter in question is the wavelength range or lambda of light that can be received by the photodiode. The lambda range graph can be seen in the datasheet. The final output from this sensor is a Red-Green-Blue color composition or known as RGB. To be able to get RGB from an object, the sensor must first be calibrated with white as a reference. data collection distance 2 cm from the sensor. white color calibration using white HVS paper.

c. LCD circuit testing

LCD testing uses Arduino Uno R3 as a tool to command the LCD to display several characters. In this LCD test, Arduino Uno R3 is given a program to display temperature and humidity values. LCD testing aims to ensure the LCD can run well. So that in the process of monitoring the temperature and humidity of the drying room, good data will be obtained.

2. Arduino Mega

Arduino Mega2560 is a microcontroller board based on the ATmega2560. Arduino Mega2560 has 54 digital input/output pins, of which 15 pins can be used as PWM output, 16 pins as analog input, and 4 pins as UART (hardware serial port), 16 MHz crystal oscillator, USB connection, power jack, ICSP header, and reset button. This is all that is needed to support the microcontroller. Simply connect it to a computer via a USB cable or power it via an AC-DC adapter or battery to start activating it. The Arduino Mega2560 is compatible with most shields designed for the Arduino Duemilanove or Arduino Diecimila. Arduino Mega2560 is the latest version that replaces the Arduino Mega version. (Djuandi, 2011)

Figure 1.2 Arduino Mega (Artanto, 2012)

3. Color SensorTCS3200-DB

Color sensors can be interpreted as a certain spectrum found in perfect/white light. Colors are divided into 2, namely primary colors and secondary colors. Primary colors are basic colors, while secondary colors are colors resulting from a mixture of two primary colors in a color space. (Aidil, 2016)

For example, as shown below. In graphic equipment, there are three primary colors of light: (R = Red) red, (G = Green) green (B = Blue) blue or what we know better as RGB, which when combined in a certain composition will produce various colors. (Aidil, 2016)

Based on the RGB decimal code, it can be seen that each color has a different value. The same thing is the case with data read by color sensors, the value obtained for each color is influenced by distance sensor to color, and light intensity from outside, such as using the TCS3200-DB color sensor. The TCS3200-DB color sensor is a color sensor made by TAOS Parralax. TCS3200-DB is an improved product from the previous product, namely TCS230. The difference between the TCS3200-DB and the TCS230 is the current consumption. The TCS3200-DB color sensor specifications are as follows:

a. Based on the TAOS TCS3200 sensor.

b. Pulse width interface with frequencies corresponding to the object's RGB values.

c. There is a pin selector to read the value of each RGB component.

d. Equipped with white LED, collimator lens, and standoff to maximize sensor readings.

e. White LED can be controlled On/Off for ambient light compensation.

f. Fully compatible with Parallax motherboards (BASIC stamp and propeller) and supports other microcontroller/microprocessor systems.

g. Module power supply 3.3 to 5 VDC and LED power supply 5 VDC.

This sensor has 4 color filter modes, namely clear mode, red filter mode, green filter mode, blue filter mode. Here the filter in question is the wavelength range or lambda of light that can be received by the photodiode. The rangelambda graph can be seen in the datasheet. The final output from this sensor is a Red-Green-Blue color composition or known as RGB. RGB of an object, the sensor must be calibrated first with white as a reference.

The data collection distance must be 2 cm from the sensor. white color calibration using white HVS paper (Aidil, 2016).

Figure 1.3 Color Sensor (Aidil, 2016)

4. DFPlayer

DFPlayer Mini is a compact MP3 module and can be directly connected to speakers. Module with battery power supply, speaker, keypad can be used alone, can also be controlled via serial port, Arduino Uno module For or series microcontroller The module itself is perfectly integrated hardware decode MP3, WAV, WMA. While the TF card driver software supports FAT16, FAT32 file system. Can be done with a simple serial command Play music, as well as how to play music and other functions, without complicated underlying operations, easy to use, stable and reliable.

