New Simple Algorithm for Detecting the Meaning of Pigpen Chiper Boy Scout ("Pramuka")

Dwijayanto G. Parrangan and Theofilus Parrangan

Informatics Engineering Department, University Atma Jaya Yogyakarta
p.dwijayanto@gmail.com, theoaruto@gmail.com

Abstract

In this research, detection the meaning of pigpen chiper using a modification of the k-nearest neighbor algorithm. The detection process is by reading the image that contains the pigpen chiper, separating the pigpen chiper characters that exist in the image, and then detects the meaning of a pigpen chiper character one by one by comparing each pigpen chiper character with the images in the database, so it can be obtained an image to be used as a reference to detect the meaning of each pigpen chiper character. By using the proses, system can detect the meaning of pigpen chiper with 80% of accuracy. The calculation process is also very simple and fast.

Keywords: pigpen chiper, boy scout, k-nearest neighbor

1. Introduction

Scouting was founded in the Dutch East Indies in 1912, and Indonesia became a member of the World Organization of the Scout Movement (WOSM) in 1953. Each year August 14 is celebrated as Pramuka Day to honor the organization's first public parade. "Scouting" is mean the work and attributes of backwoodsmen, explorers, and frontiersmen [1]. Scouting provides youth with an opportunity to try new things, provide service to others, build self-confidence, and reinforce ethical standards.

In Indonesia, boy scout is know as "Pramuka". Pramuka was derived from the abbreviation of "Praja Muda Karana", meaning "young people willing to work". Pramuka also derived from the word "paramuka" ("poromuko" in javanese), meaning a kind of troops that stands at the forefront in the battle. Pramuka has a variety of passwords or chiper, like a morse code, grass chiper, semaphore, pigpen chiper, *etc*. In this research will be discussed on the detection of the meaning of the pigpen chiper.

2. Pigpen Chiper

Pigpen chiper often called Freemason Chiper. This chiper is used by Freemason in the 16th century to save his personal notes. At this cipher, each letter of the alphabet will be changed to a symbol. Each letter is represented by a part of the box or the "pigpen" (pig pen) that surrounds it. If the second letter in the box, it needs to add a point in the center [2]. The key of the pigpen chiper can be seen in Figure 1.
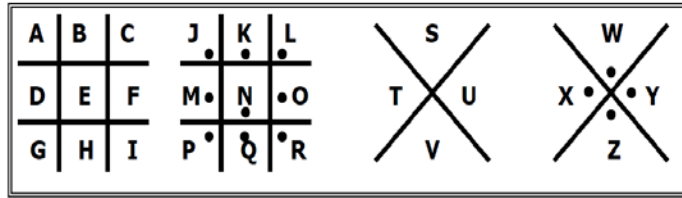
Figure 1. Key of the Pigpen Chiper

3. K-Nearest Neighbor Algorithm

K-Nearest Neighbor is an algorithm to perform classification of objects based on the distance learning data closest to the object. including k-nearest neighbor algorithm where the supervised learning new instance query classified based on the majority of categories in k-nearest neighbor. Class that appears most will be the class of the classification results. The purpose of this algorithm is to classify new objects based on attributes and training samples [3-5]. Classification is the process of finding a set of models or functions that describe and distinguish classes of data for the purpose so that the function can be used to predict the object whose class label is unknown [6]. K-Nearest Neighbor usually use a Euclidien to determine the distance of the nearest. Euclidien formula is used as below.

$$D_{euc}(P,Q) = \sqrt{\sum_{i=1}^{n} (p_i - q_i)^2}$$

4. Algorithm Approach using K-Nearest Neighbor

Algorithm used for this research was a modified algorithm k-neighbor. The difference was instead of using Euclidean formula, it was done by counting how many similar white colour between the detected image with the image in database.

The steps of this algorithm were divided into 3 steps:
a. Making database.
   1. Draw images that would be used as database.
      The images consist of only two colours, black and white. Each image made will represent a character from pigpen code.
   2. Making a Label File.
      File Label is a file that contains the name of the image and letters are represented by the images. This image will be used as database.
b. Detecting the image of pigpens's character.
   1. Reading image that would be detected.
      The image that would be detected usually consist of some character or one character minimum. The colour of that character then changed into white and the background would be changed into black. This was made so the image would have the similar pattern with the image in the database, which comprises only two colours, black and white.
   2. Splitting the characters into several images.

