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Preserving Sasak Lontar Heritage: Digital Image Enhancement using Active Contours

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***Abstract*— This research examines the object of Lontar Sasak's images in digital format. The image is taken using a scanner that uses sound pressure waves that oscillate with a higher frequency (Ultrasonic) to measure distance and find objects that you want to know in Sasak lontar. Philologists still cannot detect the Sasak script on the Sasak Lontar based on the image alone, because the resulting image is still blurry and unclear. A more accurate detection of the Sasak Lontar Image is done by taking a CT (Computed Tomography) Scan image of the Sasak lontar. However, the cost required for scanning is huge and not all Sasak lontar in the community and those in the NTB Museum which still have limited scanning machines. The method used first inputs the RGB image of the Sasak Lontar and changes it to grayscale, then performs the contour initialization step, followed by Sasak lontar script mapping using the Active Contour method, which produces binary segmentation. The next step is RGB segmentation, which is the result of Sasak script detection on the Sasak lontar. The purpose of this research is the application of the Grayscale-based Active Contour method to improve the readability of the Sasak lontar. This research can enhance the accuracy of script detection on the Sasak lontar using the Grayscale-based Active Contour method.**

***Keywords*— Sasak Lontar, Image, Active Contour, digital, Scan**

I. INTRODUCTION

Indonesia is famous for its diverse tribes, each with a unique culture and traditions [1]. However, globalization threatens this diversity because foreign cultures are considered more interesting, unique, and practical [2]. The Sasak script remains an important medium for communication in Lombok, NTB, but writing it is becoming less common [3]. Generation Z faces numerous challenges, including difficulties in reading the Sasak script [4]

The Sasak script also known as the Baluk Olas script, has two forms: the script used in social rituals and the standard script used for everyday writing and literary works [5]. Lontar Sasak is a form of signs, symbols, stories and events that are expressed in written form and created or compiled in their time [4]. Lontar Sasak certainly contains important information written by earlier generations starting from the history of a nation, places religion and more [6]. Therefore, the authenticity of the manuscript is a very sacred thing to be protected [7][8].

The lontar sasak script, including the Sasak script written on lontar, is very important as a cultural artifact that forms part of the community, knowledge, tradition, and history [9]. This lontar contains information about social life, beliefs, arts, and sciences that have been passed down from generation to generation as part of the advancement of technology and knowledge [10].

In our previous research published in the IJASEIT Journal, we developed a mobile game aimed at preserving the Sasak baluq olas (eighteen) script [11]. I Made Sudarsana, et al. in his research entitled Lontar digitalization on lontar study center, Udayana University, Denpasar, found that the digitization of lontar has an impact on the use of digital devices making it easier to access ancient lontar [12].

The current development of technology and information makes digital imaging very important[13]. Digital images are widely used in various fields, one of which is the field of Ancient Manuscripts of Lontar [3]. Digital imaging in the Sasak lontar script captures conditions that are not directly visible [1]. Each type of digital imaging has its own set of strengths and weaknesses [14].

Digital imaging technology for Sasak lontar manuscripts produces indistinct black and white 2D images, which makes it difficult for Sasak script experts to correctly read the scanned images [15][13]. The quality of the resulting images greatly affects the accuracy of the interpretation or translation [16]. Therefore, it is important to improve the clarity and detail of the scanned images to increase the accuracy and precision of the reading [17][18].

This research aims to solve problems in reading Sasak's scripts with the Grayscale-based Active Contour method. The novelty of this research is the presence of great potential to improve accuracy in the detection and interpretation of Sasak Lontar scripts. By enhancing the image quality, this method is expected to provide clearer and more detailed images, thus aiding Sasak script experts in more accurately deciphering the manuscripts. The results of this study will be validated by comparing them with original Sasak lontar manuscripts housed in the NTB State Museum, evaluated by experts in the Sasak script.