1. Full support FAT16 ,FAT32 file system ,support 32g TF card
The maximum support for this 32G U disk is 64M bytes NORFLASH
2. Various control modes available. IO control mode, serial mode, mode
AD control button

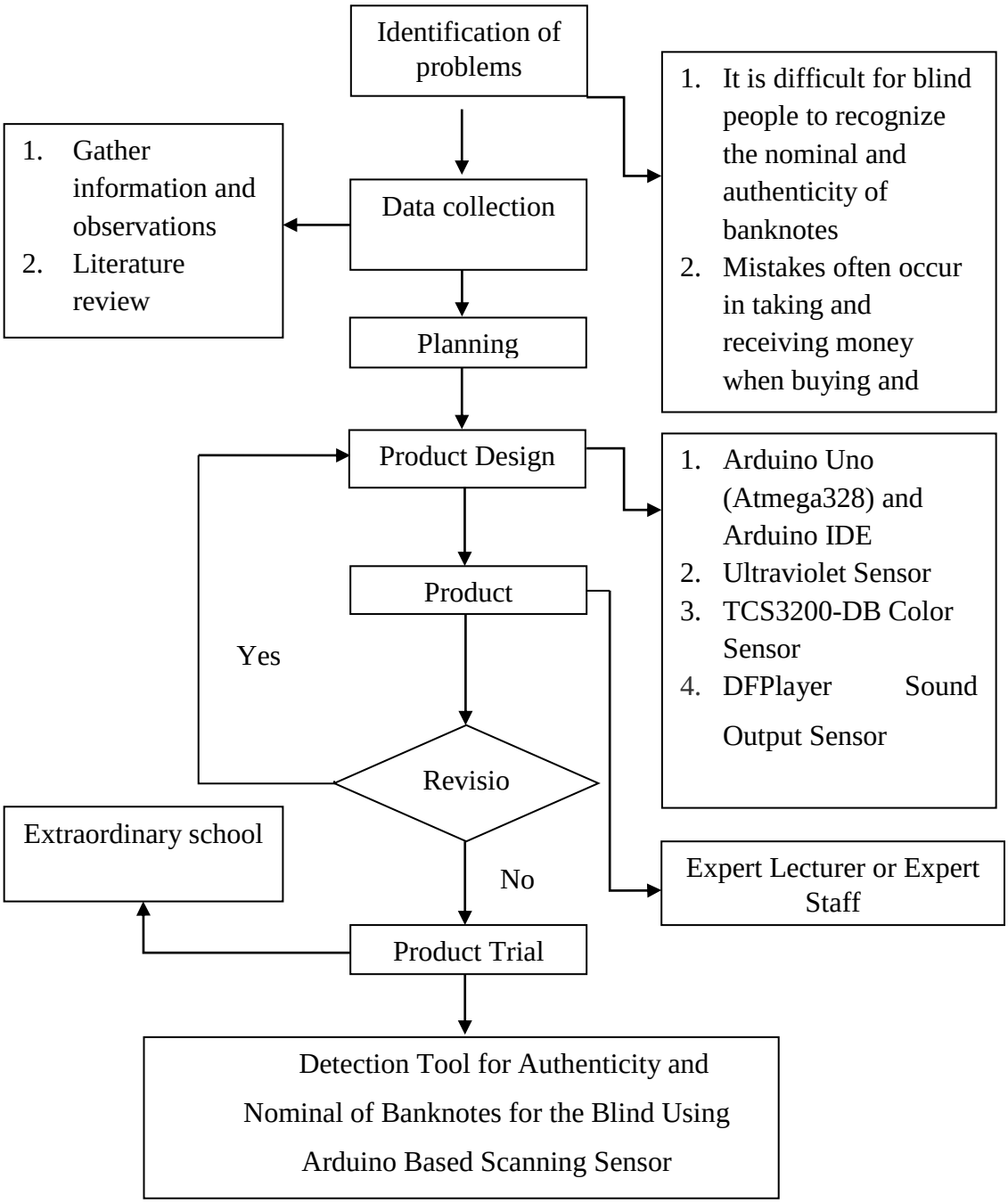
2 place broadcast language feature, you can pause the background music being played. The ad has finished playing again. The background sound continues to play

3 audio data is sorted by folder, supports up to 100 folders,
each folder can be assigned to 255 songs

4 30 adjustable volumes, six adjustable EQs

Figure 1.4 DFPlayer (Adi, 2013).

2.1 Framework of thinking



Information :

1. The author identifies the problems that exist at the Special School, Karang Tengah, Kab. Kendal, then formulate the problem being studied.
2. The author made observations, in this stage the author conducted research at the Kendal District Court class 1B. The author also conducts literature studies related to the problem being studied to find concepts or theoretical foundations that strengthen the product that will

be produced through sources including books, journals, the results of other people's research work and the internet.

