Using Artificial Intelligence to Identify the Similarity of Architectural Styles: An Application Using Architecture Style Similarity Identifier

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This paper explores the use of Artificial Intelligence (AI) in identifying architectural style similarities. The research aims to maintain the beauty of the environment and traditional building forms around Borobudur Temple. It provides a critical review of previous important research that addresses the issue of using AI in architectural decision-making, particularly about architectural styles. The research resulted in an AI-assisted application called ASSI that can identify architectural style similarities. The application works by analysing building features and comparing them with a database of architectural styles using a CNN (Convolutional Neural Network) approach.

The results show that the ASSI application can accurately identify architectural style similarities and can be used to assist architects and designers in creating new buildings that are in harmony with the traditional architecture of the region. Overall, this research makes a valuable contribution to the fields of architecture and AI and has practical applications for preserving traditional architecture in a historical context.

Keywords: Artificial intelligence, Javanese architecture, Architecture styles similarity, Convolutional Neural Network

Introduction

Borobudur Temple complex is the most significant Buddhist relic in the world and was built between 780-840 AD in the Syailendra Dynasty period. This temple is in the Kedu Valley, Central Java, Indonesia. It is currently developed based on Presidential Regulation Number 50 of 2011 concerning the 2010-2025 Tourism Development Master Plan. The Borobudur area is handling many Heritages Impact Assessment (HIA) reports from UNESCO as a form of large-scale development, one of which is the development of the Kembang Limus Community Center area within a radius of three kilometers from the Borobudur temple area and Kujon Art Market (Direktorat Jenderal Penataan Ruang 2008). The planning team has now designed the Kembang Limus Community Centre and Kujon Art Market buildings shown in 3D with the Sketchup application. The design concept is based on local wisdom and the design refers to the atmosphere of traditional buildings with local cultural patterns in the Borobudur area to maintain the beauty of the atmospheric environment and rural culture in the Borobudur temple area. The Kembang Limus Community Center Project, developed by the Public Works and Spatial Planning Agency needs to be architecturally analyzed to preserve the environmental harmony around the temple.

This study aims to analyze the results of the 3D design of traditional buildings so that a new digital system can be invented isubg AI to ascertain compatibility with styles of new interventions in the midst of the old.

Before the Kembang Limus Community Center and Kujon Art Market project was built, the design already had a similar value to the atmosphere of the surrounding environment and the typology of the Village House building. By utilizing Artificial Intelligence (AI), an artificial intelligence can analyze and determine the level of similarity between village buildings and the atmosphere of the environment. It is like an environmental card that records the past road conditions, beauty, distance between buildings and building models around the traditional houses. With this, knowledge and documentation related to the atmospheric environment for traditional buildings can be conceptualized by providing an atmosphere like the past.

This research has the following objectives.

- To develop a program known as ‘Architecture Style Similarity Identifier (ASSI) based on deep learning methods to identify traditional buildings with various building features, including images of the entire building and the style of traditional buildings, such as roofs, doors, columns, poles and roof shapes accompanied by the value of traditional building resemblance.
- To develop a website (ASSI) that can be used as an identification and comparison tool by designers/architects in maintaining the beauty of the atmospheric environment and rural culture in the Borobudur temple area. It will assist in maintaining the shape of traditional buildings and the environmental harmony of the atmosphere of traditional buildings around the Borobudur Temple.

Theoretical Basis

Artificial intelligence can improve strategies, skills, efficiency, and innovation in product creation (Borglund, 2022). It is a critical preliminary step if we want to study our design style to match the environment where the building will be erected. With AI in the construction world, architects can easily take advantage of this technology. Instead of replacing architects, AI assists in some phases of the design process. However, what needs to be underlined is that AI should not be the sole determinant of design decisions. Architects should play an essential role (Atwa and Saleh, 2023; Cudzik and Radziszewski 2018). However, AI technology can make the education system more developed and productive (Holmes et al. 2022).

The use of AI in the world of architects has been widely applied by researchers, such as the application of AI and intelligent vision in building construction with deep learning and the application of AI in managing energy in buildings (Baduge et al. 2022; Himeur et al. 2021). By using artificial intelligence, digital technology is used not only as extended hands but as an extended brain for the architects. Thus, planning and making designs can be faster, easier, and more practical, providing more diverse choices for architects to make design decisions (Effendi and Satwiko, 2021). Efficiency, creativity and productivity are also increased by utilizing AI in data analysis and design production (Harapan et al. 2021). Despite the many benefits we derive from AI to inspire and improve architectural design, it must be used ethically and responsibly to avoid negative impact on human creativity and design ethics (Hegazy and Saleh 2023).