II. Material and Method

A. Sasak Script

Sasak Baluq Olas, or Eighteen Scripts, is named as such because it comprises 18 characters[11]. Each character's pronunciation includes a consonant followed by a vowel ending in "a"[11]. To form words with the Sasak script, you simply place two or more characters together as needed[19]. There are no spaces between words in the Sasak script[11]. The following are the Sasak characters:

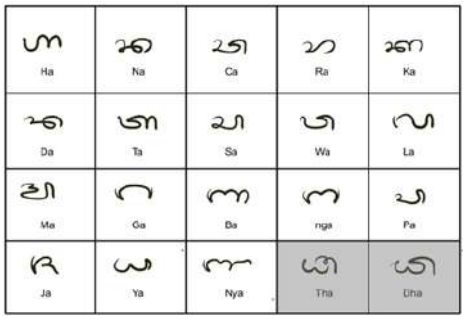

Fig. 1 Sasak Script

In the Sasak script, there are also vowel letters. This vowel is typically used at the start of writing to denote personal identity, place names, and similar references[11].

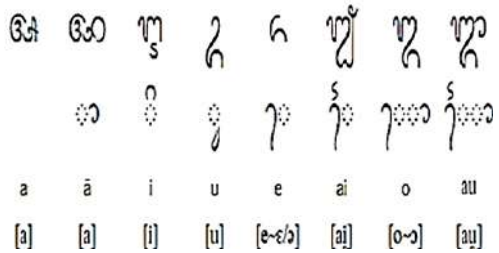

Fig. 2 Vowel Script

Numbers in the Sasak script have distinct symbols, as illustrated in the example below[13]:

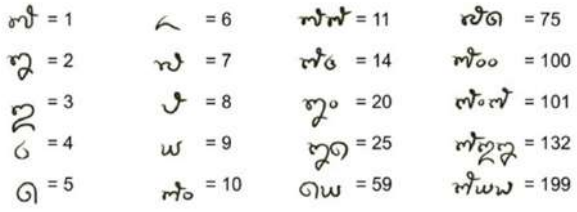

Fig. 3 Number Script

B. Active Contour

The Active Contour technique, also referred to as "snakes " is a method used in image processing to detect the outlines or edges of objects within an image[20]. Inspired by the movement of snakes navigating through energy fields to reach a position this approach involves placing a curve called the "active contour" or "snake" in the image[21]. The contour then iteratively traverses the image to locate the objects boundary, driven by two forces; a force maintaining the contour shape and an external force guiding it towards the objects edge[16].

Applications of the Active Contour method span domains including objects, in medical images tracking moving elements in videos and contributing to fields like image processing and computer vision[22]. Since its inception in 1987, by Michael Kass, Andrew Witkin and Demetri Terzopoulos this method has evolved through adaptations and advancements[23].

Active Contour in this study consists of three types of important processes, namely contour initialization, binary segmentation, and RGB segmentation[24]. These stages are designed to improve the accuracy and sharpness of Sasak lontar images in detecting Sasak script, so as to provide useful information in its readability.

C. Research Stage

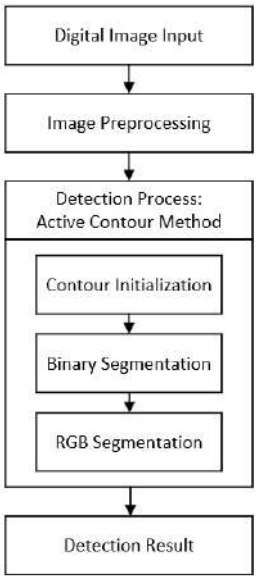

Fig. 4 Research Stage

1) Digital Image Input

This image input contains the original image data used as input in the research[25]. The image data used is in the *.jpg digital file format. All test images used are in grayscale format with a resolution of 1080 x 1350 pixels. This size was chosen to maintain uniform dimensions in the test images to be studied. The test images consist of three images[16].

2) Image Preprocessing (RGB to Gray Process)

The image preprocessing stage is a research step carried out before the main processing of the image under study[26]. The main objective of this stage is to provide good and accurate image data before the main processing is conducted, so that the results obtained after the main processing are better, precise, and accurate[27]. In this research, the image preprocessing stage involves converting the RGB color input image to Grayscale[28].

3) Sasak Lontar Detection Process

Active Contour in research involves several important steps[29]. First, an initial contour is initialized that describes areas[30] that may contain Sasak script. This step makes it possible to focus the detection on relevant areas. Next, iteration is performed to optimize the contour position by considering factors such as image gradient and internal energy of the contour[16].