3. The author plans the product and specifications that will be made so that the product created is as planned and functions well.
4. Design and engineer products using Arduino Uno (Atmega328) and Arduino IDE Ultraviolet Sensor, TCS3200-DB Color Sensor, ISD1760 IC Sound Output Sensor.
5. Validation Test, in this stage of the process to assess whether the new product design is correct, is carried out by validating competent experts to assess whether the product design being designed is valid.
6. Design Revision, after the validation test is carried out, improvements to the initial product produced are carried out according to advice from experts. If there are revisions, then return to the design according to the expert, if not directly test the product.
7. The product trial stage is carried out in the field involving potential users.
8. The final stage, this hypothesis is carried out as an illustration of a research conducted:

I. Provides explanations of symptoms and facilitates the expansion of knowledge in a field.
II. Put forward a statement about the relationship between two concepts that can be directly tested in research.
III. Provide research direction.
IV. Provides a framework for compiling research conclusions

Flow chart

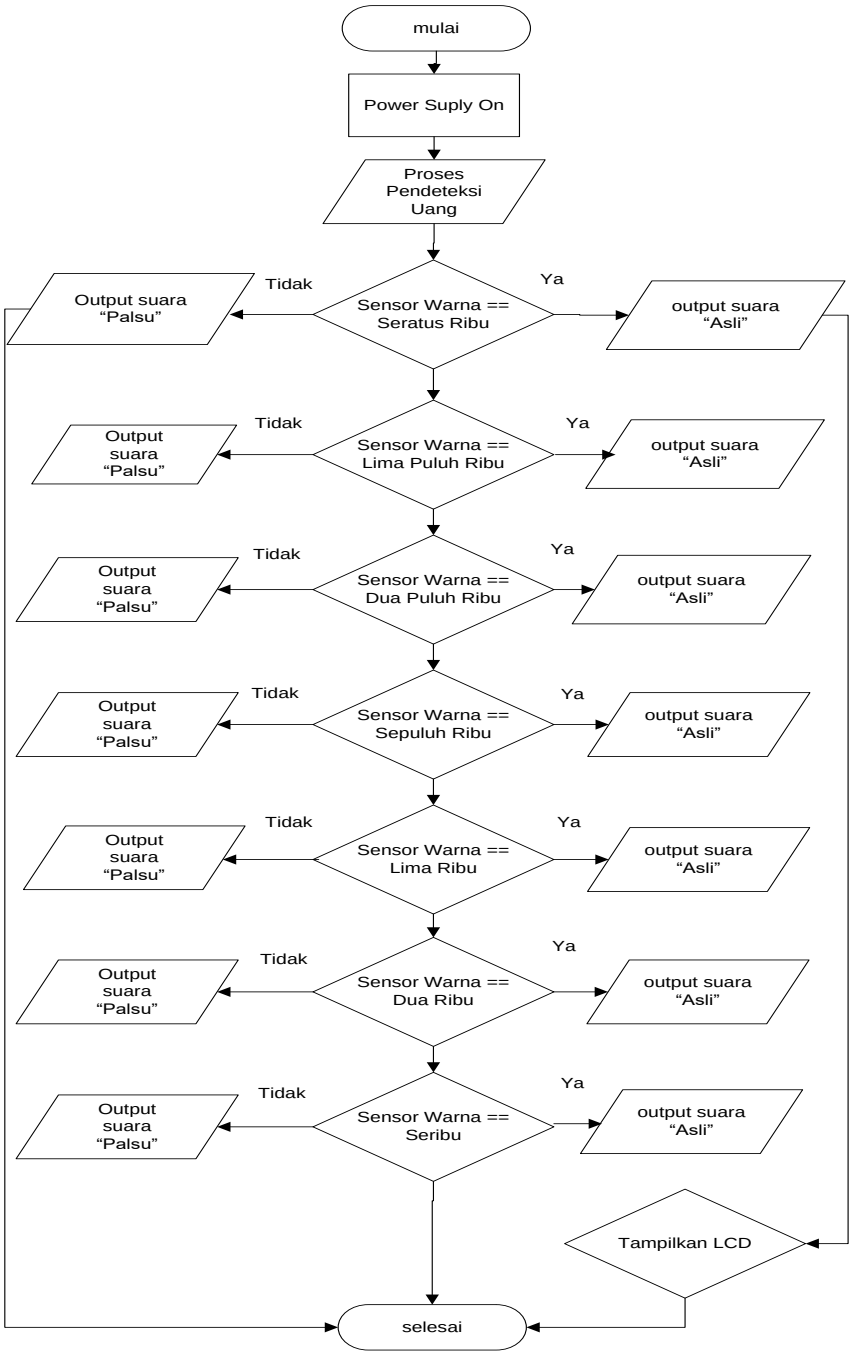


Figure 3.8 Flowchart Diagram of the authenticity and nominal value of money

Information :