Only the images from the pigpen's character would be taken. each character would be made into one image. So, if there were 5 characters in the image, 5 new images would be made. These images would then detected one by one.

c. Detecting the meaning of the character.

    1. Read and then convert the images in database into matrix.

    2. Read and then convert the character codes that had been detected into matrix.

    3. Do the calculations.

        The detected character would be then compared with every image in databse. The system would count how many similar white colour between the images. Image that have the biggest count would be used as a reference to detect the meaning of the image of detected character.

    4. Determine the meaning of the image of the pigpen's character.

        Based on the name of the image in database which is used as a reference, the system would then determine the meaning of the image of the character. This would be determined based on data in the label file.

5. Experiment

The experiment in this research was conducted using MATLAB (labolatory) program, as shown on Figure 2.
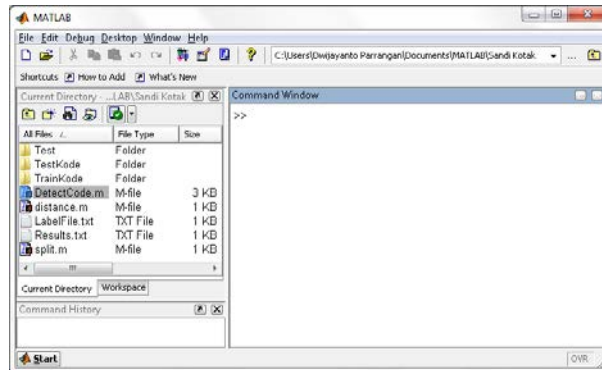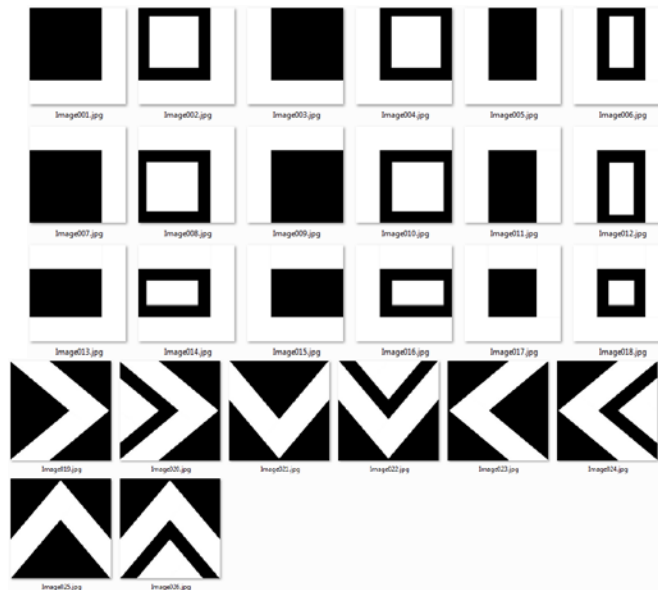

Figure 2. MATLAB Interface

The experiment conducted based on steps of the algorithm above:

a. Making database

    1. Draw images that would be used as database.

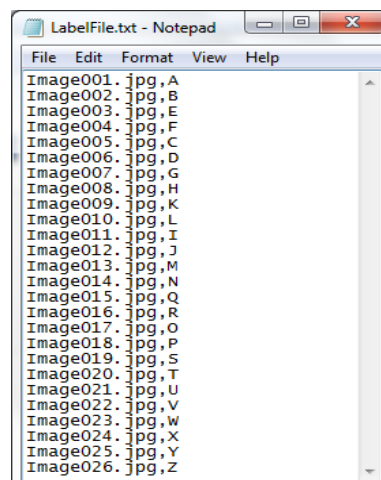   The dimension of images in database (Figure 3) were 400x400 pixel and made using Adobe Photoshop.