4) Sasak Lontar Detection Results

The result of Sasak Lontar image detection is the final stage in this research, where the goal is to display part of the clean Sasak lontar image so that it is easier to read. This detection process is the result that combines the previous steps from beginning to end. The detection results that have been identified in the previous RGB segmentation process, which have irregular spheres with yellow edges, are converted into yellow perfect circles with the same position as the RGB segmentation results[31].

III. RESULT

A. Digital Image Input

The Sasak Lontar digital image input process involves several important steps to produce a quality digital image ready for further processing. The first step is to acquire images of Sasak Lontar. Image Acquisition can be done using a high-resolution digital camera placed in the right position to get clear and focused images. Sufficient and even lighting is essential to ensure good image quality.

The digitization process carried out consists of the stages of selection, shooting, editing, and saving. The real description of the manuscript digitization process carried out, the author provides an overview of the flow of the manuscript digitization process as follows: damage ± 60% such as broken, dry, and perforated manuscript conditions. Next, the image capture process is carried out using a Canon EOS 7D digital camera. Manuscripts that have been photographed will automatically enter the computer. The results of the manuscript shots are then edited to tidy up the image. The first editing process that is carried out using Microsoft Office Picture Manager is to do cropping and lighting (contrass). After editing, then proceed with editing the incorporation of manuscript transliteration using Corel Draw. After it is considered neat, then the digital file is stored in a folder according to the script code.

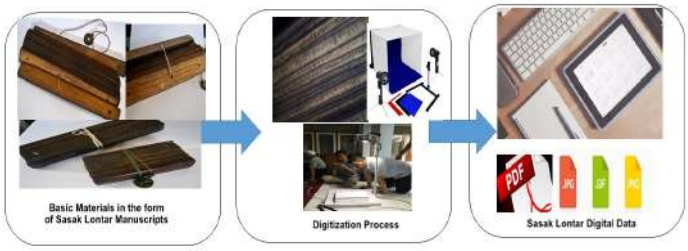

Fig. 5 Image Acquisition

Figure 6 below shows a sample of a Sasak lontar manuscript.

Fig. 6 Sample Sasak Lontar Manuscript

B. Image Preprocesssing

Image pre-processing of Sasak lontar is an important step in the process of digitizing Sasak lontar manuscripts. The main purpose of this stage is to provide good and accurate image data before the main processing is carried out, so that the results obtained after the main processing process are better, precise, and accurate. In this research, an image pre-processing stage is carried out by converting the RGB color input image into Grayscale. The following is Algorithm and Pseudocode for RGB to Grayscale conversion.

1) Algorithm: RGB to Gray

- Read the input image
- Convert RGb image to Gray
- Display Grayscale Image

2) Pseudocode: RGB to Gray

Input:

Image input

Img = imread(fullfile(name_folder,name_file));

Initialization:

Img_gray = rgb2gray(Img);

Output:

figure, imshow(Img_gray);

Pseudocode illustrates the steps to convert a color image into a grayscale image. First, the input image is input using the imread function. Then, the image is converted to a grayscale image using the rgb2gray function and stored in the Img_gray variable. Finally, the resulting grayscale image is displayed using the imshow function. By using this Pseudocode, a color image can be converted into a grayscale image for use in further image processing.

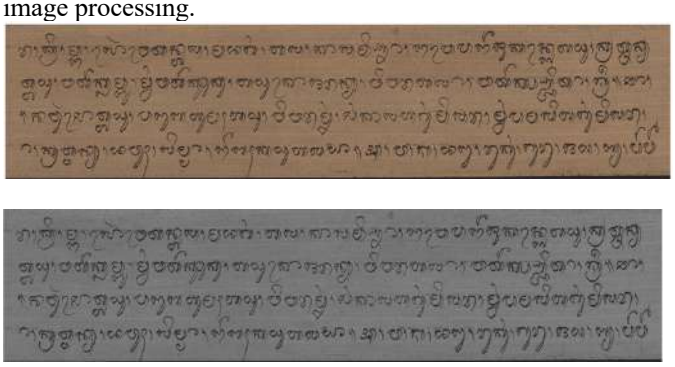

Fig. 7 Example of Image Preprocessing

C. Sasak Lontar Detection Process

The Active Contour method, also known as “Snakes” or “Level Sets”, is an effective image processing technique for detecting objects with fuzzy or complex boundaries[23], such as Sasak Lontar. This method works by defining an initial curve around the object to be detected and then iteratively updating the curve to minimize internal and external energy.

