

Process Architecture Design for Thai Font Using Artificial Intelligence and Big Data

Boonchom Sudjit^a, Thana Sukvaree^b, Prasong Praneetpolgrang^c,
^{a,b}School of Information Technology, Sripatum University, Bangkok, Thailand, ^cComputer Department, Navaminda Kasatriyadhiraj Royal Air Force Academy, E-mail: a:sudjit99@gmail.com, b:thana.su@spu.ac.th, c:prasong_pr@rtaf.mi.th

This research aims to design a process architecture for the development of applied graphic fonts with artificial intelligence technology based on the big data of wisdom and identity of Thai Alphabet art and to design the character set prototype. There are 7 steps to conduct the research as follows; 1) data collection 2) interviews with experts, 3) data analysis, 4) process architecture design, 5) use of artificial intelligence in design, 6) creation of font prototype and 7) conclusions and evaluation. This study is both qualitative and quantitative research. In terms of qualitative research, data was collected from in-depth interviews with 10 experts and the quantitative research was done by collecting data from questionnaires from a specific sample of 50 people and then analyzed the data to design a prototype character set. The results of the research showed that the designed process architecture was at the most appropriate level ($\bar{x} = 5.00$). In addition, when using artificial intelligence technology to assist in the research process, it can help identify local Thai identity, art and culture very well.

Keywords: *Architecture Design, Graphic Font, Big Data, Identity*

Introduction

Currently digital technology plays an important role in transformation, improvement and development on the efficiency enhancement of various transactions, especially the use of public relations media in new forms of digital advertising media play a large role because it can attract consumers' attention including easy and quick understanding of products and services. In the design of the identity of today's Thai Alphabet art, digital technology has also been applied. That is to say, using new media in digital form will make communication more

efficient, especially proactive graphic design in advertising media and public relations that put the identity of the Thai Alphabet art of each region through pictures, colors or text, which is the text that can be easily read and understood will enhance interest, understanding and access to feelings and knowledge about the products, services of the organization or agency to customers and users. In this way, the consumers who are in the local community will have a feeling of pride and attachment to the identity of being Thai in each region.

At present, Thailand has given importance to creation of the identity of the Thai Alphabet art which can be considered as a mark that expresses the uniqueness of the national culture used to communicate and create understanding of people in society. This is a cultural heritage that is beautiful and of great value and reflects the cultural prosperity of the nation. However, the traditions and way of life of the Thai people in each region often have unique identities. Therefore, the application of modern digital technology should take into account on the context of the local community in each region.

Today, to reach the needs of users or customers, it is important to focus on the culture and way of life of people in society or local communities in each region. However, the building of quality differentiation and added values to that product or service requires digital technology that is suitable for the art of design and marketing. Therefore, in designing a font of wisdom and a prototype Thai identity with artificial intelligence technology and big data through process architecture, it is necessary to integrate local valuable arts and culture into the digital media of each region of Thailand.

Literature Review

Shneiderman, B., (2020). presents a new conceptual framework for simplifying artificial intelligence research using simulation techniques to understand how to build systems that work better than humans and use artificial intelligence applications to design products and services that are widely used effectively.

Doncel, V. R., Nikolaidis, N., & Pitas, I., (2007). studied the creation and expansion of an algorithm targeting watermarks on images by modifying the Fourier descriptors magnitude in an imperceptible way. The watermark that embeds the polygonal line watermarking is essentially the original form in the Fourier indicator in an invisible way. Polygon line-embedded watermarks are an important native format in 2D vector graphics data. The ability to digitally watermark such characters helps watermark cartoons, drawings and Geographic Information System (GIS) data in vector graphics more efficiently.

Zhang, Y., Fan, Q., Bao, F., Liu, Y., & Zhang, C., (2018). studied the S Single-Image Super-Resolution Based on Rational Fractal Interpolation. Its purpose is to present the process of creating higher resolution photos (Superresolution (SR)) which leads to processing by splitting

the dimensions of the image in order to lead to higher resolution. In this research, the researchers used a new model of resolution estimation technique to examine the properties of the image. The results of the analysis revealed the process of applying modeling techniques as well as the development of high-performance visualization algorithms.