Therefore, we must be careful in the growing influence of AI technology. Indeed, we must engage AI only as a tool to help but not overpower our human intelligence.

Examination of previous literature are needed to understand what has been previously done, in the preparation of this research to produce novelty from existing ones. Here is a review of 2 applications like ASSI. Table 1 will explain the comparison of the three.

Tabel 1: Comparison of Literature
Source: Author

No	(1)	(2)	(3)
Aplication	**Automatic architectural style recognition** (Mathias et al., 2012)	**Classification for Architectural Design through the Eye of Artificial Intelligence** (Yoshimura et al., 2019)	**ASSI**
Content	Architectural style recognition uses image recognition and image processing technologies. With a four-stage method for automatic building classification by architectural style, which includes the steps of scene classification, image alignment, façade separation, and style classification. The author also created a publicly available data set of façade drawings covering three different architectural styles, namely the Flemish Renaissance, Haussmannian, and Neoclassical	Use of deep learning and computer vision techniques to measure visual similarities between architectural designs by different architects. The results showed that the architectural features studied conformed to traditional understandings of architectural design and could be used to measure visual similarity between architects.	Development of applications that use artificial intelligence (AI) methods to identify similarities of traditional buildings and help architects quantitatively measure the content of traditional architectural styles in their designs. This study used the Convolutional Neural Network (CNN) method to identify similarities between traditional buildings based on images of walls, columns, and roofs of buildings. The results showed that applications developed on the website can help architects in preserving traditional buildings and promoting cultural sustainability.

Comparison of the results of research (1) and (2) focuses on measuring the similarity of architectural styles of buildings from the shape and façade of ornaments. While ASSI focuses on identifying similarities between traditional buildings based on images of walls, columns and roofs of buildings and developed on the website to be accessible to all users.

Research Methods

In this study, analyzing the traditional buildings at the Borobudur Temple area was carried out by identifying building types by taking detailed pictures of doors, windows, columns, walls, and roof forms from various points of view. Those data were used as training data so the computer could recognize the building styles. The tested data used come from the traditional buildings designed by the Kembang Limus Community Center Kujen Art Market Architects. Deep Learning with a Convolutional Neural Network (CNN) method is used to identify the styles. The CNN method is most widely used to identify objects by researchers in the field of AI (Gallego, Pertusa, and Calvo-Zaragoza 2018); (Le, Ho and Ou, 2017); Santoso and Ariyanto, 2018).

CNN is also used to identify regional architectural features in a clear convergence of architectural styles in a particular region. Machine learning approaches can be used as a support vector machine (SVM) to recognize regional architectural forms (Zou et al., 2023). Therefore, the approach and utilization using machine learning methods can help in the preservation and restoration of cultural heritage sites.

Images of traditional building objects taken were used as variations to identify ornamental buildings and then entered into Deep Learning so that computers could learn to recognize these building objects. In classifying an object, feature extraction is done from the images using a Convolutional Neural Network (CNN). Compared to traditional procedures for manual feature extraction, this research used CNN, avoiding complicated feature engineering procedures (Indrani, Khrisne and Suyadnya, 2020; Sun et al., 2022). Another reason is due to the consideration that CNNs can perform data training automatically without having to label the data to be classified like in Machine Learning techniques. In addition, in terms of feature extraction and limitations, CNN decisions can be made for large amounts of data or so-called unbalance.

This research started by conducting a literature study on digital architecture delving into aspects such as deep learning and CNN, formulating, and determining the research object in terms of Javanese architecture styles and then collecting data of traditional building styles.

Collection of building data was carried out in October 2021 in Ringin Putih Village in the Borobudur Temple area, Central Java. It involved taking pictures of traditional buildings with Village House wages with Panggang Pe model roofs. In the Ringin Putih village, there are several traditional houses more than 50 years old with pristine conditions. Data used to identify the similarity of traditional building in terms of uses, building criteria/characteristics such as roofs, doors, walls, pillars, structures, building floors and full drawings of buildings.

100 data for each criterion were taken. The total data used was 750 building drawings. All the data is used as training data in programming with the CNN method. The test data uses original data from Kampung houses and 3D data designed by traditional 'architects' employed for the development project of the Kembang Limus area, in the Borobudur area, Central Java, Indonesia in the 2021 Heritage Impact Assessment project.