Starting from the power supply being turned on then the process of detecting the authenticity and nominal value of the banknotes via the TCS 3200 DB color sensor. After the color sensor reads the Red Green and Blue values, the sensor will determine the nominal

amount which will then be output via the LCD in the form of text, and will be output by Dfplayer in the form of sound.

RESULTS AND DISCUSSION

Based on the results of research and findings at the Kendal Independent Special School, blind students still have difficulty recognizing the nominal value of rupiah banknotes and the authenticity of rupiah banknotes, students only rely on their sense of touch to recognize rupiah banknotes, after I conducted research and tried the students To identify the nominal value of the money, some of the students mispronounced the nominal value of the banknotes, and with the tool I made, namely a tool for detecting the nominal value and authenticity of rupiah banknotes using a scanning sensor, I hope it will make it easier for the blind to recognize the nominal value and authenticity of the money. rupiah paper.

The author conducted research aimed at making it easier for people with disabilities, especially blind people, to more easily recognize the authenticity and nominal value of rupiah banknotes, therefore the author wants to provide a solution that the author will provide is "A tool for detecting the authenticity and nominal value of banknotes for the blind using a scanning sensor based Arduino." The tools that support this research are Arduino Uno R3, TCS-3200 DB Color Sensor, 12C LCD Module, DFPlyer, and Ulta Violet Sensor as tool calibration. The working principle is that when initially activated the LCD will notify the initial state when the device is ready to be used, then enter the money to be detected after it is read by the color sensor then the device will be output via DFPlayer and LCD 12C then from testing this tool you can determine the nominal value of money and the authenticity of rupiah banknotes.

1. The tool tester is in the initial display state when the purchase money is detected

Figure 1.5 Initial display before money is detected

The image above is the initial display when the money has not been entered for detection, a sound will appear, please enter the money, along with the text output that appears on the LCD.

1. Testing of nominal detection equipment and authenticity of real IDR 100,000 money

Figure 1.6 Display of genuine IDR 100,000 currency detection

The image above shows the nominal value of Rp. 100,000 original on the LCD display which will also be output by voice via DFPlayer. Apart from that, if the money is successfully detected the LED light will light up.

2. Testing of counterfeit Rp. 100,000 nominal and currency detection equipment

Figure 1.7 Display of fake IDR 100,000 note

The image above shows the nominal value of Rp. 100,000 fake on the LCD display which will also be output by voice via DFPlayer besides that if the money is successfully detected the LED light will light up

CONCLUSION

Based on the results of the research that has been carried out, the following conclusions are obtained:

1. The old system still makes it difficult for the blind to recognize the authenticity and nominal value of banknotes. The author conducted research with one of the blind students at Kendal Independent Special School that it was less effective for blind people to recognize the authenticity and nominal value of rupiah banknotes by just using their sense of touch. .
2. In creating a new system, it is concluded that there is a match between the problem and the solution. This is proven based on the validation results that have been carried out on design experts and material experts which produce numbers that determine the results of the new system, namely validation on design experts and material experts produces a value of 25 which means "Good".
3. After testing the tool at the Kendal Independent Special School. Blind students only recognize money by inserting money into a tool in the form of a box which outputs sound via Dfplayer without touching it, making it easier and more effective to recognize rupiah banknotes. After testing, it produces a score of 36, which means the system is "Very Effective."

SUGGESTION

From the conclusions above and the system that has been created, several suggestions can be put forward for consideration for further development, namely as follows:

1. For better results in reading banknotes, this tool can be combined with an image capture tool in the form of a camera and then the image results are processed by software to get smaller and more accurate error reading results.
2. So that this tool is easier to function as it should, it would be better
   if the power source can be replaced with a battery.
3. For the final project, it can be further developed so that this tool can detect more than two editions of money output.

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