Wallop P., (2018). presents the process of transcribing the Dharma Lanna Alphabet which has evolved to transmit the Dharma Lanna Alphabet from the past to the present inspired by the relevant architecture of Buddhist temples. In the past, the temple played an important role in the transmission of Dharma Lanna Alphabet based on the steps of Buddhist rituals. Most of the content of the transmission of the Dharma Lanna Alphabet focuses on religion, rituals and beliefs in the Lanna Kingdom. But at present, the temple has reduced its role in the study of the Dharma Alphabet causing the conservation of the Dharma Alphabet to have a narrow circle which is limited to a group of folk medicine healers, teachers, local philosophers and Chiang Mai University, etc.

Ardiyan, A., & Syamsuddin, D., (2019). describes the creative process and techniques of digital sculpting that focus on designing the shapes and textures of characters in online games. The results of this research have had an effect on creating shapes and images on the surface of characters in the past and present. Especially the characters which are local arts, such as puppetry, found that this process can be used to develop characters in today's games that are popular among the new generation making it widely accepted in the art of puppetry. This is regarded as the preservation of puppetry or shadow puppetry in the form of protection of traditions.

Methodology

This research consisted of seven steps in conducting the research as follows:

3.1 Data Collection:

The researcher collected information from documents, textbooks, research related to the identity of Thai Alphabet art to be used in the design of process architecture and the design of applied graphic fonts. In addition, the researcher collected 1,000 images of the identity, arts, culture, traditions and culture of each region in each of the four regions, totaling 4,000 images.

3.2 Experts Interviews:

The researcher conducted in-depth interviews with 10 experts from all regions in Thailand to design a process architecture for developing applied graphic fonts with artificial intelligence technology based on big data of wisdom and identity of Thai Alphabet art.

3.3 Data Analysis:

The researchers used data collected from in-depth interviews with experts and 50 online respondents and analyzed to find the connection of wisdom and identity of Thai Alphabet art to be used in the design and development of prototype fonts.

3.4 Architecture Design:

The researcher used the information obtained from the in-depth interview process with experts to analyze the content (Content Analysis) to design the process architecture.

3.5 Artificial Intelligence:

At this stage, the researcher grouped the identity data of each region of Thailand into 4 groups and modeling in 2 steps which are 1) Step of learning (Train) in creating a model and 2) Step of testing (Test) to create a model for machine learning to use image data which the researcher measured the efficiency of prediction on the accuracy of modeling by using the measurement

$$Accuracy = \frac{(TP + TN)}{(TP + TN + FP + FN)}$$

of accuracy (Accuracy) as a percentage (%). The formula can be calculated as shown in Equation (1).

$$\begin{aligned} TP &= \text{True Positive} \\ TN &= \text{True Negative} \\ FP &= \text{False Positive} \\ FN &= \text{False Negative} \end{aligned} \tag{1}$$

The researcher used the intellectual and artistic identity information to create an architecture using artificial intelligence technology to help guide the design of the identity prototype and lead to further development of the original font set.

3.6 Prototype Letters Creation:

At this stage, the researcher used the process architecture to help design the prototype font then tested on Windows & Mac operating systems with a computer graphics program.

3.7 Research Results Conclusion and Evaluation:

When designing a process architecture for developing applied graphic fonts with artificial intelligence technology based on the Big Data of the wisdom and identity of Thai Alphabet art, the researcher therefore assessed the suitability of the aforementioned process architecture evaluated by experts.