Figure 3. Images used as Database

2. Making label file

Label file (Figure 4) was made based on pigpen's code keyword. For example, letter 'A' represented by 'image001', letter 'B' represented by 'image002', *etc*.

```
LabelFile.txt - Notepad
File  Edit  Format  View  Help
Image001.jpg,A
Image002.jpg,B
Image003.jpg,E
Image004.jpg,F
Image005.jpg,C
Image006.jpg,D
Image007.jpg,G
Image008.jpg,H
Image009.jpg,K
Image010.jpg,L
Image011.jpg,I
Image012.jpg,J
Image013.jpg,M
Image014.jpg,N
Image015.jpg,Q
Image016.jpg,R
Image017.jpg,O
Image018.jpg,P
Image019.jpg,S
Image020.jpg,T
Image021.jpg,U
Image022.jpg,V
Image023.jpg,W
Image024.jpg,X
Image025.jpg,Y
Image026.jpg,Z
```

Figure 4. Label File

b. Detecting the image of pigpen's character.

1. Read the image that would be detected.
   Image that would be detected in ths experiment has .jpg format and comprises 7 characters. Figure 5 was the real image and after converting the coulour would be changed into Figure 6.
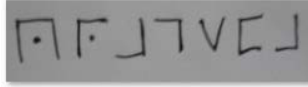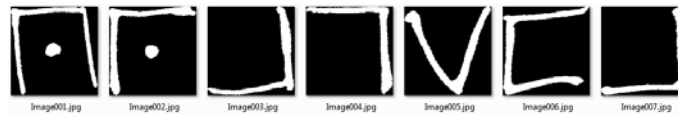
Figure 5. Image that Would be Detected

Figure 6. Image after Converting Process

2. Splitting the characters into several images.
   7 images of character (Figure 7) would be formed from Figure 6, which is the would be detected one by one. These images would be changed into 400x400 pixel, the same as the dimension of images in database.

Figure 7. Result of Splitting Process

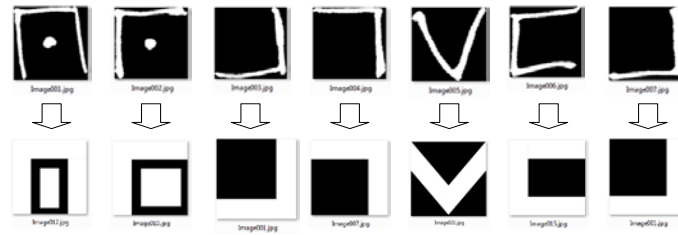c. Detecting the meaning of pigpens's character.

   1. Read and then convert the images in database into matrix.
   2. Read and then convert the character codes that had been detected into matrix.
   3. Do the calculations.
   The calculation performed by counting how many silmilar white colours between the image of the character and every image in database, as shown on Figure 8. Reccurence i and j would be done 400 times, because the matrix formed had dimension of 400x400.

**Figure 8. The Calculations used for Detection**

The claculation would be done for every images of character. From the reseult, reference image would be drawn from each pigpen's character image, as shown on Figure 9.

**Figure 9. Character Image (Top) and the Refrence Image (Bottom)**

4. Determine the meaning of pigpen's character image

Based on image name from image databse that being used as a reference, the system would then determine the letters from detection result (Figure 10)
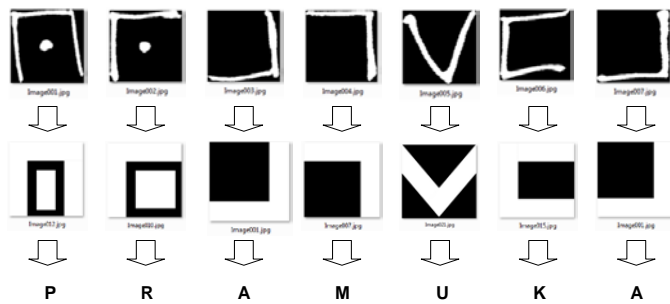
Figure 10. Detection Result

Based on the process above, the result of detection would then saved to result.txt file. this file contained name of the image of the detected pigpen's character image, the expressed detection result of the detected image, and the name of the refrence image (Figure 11)
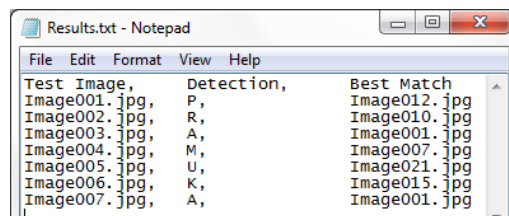
Figure 11. Result File