The next step after obtaining building data is pre-processing data in the form of data cropping, resizing and augmentation and extract. Next, it involved creating a model architecture by using the VGG16 architecture model.VGG16 is a CNN architectural model used to improve performance to identify architectural styles of buildings. VGG16 is one of the algorithms for image classification and is easy to use. In analyzing and identifying similarities in traditional building architectural styles, VGG model has a large kernel filter size, consisting of 11 and 5 convolution layers with a filter kernel size of 3x3. The input image size is 224 x 224. Tests were carried out to identify this building using the accuracy test method with the matrix confusion method. Testing is carried out from the training process of the completed model architecture. Conclusion is made after obtaining the best accuracy test value which is close to 100%. After the test obtained the best results, it produced a system interface using website technology. The development of this interface is used to make it easier for architects when testing the results of 3D images that have been created. It can easily detect the resulting website application. The stages of this research are described in Fig. 1.

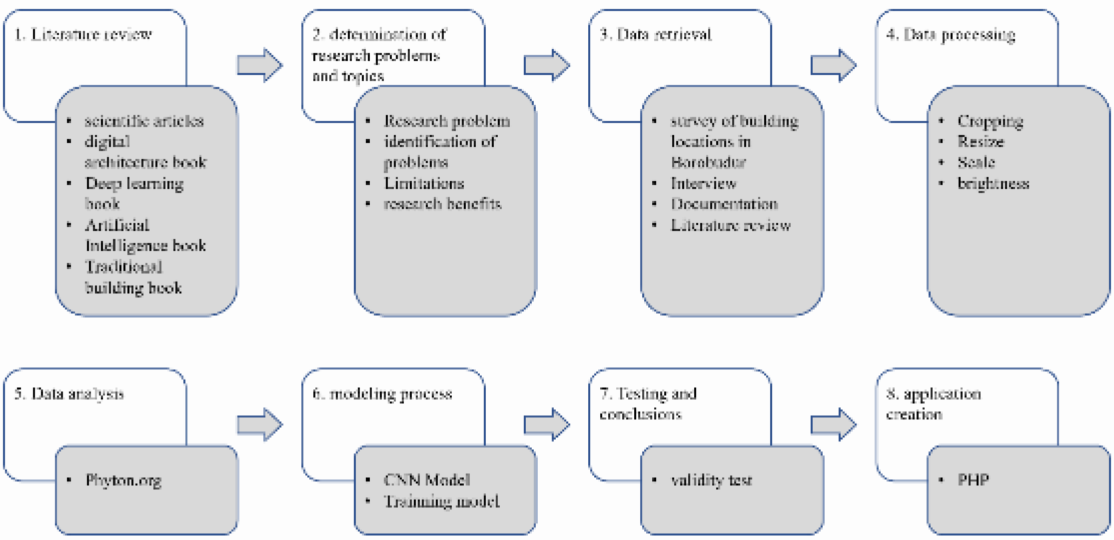


Fig. 1: Stages of Research
Source: Authors

Findings and Discussion

Case Study

The City Government plans to develop the Kembang Limus tourist area by creating the Kembang Limus Community Center building. Currently, the design process of the building model of the Kembang Limus Community has been completed by the Architect Team in 3D with the Sketchup application. The Architect Team intends to analyze the similarity of design results by paying attention to the suitability of the atmospheric environment between the building design model and the real area in the Kembang Limus tourist environment. The goal is that before the Kembang Limus project begins to be built, the design model already has compatibility with the surrounding environment. It is in accordance with the philosophy of the Village House building in terms of building style and atmospheric environment around the Kembang Limus tourist village. For this reason, to minimize the occurrence of errors in the design of the Kemabng Limus Community Center building, it is necessary to analyze the environment, atmosphere, building and the style of the building model. Following figure shows the location of the Village House building from which data was collected.