The Active Contour method has several advantages for Sasak Lontar detection, namely:

- Ability to detect objects with unclear or complex boundaries: Sasak Lontar often have unclear and complex boundaries, so the Active Contour method is very suitable for detecting such objects.
- Resistance to noise: The Active Contour method is resistant to noise in images, so it can produce accurate detection even in noisy images.

- Ability to adapt to different shapes of Sasak Lontar: Sasak Lontar can have various shapes and sizes, and the Active Contour method can adapt to these various shapes.

1) Contour initialization

The contour initialization process is the process of recognizing the coordinate position of all sasak lontar areas detected in the image so that it becomes a unified object or a certain pattern so that it can be recognized as a complete object[32]. The contour initialization process is carried out with the aim of providing knowledge to the system which is made which is the Sasak lontar region and which is not the Sasak lontar region from the input image. The following is the contour initialization algorithm:

- Recognize the coordinates of Sasak Lontar area image
- Activates the coordinates of the Sasak Lontar area as an object boundary
- Stores the coordinate values of the Sasak Lontar area as an object boundary
- Connects each Sasak Lontar area coordinate as an object boundary line
- Saves the object boundary line as a contour
- Display the object boundary line

2) Binary Segmentation

Binary segmentation is a segmentation performed on the image into two types of segmentation (binary), namely segmenting the image into black and white colors. This is done with the aim that the Sasak Lontar image can be used for mapping the Sasak lontar area.

Binary Segmentation Algorithm:

- Read the contour initialization image
- Perform active contour method
- Performing binary segmentation process
- Display the result of the active contour method (binary segmentation)

3) RGB Segmentation

RGB segmentation is the process of displaying the results of Red Green Blue (RGB) segmentation that has been done in the previous process. In this result, the image will be seen in the form of 3 colors, namely the colors Red, Green, Blue. With the results of this image, the boundaries of the detected objects will be displayed in the form of colored lines.

The following is the RGB Segmentation Algorithm:

- Read the RGB segmented image
- Calculating the area of sasak lontar
- Saves the RGB segmentation result image
- Display the RGB segmentation result image

Figure 8 below is an example of the expected result of RGB segmentation.

Fig. 8 Example of Sasak Lontar Detection Process

D. Sasak Lontar Detection Results

The result of sasak lontar detection is the final stage in this research, where the goal is to display part of the sasak lontar image. This detection process is the final result that combines the previous steps from start to finish. In the detection result, the sasak lontar that has been identified in the previous RGB segmentation process, which has an irregular circle shape with yellow edges, is converted into a yellow perfect circle with the same position as the RGB segmentation result. The following below is the algorithm used to perform sasak lontar detection results.

- Read the RGB segmented image
- Calculate centroid and radius values
- Display the detection result image of sasak lontar

Figure 9 below is an example of the expected result of sasak lontar detection.

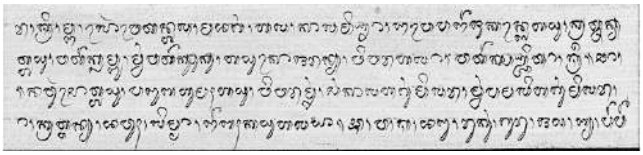

Fig. 9 Expected Result of Sasak Lontar Detection

IV. CONCLUSIONS

This research investigated the application of the Grayscale-based Active Contour method for enhancing the readability of Sasak Lontar manuscripts. By addressing the challenges posed by current digital imaging technologies, which often produce unclear or blurry 2D black-and-white images, this method aims to improve the accuracy and clarity of these images. There must be an improvement in image quality for accurate interpretation and translation by Sasak script experts.

The results indicate that Sasak lontar scripts can be efficiently identified and enhanced from 2D photos using the Active Contour approach, which greatly increases the scripts' readability. We estimate that the accuracy rate using the active contour method can reach 86% after validation by Sasak script experts.

Further research can be carried out to enhance the accuracy of identifying and interpreting lontar manuscripts. One of them is by combining AI and machine learning technology. Combining AI and conventional image processing such as the active contour method can enable the creation of an automated and complex system for the preservation and digitization of ancient manuscripts.

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