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To cite this article: Ramiati *et al* 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **846** 012008

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# Recognition of Image Pattern To Identification Of Braille Characters To Be Audio Signals For Blind Communication Tools

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**Abstract.** The five senses are a source of information in humans. The sense that is the main source of information is the sense of sight. Some humans are created with limited sense of sight. The blind performs reading and writing activities using Braille characters. Braille characters are writing or printed systems for the visually impaired in the form of codes consisting of six dots in various combinations that are highlighted on the paper so that they can be touched. Those with significant visual impairment need special education or learning services. Information is very important for everyone, including blind people. Submission of information is done through various media. One media that is often used is print media such as books. But books available on the market do not adapt the way for blind people to capture information. This research offers alternative solutions to overcome the above problems, namely communication aids for reading the blind. The implementation is in the form of a scanner and webcam that is equipped with a braille character text to speech system as an alternative to the lack of blind reading media, especially braille print books. The method, the reading of Braille character scripts by studying braille characters from a to z. First, a webcam or scanner captures braille characters. Second, the system will convert Braille characters and translate Braille characters into alphabetical form through Optical Character Recognition (OCR) image processing. Recognition of Braille character patterns in written text using Artificial Neural Networks (ANN). The results of research on braille character testing are in the form of alphabetical texts a to z, and audio signals of alphabet pronunciation. The results of testing the introduction of braille character patterns using a scanner for training data 100% and for testing data 90.38 % and 96.15 %.

## 1. Introduction

Braille character converter system is a system that can translate Braille characters into latin characters automatically. The system changes the image of braille letters and the identification of alphabetical letters and binary data from Arduino UNO. From the results of testing Braille with the camera using a time from 3 seconds to 5 seconds, the accuracy rate is 92.3% [1]. The system will recognize Braille characters and classify Braille characters into text using the Optical Character Recognition (OCR) method. Then the system will change the braille character that has become a latin character (text) into sound using a diphone system that will chop words into syllables. Diphone system used is using the Text To Speech application [2].



Inspired by the superiority of the human brain, the field of Artificial Neural Network (ANN) or a network of artificial brain cells has been developed to enable the learning process to be implemented in a system [3]. ANN is used to identify braille characters [4]. This new breakthrough makes the intelligence system a step further [3]. Braille research continues to be developed, both hardware and software. Braille research uses computer vision[5]. This research will design a braille character translator system using the Artificial Neural Network (ANN) method. Broadly speaking, this research is braille image processing with sound output with a mini PC, so that braille letters or braille character scripts can be enjoyed by listening. This literature review aims to create a Braille character translator system into an audio signal using ANN through image processing.

## 2. Methodology

The research method process in this research uses an experimental method which consists of the study of literature, hardware design, and software development.

### 2.1 Literature study

At this stage the literature discussion activity of a study is carried out by planning a braille characters recognition system in which the results are written text and sound signals, where the writer collects data and learns relevant basic theories from various sources.

The following are the stages of the research methods used in this study as follows:

#### 1. Data Collection

In this study the data used include:

##### a. Sample Data

Braille characters or letters are letters used by blind people to read and write. Braille characters data with a six-point pattern in the form \*.jpg.



Figure 1. Braille Characters[6]

##### b. Target data

This data was obtained from training data which is in the form of targets of letters of the alphabet that identify from braille characters.

##### c. Training data and testing data

This data is used as a training and testing process system.

#### 2. Data Processing

In data processing, data in the form of braille character images are processed using digital image processing principles to obtain the characteristic features of each braille character. Digital signal processing to identify braille is also applied at this stage with the support of a raspberry pi device[7].

### 2.2 Hardware Design

At this stage the activity carried out by the writer is to make a hardware design based on Figure 2.

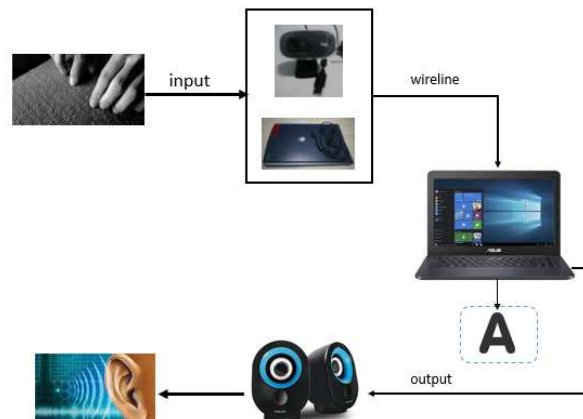


Figure 2. Design of Communication Devices for the Blind Text To Speech

At this stage, the interface display is designed based on the Graphical User Interface (GUI). The purpose of using the interface design based on this GUI is to facilitate the display in the use of the system.