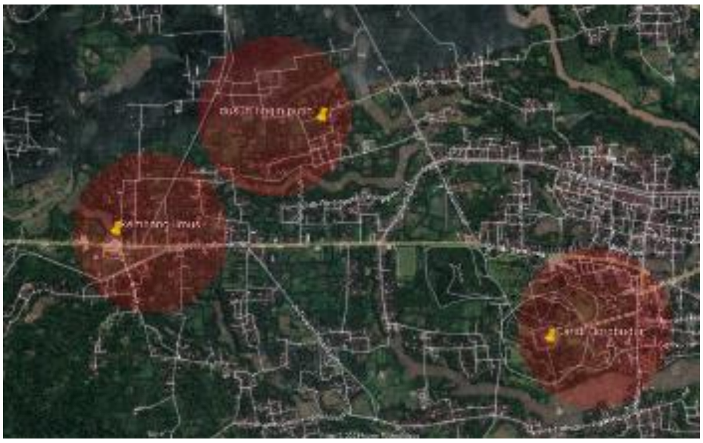


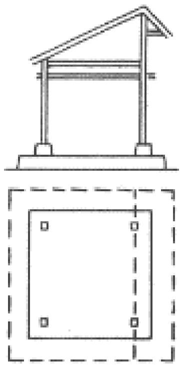
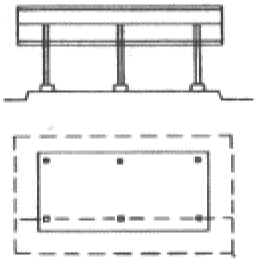
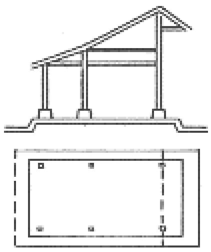
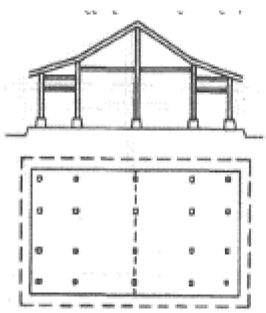
Fig. 2: Location of Ringin Putih and Kembang Limus
Source: Author

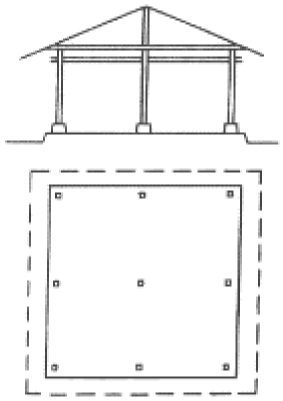
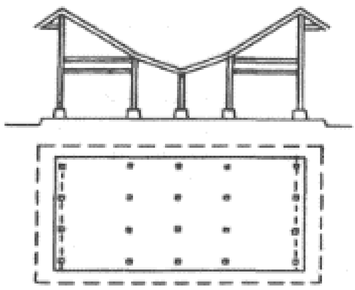
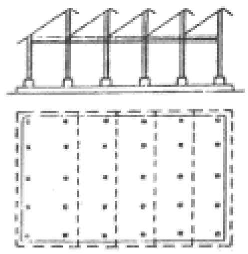
The image data obtained was a building object with a *Panggang Pe* style in the Borobudur Temple area. Data collection used two methods:

a. Utilizing the google street view application to survey the location for specific characteristics.
b. Field recording of the traditional buildings consisting of their ornament, shapes of the roofs, pillars, and the walls.

According to literature on Javanese architectural domestic buildings, both those buildings with *Panggang Pe* roofs included in the Kawruh Griya and Kawruh Kalang groups (Prijotomo, 2006) are unknown (Hamzur, 1986; Josef, 2006). However, in later literature, that style is recognized. *Panggang* means baking over coals and *Pe* means drying in the sun (Hamzur, 1986). Thus, *Panggang Pe* means baking under the sun. Buildings with *Panggang Pe* are small buildings with roofs supported by four or more poles. The roof of the building is used to dry several agricultural products such as cassava, corn, rice, tea leaves, cloves and coffee. These agricultural products are dried on the roofs to dry quickly because they avoid the influence of groundwater evaporation and prevent disturbing animals such as chicken and goats. For this reason, buildings with *Panggang Pe* roofs are widely available in areas that produce agriculture. The types of *Panggang Pe* houses are categorized as shown in the Table 1 (Hamzur, 1986).

Table 1: Types of *Panggang Pe* House
Source: Hamzur, 1986

Number	Types	Information	Illustration
1	*Panggang Pe* (main/ core)	The shape of the *Panggang Pe* roof is most straightforward, supported by four poles; one pair of poles is higher than the others.	
2	*Panggang Pe Trajumas*	The roof is supported by six columns (jv. *saka*) and uses three rods (jv. *pengerat*) to connect the top on the short side.	
3	*Panggang Pe Gedhang Selirang*	The main *Panggang Pe* with an overhang at the back side (of the short poles). *Gedhang Selirang* means a set of bananas.	
4	*Panggang Pe Gedhang Setangkep*	Two *Panggang Pe Gedhang Selirang* joined in mirror symmetry at the high poles.	

5	*Panggang Pe Empyak Setangkep*	Two roofs of the main house are joined together on the front/side of the high poles; the roof on both sides can meet at the top end and can also be one roof extended and above the other roof.	
8	*Panggang Pe Cere Gancet*	Two *Panggang Pe Gedhang Selirang* joined in mirror symmetry at the short poles.	
9	*Panggang Pe Barengan*	Buildings are lined up consisting of several *Panggang Pe* houses. *Barengan* (jv.) means together.	