Results and Discussion

4.1 Results from data analysis

The result of designing process architecture for developing applied graphic fonts with artificial intelligence technology based on big data of wisdom and identity of Thai Alphabet art obtained from in-depth interviews with 10 experts from 4 regions, divided into 4 groups: Group 1, 2 Northeastern (Isan) experts who had given handicraft and followed by architecture (local temple); Group 2, 2 experts, who had given importance to fonts based on wisdom that are clear in the identity of the arts, such as Dharma Alphabet or astrological numbers and the appearance or Spherical Shape; Group 3, 3 experts in the central region, who gave importance to the fonts that emphasize on architecture such as Thai-style houses which are structures that are beautiful, strong, stable, elegant, and the layout of Carvings on various dishes and Group 4, 3 Southern experts who focused on the wisdom and identity of the arts such as Nang Talung (Shadow Play) and Manohra (Southern local dance) which is clear in its shape. The lines and patterns of the Kolae boat and the Batik cloth are also important. Details can be shown as in Table 1.

Table 1: Results of in-depth interviews with experts based on the wisdom and identity of Thai script art in 4 regions

Group	Region	Number of Experts	Based on Wisdom / Identity
1.1	Northeast	2	Arts & Crafts
1.2	North	2	Dharma Alphabet
1.3	Central	3	Architecture
1.4	South	3	Shadow Play

From Table 1, the results of in-depth interviews from 10 experts from 4 regions revealed that, for the northern region, there are variables that are important and should be developed into a prototype of the Thai Alphabet, namely the Dharma Alphabet, where the northeastern region variables are arts and crafts, the central region variable is architecture and the southern region variable is Nang Talung respectively.

4.2 In Figure 1, the content analysis is derived from in-depth interviews with 10 experts and synthesizes the content into a process architecture design for the development of applied graphic fonts with artificial intelligence technology based on big data of wisdom and the identity of Thai Alphabet art can be divided into 4 groups as follows:

Group A represents the wisdom and identity of the Northeastern region. It consists of two variables: A01 (Handicraft) and A02 (Architecture).

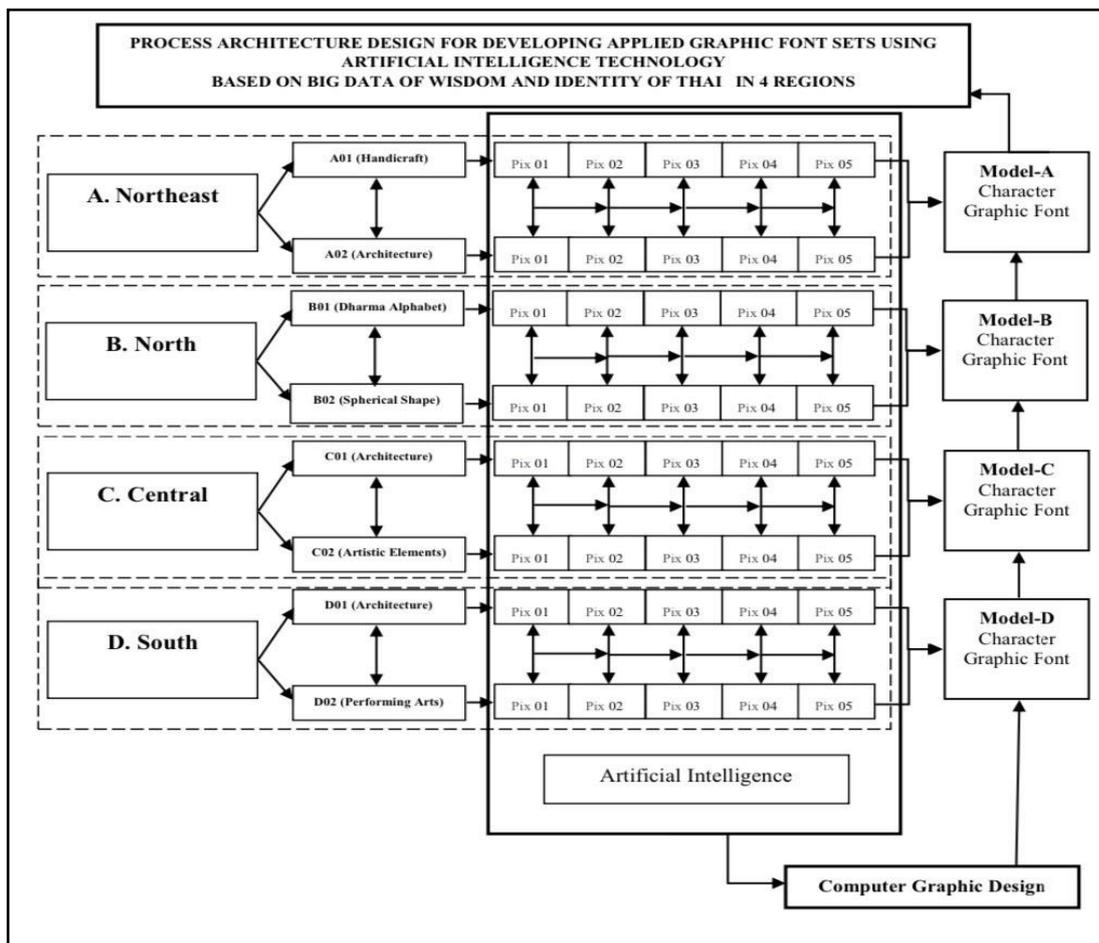
Group B represents wisdom and northern identity. It consists of 2 variables, namely B0 1 (Dharma Alphabet) and B02 (Spherical Shape).