In this study the manufacture of hardware or systems that are built begins with taking pictures of braille characters. The hardware used in this system is a PC (laptop), camera or webcam (Logitech C270 HD), scanner (CanoScan Lide 20) and speakers as sound output. Braille characters are captured by webcam and scanner. Communication between the laptop and webcam / scanner uses Wireline.

### 2.3 Software Development

At this stage the authors carry out the process of design and manufacture of software for data acquisition, image capture braille characters. Braille image processing using matlab[8][9], block diagram of braille character image processing in figure 3.

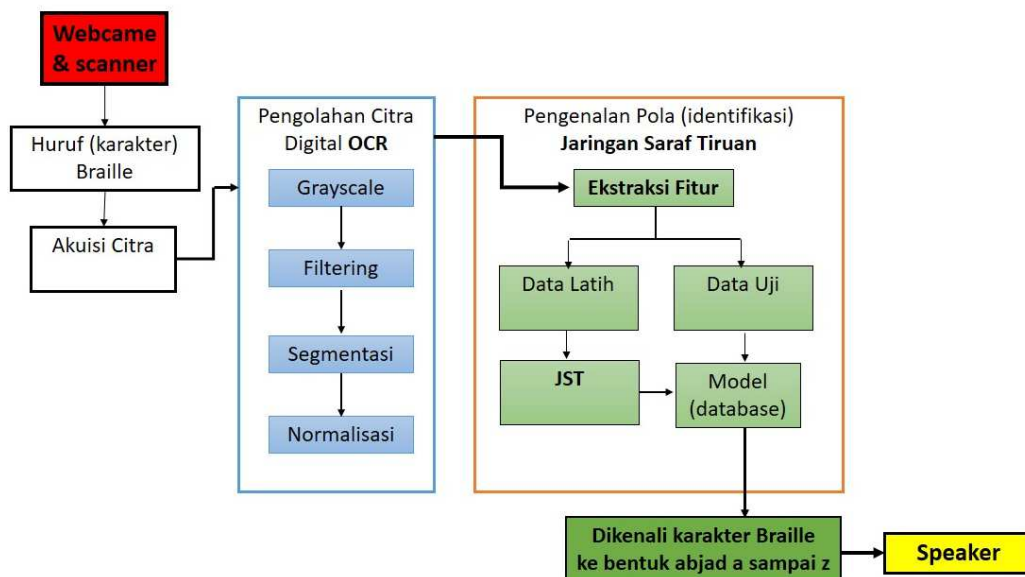


Figure 3. Braille Character Signal Processing Block Diagram

Based on Figure 3, digital image processing is the camera capturing braille letters. The result is a digital image of braille letters analyzed and image acquisition per character[10]. Then the results of image acquisition are processed using digital image OCR to identify the image of letters and numbers that are converted into writing files. The stages of digital image processing are grayscale, filtering,

segmentation and normalization. After that, the feature extraction process uses the Multi-level thresholding method in the form of a binary pattern.

Then proceed with the introduction of image patterns. The result of image feature extraction is to obtain certain characteristics of the observed letter characters. Image data that has features is saved and pattern recognition is performed. The process of pattern recognition of an image is divided into two, namely the process of training data and test data. The training data is obtained using the Artificial Neural Network method to produce a training model as a database. The training model is used for the testing process. The test results in the form of identification of braille character identification. Finally audio signal processing. This stage produces sound signals based on identification of recognizable braille letter patterns.

### 3. Result and Discussion

The review of literature studies in this study is limited to journals published in 2010 to 2018. The results of the implementation of the introduction of braille character patterns into sound signals using matlab. Image processing and pattern recognition of braille images using Artificial Neural Networks and output into voice signals using text to speech. Pattern recognition consists of training and testing. Braille letters are taken from braille books that are captured using a *webcam (Logitech C270 HD Webcam)* and scanner (*Scanner Canon Canoscan Lide 20*) with an image resolution of 165 pixels x 110 pixels.

At the training stage using the Radial Basis Function Network (RBFN) Neural Network. The accuracy of training and testing depends on the training parameters. The training used 48 samples of braille font images where 26 samples used HVS paper and 26 samples used drawing paper. Table 1 below shows the training parameter values.