The survey was conducted on October 3 and 10, 2021, in Ringin Putih village, Borobudur Temple area, to take pictures of local traditional buildings with *Panggang Pe* roofs. Several traditional houses more than 50 years old and pristine were selected. It can be seen from the topology of buildings, such as roofs, doors, walls, pillars, structures, and floors of buildings that they are still original and have not undergone any modifications. For the atmospheric environment, the survey team observed the environment's temperature, the condition of the entrance to the village area, the distance between the buildings, and the aesthetics of the domain. In addition, interviews were conducted with homeowners about the condition of the roads around their houses. They prefer dirt roads, so water absorption is good (especially when compared to stone or asphalt roads). Tables 2 and 3 are the results of traditional building images, which became the original data of the *Panggang Pe* house. It was used as comparison data in analyzing building similarity from the side of styles.

Table 2: Building Model, for data analysis of building similarity in Ringin Putih Village, Borobudur, Central Java
Source: Authors

Building Model of the Building and its Description

Model 1

Model 2

Model 3

Building Description:

1. Roof Model: *Panggang Pe* roof with clay tiles and a ridge. The roof is balanced between its left and right sides to form a pointed triangle.
2. Door Model: The size of the door is smaller when compared to the size of a modern houses because it is built on the philosophy that every guest who enters the house respects the host.
3. Pillars: The village house has multiples of four poles, with the smallest number of eight poles. In the example, the house has eight original poles with a living room, a family room, a kitchen, a bedroom, and a terrace. The supporting posts are made of rafters, beams, and batten wood. Usually, this house has terraces on the front and back sides (Fig. 2)

Fig. 3: Pillars
Source: Authors

4. Wall Model
   The wall model is still natural; it has been protected with white paint.

Fig. 4: Wall details
Source: Author

5. Roof Model

Fig. 5: Roof model
Source: Authors

6. Environmental Conditions:
   a. The beauty of the environment: Still beautiful, with many trees and plants, do not use fences or use ones made of plants.
   b. Road conditions: A rocky road (or concrete block) enters the area. However, it is preferred to use dirt roads to improve water absorption.
   c. Distance between buildings; The traditional buildings in this area are 50 meters away from each other (although today, there are modern buildings five meters away).
   d. Temperature: In the dry season, the home environment in this region has temperatures of 25-28 ^{o}C.

The survey mapped the data into seven data groups: images of entire buildings, roofs, pillars, walls, doors, windows, and columns. Table 4 shows the number of image data obtained, amounting to 750 images.

Table 3: Acquisition of Building Image Data from Survey Results
Source: Author

No	Data Type	Amount
1	Full building	150 images
2	Roof	130 images
3	Pillars	30 images
4	Walls	33 images
5	Door	130 images
6	Windows	30 images
7	Column	200 images
	Total	**750 Images**

Data Analysis

Image processing uses field images from the 750 images (Table 3). One hundred pictures were taken from each building, including ornaments, roof shapes, walls, and pillars. The total number of images used as data is 1600 images. All building images are saved in JPEG / BMP format for later improvement of photo quality and literature images before further processing.

The images were then refined first (e.g., cropped, enhanced) to improve image quality. With the image augmentation method, an image was collected into a data set (e.g., rotating the image to 20, 30, 60, and 150 degrees, flipping the image horizontally and tilting the image). 6,400 images were produced in the dataset. This dataset was then divided into 4,480 (70% of total data) as (1) images from the training dataset and 1920 (30% of the entire data) (2) images from the test data set. Images taken using a camera in the form of photo files are taken by rotating in the direction of 20, 30, 60, and 150 degrees, then flipping the image horizontally and tilting the photo image. Furthermore, the photo is managed first to be included in the data set; photo images are enhanced using samples and cropped to improve image quality with a resolution of 1,800 x1,800 pixels.

The images are collected into a data set by the image augmentation method. After taking and processing, images are intended read by machines from various directions to produce 6400 images in the data set. DAT asset is then divided into 4480 (70% of the total data) images from the data set given training and 1920 (30% of the entire data) images of the test dataset. Different but almost close to similar images are given for testing in the data set so that the machine can compare the original object and the one that is not.

Description of the Architecture Style Similarity Identifier (ASSI) Application

ASSI was made using the concept of Artificial Intelligence (AI) to help detect the style of the Kembang Linus Community Center building. It uses the Convolutional Neural Network (CNN) algorithm as one of the most popular algorithms today for researchers in the field of AI, especially in deep learning.

Analyzing building objects begins with taking pictures of buildings. From these pictures, the main characteristics of the analyzed building are taken. In this case, the style of the building in the form of roof, walls, columns, doors, windows, and building pillars were taken. 70% of the 750 data obtained, i.e., 525 building objects, were used for data training. The remaining 30% of the data was used for validity tests to get accuracy from the application's training process. After achieving a minimum accuracy of 90% on the validity test of the data, the system was ready to be tested with actual data.