Figure 12 shown the interface of detection process that was performed on MATLAB.

```
Command Window
>> detectkode
Loading Train Image # 1
Loading Train Image # 2
Loading Train Image # 3
Loading Train Image # 4
Loading Train Image # 5
Loading Train Image # 6
Loading Train Image # 7
Loading Train Image # 8
Loading Train Image # 9
Loading Train Image # 10
Loading Train Image # 11
Loading Train Image # 12
Loading Train Image # 13
Loading Train Image # 14
Loading Train Image # 15
Loading Train Image # 16
Loading Train Image # 17
Loading Train Image # 18
Loading Train Image # 19
```

```
Loading Train Image # 20
Loading Train Image # 21
Loading Train Image # 22
Loading Train Image # 23
Loading Train Image # 24
Loading Train Image # 25
Loading Train Image # 26
Loading Test Image # 1
Loading Test Image # 2
Loading Test Image # 3
Loading Test Image # 4
Loading Test Image # 5
Loading Test Image # 6
Loading Test Image # 7

Result: P R A M U K A

Done
ans =

     1
```
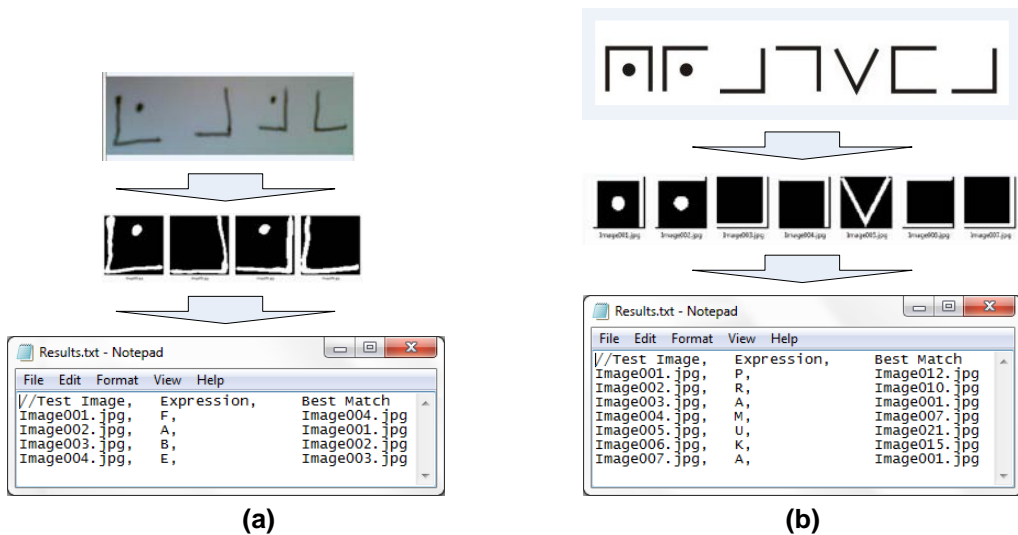
Figure 12. Detection Process on MATLAB