Table 1. Training Parameters

No	Parameter	Value
1	Max. number of neurons	15
2	Number of neuron to add between display	25
3	Param. goal	1e-06
4	spread	1

#### ➤ Braille Character Image Processing Results

At this stage, the data set is processed using digital image processing techniques to obtain feature extraction from each braille character. The process begins with enhancement techniques, namely the transformation of RGB (color) images into grayscale form. The goal is to determine the distinguishing regions in the image with the condition of only two black and white colors. Figure 4 Data Processing Results of Braille Character Images.

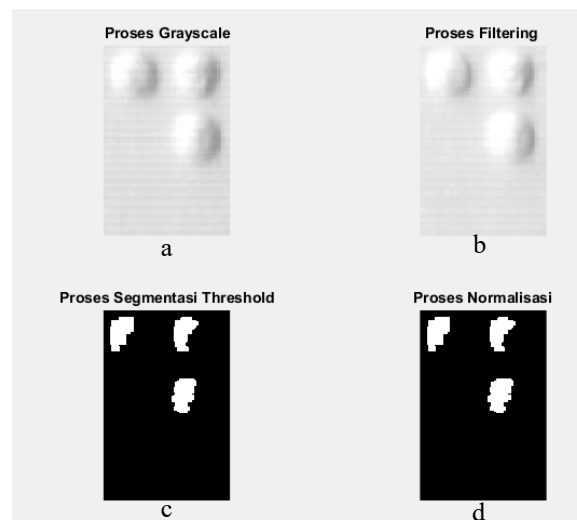


Figure 4. Data Processing Results of Braille Character Images

The second process is filtering to reduce noise, so the resulting image is smoother. Filtering results can be seen in Figure 4b. The third process of segmentation is to divide the image into segments and focus on specific objects. The results of segmentation like Figure 4c. And the final image processing is normalization. Normalization is done before entering the recognition process. This process aims to adjust the input image data with image data in the database. The results of normalization are shown in Figure 4d.

The result of the extraction of the braille letter images. Feature extraction aims to determine the characteristics of each of each braille character. The feature extraction method used in this study is a binary pattern. Multi-level thresholding is an image segmentation method that uses two or more threshold values. Its characteristic extraction technique is converting pixel values to grayscale images into binary or Multi-level thresholding. The results of the extraction of braille characters can be seen in table 2 and figure 5.

Table 2. Data Extraction Results Braille Characteristics

Feature1	Feature2	Feature3	Feature 4	Feature5	Feature6	Target
1	0	0	0	0	0	a
1	0	1	0	0	0	b
1	1	0	0	0	0	c
1	1	0	1	0	0	d
1	0	0	1	0	0	e
1	1	1	0	0	0	f
1	1	1	1	0	0	g
1	0	1	1	0	0	h
0	1	1	0	0	0	i
0	1	1	1	0	0	j
1	0	1	0	0	0	k
1	1	1	0	0	0	l
1	1	0	0	1	0	m
1	1	0	1	1	0	n
1	0	0	1	1	0	o
1	1	1	0	1	0	p
1	1	1	1	1	0	q
1	0	1	1	1	0	r

0	1	1	0	1	0	s
0	1	1	1	1	0	t
1	0	0	0	1	1	u
1	0	1	0	1	1	v
0	1	1	1	0	1	w
1	1	0	0	1	1	x
1	1	0	1	1	1	y
1	0	0	1	1	1	z

The results of identification of braille letter pattern recognition for 100% training data and 100% testing data, can be seen in table 3. For experiments on braille letter pattern recognition can be seen in test 1 (HVS paper) with 90.38 % accuracy results. Testing 2 (drawing paper) with an accuracy of 96.15 %. Testing 1 and testing 2 using a scanner, the results of its implementation can be seen in Figure 7. Testing 3 using a webcam with an accuracy of 57.69 %, can be seen in figure 6. The results of Braille Recognition Experiment can be seen in table 3.

Table 3. Result of Braille Recognition Experiment

Phase	Percentage	Error
Training	100 %	0
Testing	100 %	0
Testing 1	90.38 %	9.62 %
Testing 2	96.15 %	3.85 %
Testing 3	57.69 %	42.31%

In the next stage, an interface is implemented using the Matlab Interface GUI. Figure 5 shows the results of the implementation of the interface in this study. Figure 6 and Figure 7 are the experimental display of braille character identification experiments.