Fig. 6 shows the stages of developing ASSI using AI concepts.

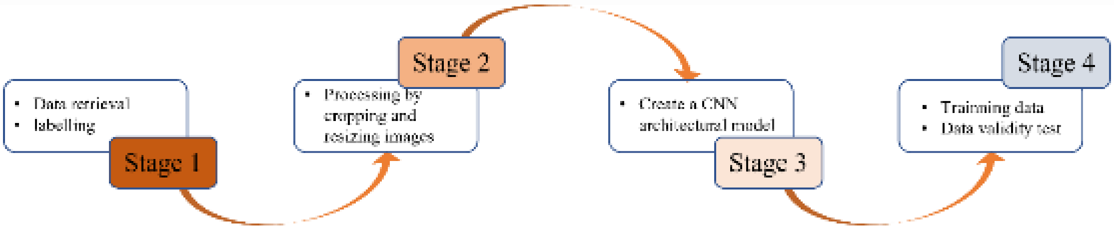


Fig. 6: Stages of making the Architecture Style Similarity Identifier (ASSI) application.
Source: Authors

After the building data was obtained, image data processing was carried out before analysis was done to identify the similarity of the building with the application. Fig. 7 describes the process of using building images; in this case, the roof of a building.

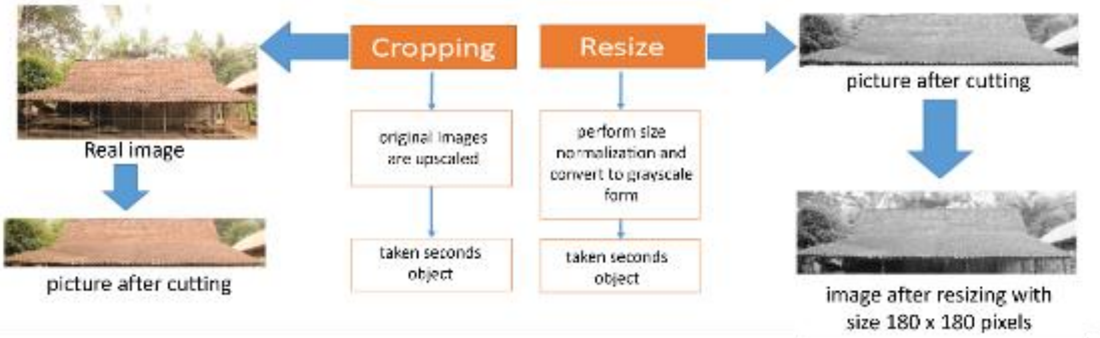


Fig. 7: Building image processing.
Source: Authors

Fig. 8 shows how ASSI detects similarities between the *Panggang Pe* building and the 3D model of the Kembang Limus Building.

Fig 8.a. 3D model of the roof of the Kembang Limus building.

Fig 8.b. Building position once uploaded in the application.