Group C represents wisdom and identity of the central region. It consists of two variables: C01 (Architecture) and C02 (Artistic Elements).

Group D represents the wisdom and identity of the southern region. It consists of two variables: D01 (Architecture) and D02 (Performing Arts).

The results from in-depth interviews from experts once the data segments are separated brings into the process architecture design process using artificial intelligence technology to obtain the prototype font and can show the details of the process architecture design as depicted in Figure 1.

Figure 1 Process Architecture Design



The results of the data analysis revealed that the variables that are important to the design process architecture for graphic typography are eight variables that are crucial to the process that lead to the creation of a prototype font in a graphic typography design.

4.3 The results of the analysis of opinion-level data from the online questionnaire taken from variables affecting the design of process architecture for the development of graphic fonts in

the wisdom and identity of Thai Alphabet art from a sample of 50 people is shown in Tables 2, 3 and 4 as follows:

Table 2 Arts and Crafts

2. Local Arts and Crafts	\bar{X}	S.D.	Interpretation
2.1 Local arts and crafts using materials natural origin.	4.22	0.89	Highest
2.2 Local arts and crafts that are beautiful and catches the eye of the beholder.	4.08	0.85	High
2.3 Local arts and crafts that have a texture clearly different.	4.20	0.83	High
2.4 Local arts and crafts that are unique to that locality.	4.24	0.80	Highest
2.5 Local arts and crafts that have size and proportion with suitability and harmony.	4.16	0.79	High
2.6 Local arts and crafts that mostly come from basketry method.	4.00	0.80	High
Overall Average	4.15	0.83	High

From Table 2 it can be explained that overall average of respondents' opinions on arts and crafts the values were at a high level ($\bar{x} = 4.15$, $SD = 0.83$).

Table 3 Dharma Alphabet

3. Dharma Alphabet	\bar{X}	S.D.	Interpretation
3.1 Dharma Alphabet that conveys the past.	4.14	0.85	High
3.2 Dharma Alphabet found in palm leaves and folds.	4.14	0.92	High
3.3 Dharma Alphabet that has obvious unique identity.	4.16	0.88	High
3.4 Dharma Alphabet characters that are similar in appearance or identity to Burmese, Mon and etc.	4.06	0.99	High
3.5 Dharma Alphabet with Spherical features.	4.06	0.89	High
Overall Average	4.11	0.91	High

The overall mean of the respondents towards Dharma Alphabet was at a high level ($\bar{x} = 4.11$, $SD = 0.91$).