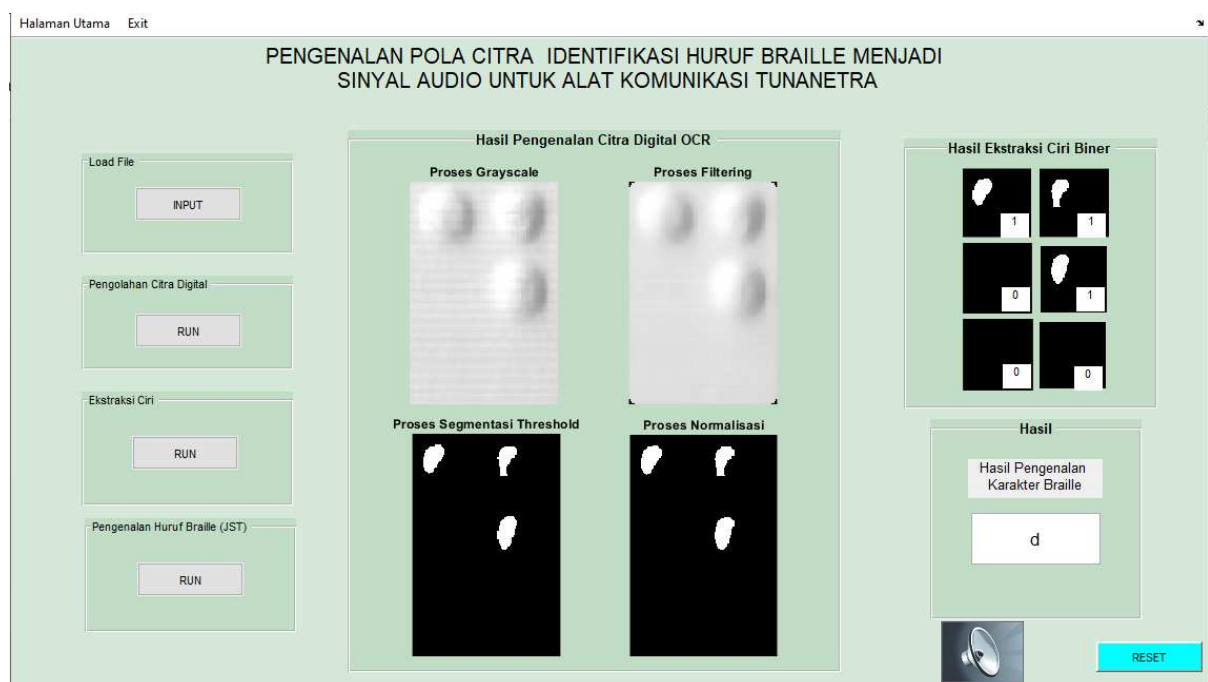




Figure 5. Results of the Implementation of the Pattern Recognition System for Braille Character Images Into Sound Signals

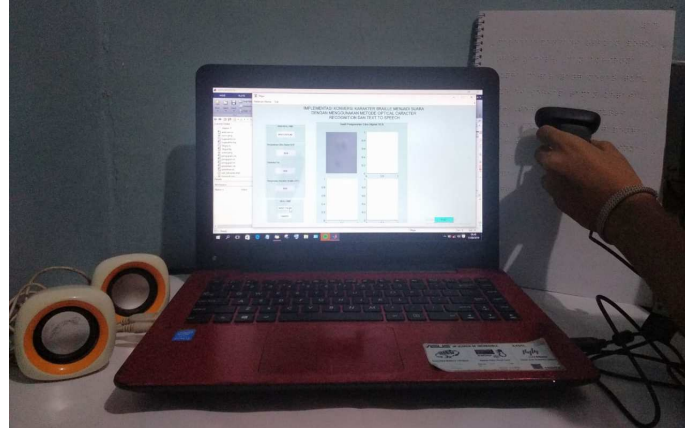


Figure 6. Integration Design of Real Time Braille Character Identification Program using Webcam

Braille character test results using a webcam are far from perfect because of its low accuracy. The system encountered an identification error of 42.31%. Errors due to several reasons, namely the object or sample that is too small, the webcam's focus in recognizing the sample, the webcam's distance from the sample, and the intensity of the light used. The test results can be seen in Figure 6.



Figure 7. Display Experiment Identification of Braille Letters into Audio Signals for Blind Communication Tools using Scanners

#### 4. Conclusion

Based on testing and evaluation results of this study can be concluded as follows:

1. Artificial Neural Network pattern recognition method with feature extraction of multi-level thresholding binary patterns can recognize Braille characters well with testing accuracy of 100%, 90.38%, 96.15% and 57.69%.
2. This research can be a reference to facilitate communication with the blind. The implementation in this study uses matlab integration with the device, while testing in realtime in the process of using the Raspberry Pi mini PC.

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