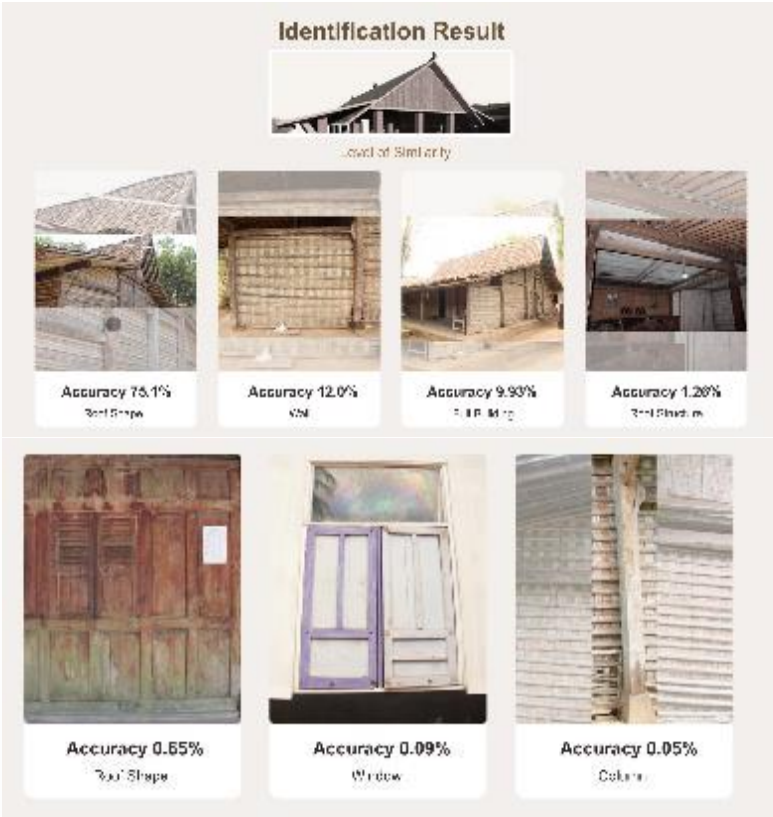


Fig 8.c. Results of building similarities identification

Results of the Analysis of Village House Buildings Using ASSI

Before the analysis, testing was first carried out on the suitability of the Kembang Limus Community Center building. The test was carried out by uploading the design of the Kembang Limus Community Center and images of houses in Ringin Putih village to ASSI. It was to show whether ASSI can detect the similarity of the design style of Kembang Limus with the style of houses in Ringin Putih village. The experiment consisted of two stages as follows.

1. Testing the stylistic similarity of houses in the dominant Ringin Putih village. At this stage, ASSI learns to recognize a specific style (in this case Panggang Pe) in the houses in the village.
2. Testing the results of 3D drawings of the Kembang Limus Community Centre building design that had been converted into JPEG type so that ASSI could recognize it.

The tests showed the performance of ASSI. It used data on village house objects taken from the internet and in the field where the second survey was conducted. The test was conducted with five experiments using 5 Village House Test data models. The results are presented in the Table 4. The experiment tested model data on roofs, entire buildings and poles. This test result gives different similarity value results. Testing is carried out with two types of data sources, namely:

1. Image data of original village house buildings taken from the internet and photos directly. Data is handled in entire buildings, roofs, walls, poles, and window shapes. All the data is tested individually with the application that has been created.
2. Data from the results of the 3D design model that the architect has made for Kembang Limus Community Centre has taken several features such as roof shape, column shape, and model of the entire building. All these data is tested using the application that has been created.

The results of the image similarity data test matched the results of the *Panggang Pe* house image to be tested with the similarity detection application that had been created, as presented in the Table 4.

Table 4: Test Result and Data Analysis
Source: Authors

Experiment	Data type	Action
1st test	Full building of *Panggang Pe*	Upload the original building image data of *Panggang Pe* house into the application.
Analysis result	Based on the identification results in the data test conducted in experiment 1, the following accuracy values were obtained: 1. For the whole building, the similarity was 89.2% 2. For the roof, the similarity was 10% because the test data is for the whole building, while the data in the system looked partly from the size and color. For walls, it was not very clear, so the system only recognized 0.44%	
2nd test	Rooftop images of *Panggang Pe*	Uploaded roof image data from the original building of *Panggang Pe* into ASSI
Analysis result	The roof image test has a conformity of 99.1%. It was because the system identifies objects other than poles, namely walls. For whole buildings, suitability is 0.58%. It was because objects taken from the roof of the building matched the data in ASSI.	
3rd test	Pillar images of *Panggang Pe* house	Upload pillar image data from the original *Panggang Pe* into ASSI.
Analysis result	Based on the identification results in the data test conducted in experiment 3, following accuracy values were obtained: For the pole image, test data had a conformity of 96.4%; this was said to be conformity with the original image close to very similar between the test data and the data in the system (ASSI).	
4th test	Images of the roof of the Kembang Limus Building	Upload roof image data from the 3D model of the Kembang Limus building into ASSI.
Analysis result	For the test data, the roof design of the Community Centre building had a suitability of 86.2%; It was because the system increasingly recognized the object of the roof of the Community Centre building with a decrease in resolution and changes in the color of the roof which was made close to the data in the system (ASSI).	
5th test	Images of the roof of the Kembang Limus Building	Upload roof image data from the 3D model of the Kembang Limus building into ASSI.
Analysis result	For the test data, the image of the roof of the Community Centre building had a conformity of 97.7%; It was because the system increasingly recognized the roof object of the Community Centre building with a decrease in resolution and changes in the color of the roof which was made close to the data in the system.	
6th test	Image of the column of the Kembang Limus building	Upload column image data from different sides of the 3D model of the Kembang Limus building into the system (ASSI).
Analysis result	Based on the identification results in the data test conducted in experiment 6, it was carried out by preventing the Community Centre building pole data from having a conformity of 24.0%; It was because the object was not recognized by the system and was considered different from the data contained in the system because the image was too dark.	

7th test	Image of the column of the Kembang Limus building	Upload complete image data of the Kembang Limus building from different sides into ASSI.
Analysis result	Based on the identification results in the data test conducted in 7th experiment, which was carried out by uploading the whole building design data Kujon Art Market has a suitability of 66.2%; It was because the system did not recognize buildings, so it was considered different in terms of color and the absence of objects such as walls and doors.	