Below were another experiments conducted based on this research. turns out not all pigpen's character image could be detected correctly. From 5 experiments that were conducted below, 3 images were perfectly detected, while the other 2 were detected incorrectly (resulted in wrong letters). 3 images with succesful detection are Figure 13a ("FABE"), Figure 13b ("PRAMUKA"), and Figure 13c("BERNADETTA"). 2 images with failed detection are Figure 13d and Figure 14d. On Figure 13d, the pigpen was decoded as "DEFI" while the result of detection was "JEFI". On Figure 13e, the pigpen was decoded as FACEBOOK, while the detection result was "FCCEBOOK".
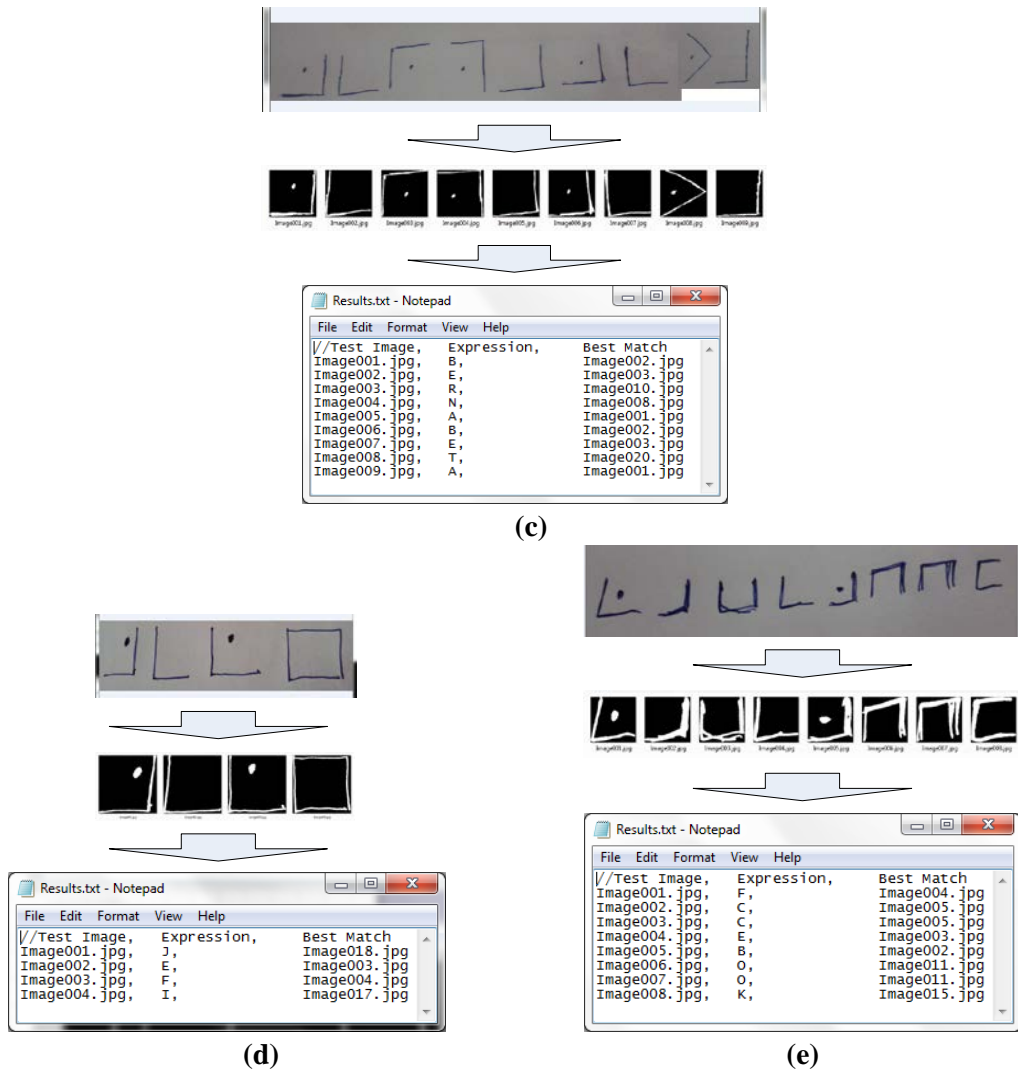
```
Results.txt - Notepad
File  Edit  Format  View  Help
//Test Image,    Expression,      Best Match
Image001.jpg,    F,               Image004.jpg
Image002.jpg,    A,               Image001.jpg
Image003.jpg,    B,               Image002.jpg
Image004.jpg,    E,               Image003.jpg
```

(a)

```
Results.txt - Notepad
File  Edit  Format  View  Help
//Test Image,    Expression,      Best Match
Image001.jpg,    P,               Image012.jpg
Image002.jpg,    R,               Image010.jpg
Image003.jpg,    A,               Image001.jpg
Image004.jpg,    M,               Image007.jpg
Image005.jpg,    U,               Image021.jpg
Image006.jpg,    K,               Image015.jpg
Image007.jpg,    A,               Image001.jpg
```

(b)

(c)

(d)

(e)

Figure 13. Several Images that had been Detected

6. Conclusion

As shown by this research, the proposed algorithm could be used to detect or decipher pigpen's code with 80% accuracy. Data input used for this research were pictures that has the image of pigpen's code character and has .jpg format. Increasing the number of images added to database can be done to improve the accuracy of detection. So, increasing the images used as database would produce more accurate results.

Acknowledgements

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Authors

Dwijayanto Gusti Parrangan received his Bachelor and Master degree in Atma Jaya University Yogyakarta, Indonesia in 2011 and 2013. His research interests in Mobile Computing and Image Processing.

Theofilus Parrangan is a student of Informatics Engineering, Atma Jaya University Yogyakarta, Indonesia. His research interests in Enterprise Information Systems.