After 22 tests, ASSI proved to detect buildings with different levels of similarity. The difference is due to differences in image position, building color, and image quality obtained in the field. Table 6 shows test data acquisition, while the Fig. 59 shows the test results graphically.

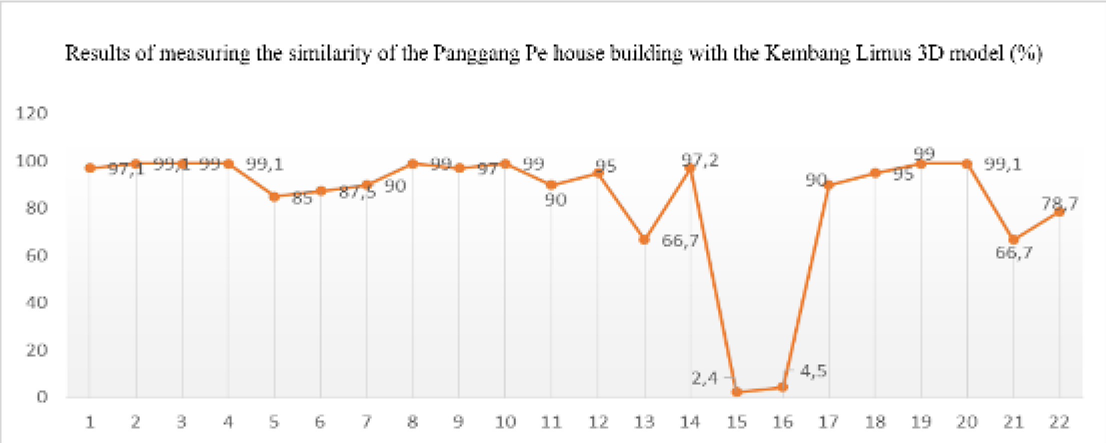


Fig 9. Similarity of the Original *Panggang Pe* house with the 3D Model of Kembang Limus
Source: Authors

Table 5: Similarity of Original *Panggang Pe* with the 3D Model of Kembang Limus
Source: Authors

Experiment	Types of Styles	Similarity (%)
1st	Full building of the original *Panggang Pe* building	97.1
2nd	Full building of the original *Panggang Pe* building	99.1
3rd	The roof of the original *Panggang Pe* House	99.0
4th	The roof of the original *Panggang Pe* House	99.1
5th	The walls of the original *Panggang Pe* House	85.0
6th	The walls of the original *Panggang Pe* House	87.5
7th	The poles of the original *Panggang Pe* House	90.0
8th	The poles of the original *Panggang Pe* House	99.0
9th	The doors of the original *Panggang Pe* house	97.0
10th	The doors of the original *Panggang Pe* house	99.0
11th	The windows of the original *Panggang Pe* house	90.0
12th	The windows of the original *Panggang Pe* house	95.0
13th	The roof of the Kembang Limus building 3D model	66.7
14th	The roof of the Kembang Limus building 3D model	97.2
15th	The walls of the Kembang Limus building 3D model	2.40
16th	The walls of the Kembang Limus building 3D model	4.50
17th	The poles of the Kembang Limus building 3D model	90.0
18th	The poles of the Kembang Limus building 3D model	95.0
19th	The pillars of the Kembang Limus building 3D model	99.0
20th	The pillars of the Kembang Limus building 3D model	99.1
21st	Full 3D model of Kembang Limus Building	66.7
22nd	Full 3D model of Kembang Limus Building	78.7

Table 5 shows the results of the original *Panggang Pe* test with ASSI. Experiments 1-12 showed high similarity results. It is because the original image of the *Panggang Pe* building taken randomly from the internet was close or like the image data that ASSI had recognized in terms of roof shape, the whole building, image color, window shape, column shape, and wall shape. The similarity test results were very high, averaging 94.7%. The experiments 13-22, testing data of the 3D model of Kembang Limus, which adopts the concept of *Panggang Pe*' building had an average accuracy value of 69.9%. The highest similarity value was found in the shape of the roof and columns because the Kembang Limus building does not have windows, doors, walls and poles. The Kembang Limus building consists of a roof and columns only.

Conclusions

The trial results show that applying artificial intelligence to ASSI was successful. ASSI can detect the degree of similarity of the *Panggang Pe* style in a house up to an accuracy rate of 94.7%. ASSI detected that the Kembang Limus 3D model, which is a new design, bears a 69.9% resemblance to *Panggang Pe*. It is because the Kembang Limus building consists of roofs and poles only, while the ASSI assessment includes roofs, doors, walls, windows, ornaments, and the whole building.

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