Table 4 Architecture

4. Architecture	\bar{X}	S.D.	Interpretation
4.1 Architecture that conveys idea of religion and local cultural identity of society in each region.	4.26	0.75	Highest
4.2 Architecture that has clear process step toward design.	4.20	0.69	High
4.3 Architecture that concerns functional use and proportion of space in use.	4.26	0.80	Highest
4.4 Architecture that is shaped by geometry.	4.26	0.82	Highest
4.5 Architecture that its beauty is different from the viewing distance.	4.18	0.71	High
Overall Average	4.22	0.75	High

From Table 4 it can be explained that the respondents' opinions on the architecture value were at a high level ($\bar{x} = 4.22$, $SD = 0.75$).

In conclusion, this research can explain that, in Tables 2, 3 and 4, the importance of a local identity pattern with a historically important root method based on wisdom of each region.

Table 5 The results of the process architecture evaluation

5. Estimate	\bar{X}	S.D.	interpretation
5.1 Suitability of the process architecture	5.00	0.00	Highest
5.2 Acceptance of the process architecture	4.80	0.40	Highest
5.3 Efficiency of the process architecture	4.80	0.40	Highest
Overall Average	4.86	0.26	High

From Table 5, it can be explained that, from the evaluation results of the process architecture, it was found that the opinion level of the experts was the highest overall average ($\bar{x} = 4.86$, $S.D. = 0.26$). When considering each issue, it was found that assessment items on the suitability of the process architecture has the highest value ($\bar{x} = 5.00$, $S.D. = 0.00$).

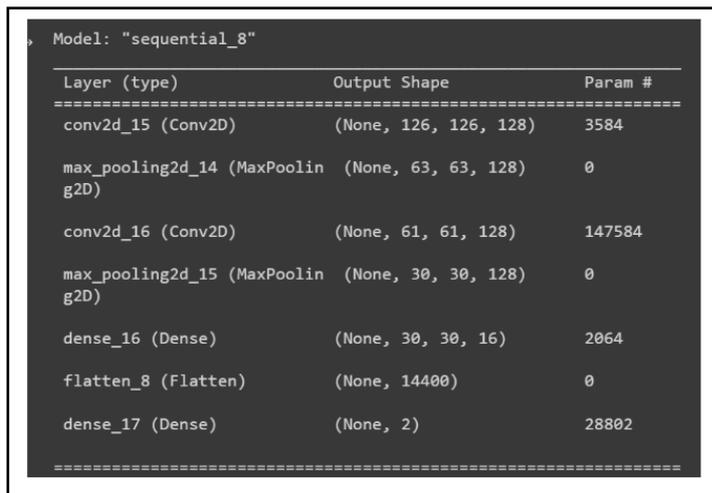
4 .4 Results of designing process architecture for developing applied graphic fonts with artificial intelligence technology based on big data of wisdom and identity of Thai Alphabet art.

For the research results at this stage, the researchers applied big data analytics technology in the process of obtaining the applied graphic fonts since the datasets come from a variety of sources, then analyze and understand the properties of the data that affects the use in decision

making for the design of graphic fonts to be the most appropriate consisting of 1) Collecting information about wisdom, identity, culture and traditions in all 4 regions to find the relationship of the data, 2) Using the collected data to prepare the data, sort the data, and manage the data to be accurate and appropriate to obtain the information that is ready to be used for the analytical process for further font design and 3) Bringing accurately managed data to the process of artificial intelligence technology to get advice of the next process architecture design process.

In the process of artificial intelligence technology, the researcher took the data of each region of 1,000 images and then divided the data into 2 sets. The first set amounted to 80% of the data set to be used to teach the machine to learn the data. And, the second, 20% of the data were used for testing character prototypes using deep learning techniques. The structure of the prototype is shown in Figure 2.

Figure 2 Process Architecture Prototype for developing applied graphic font



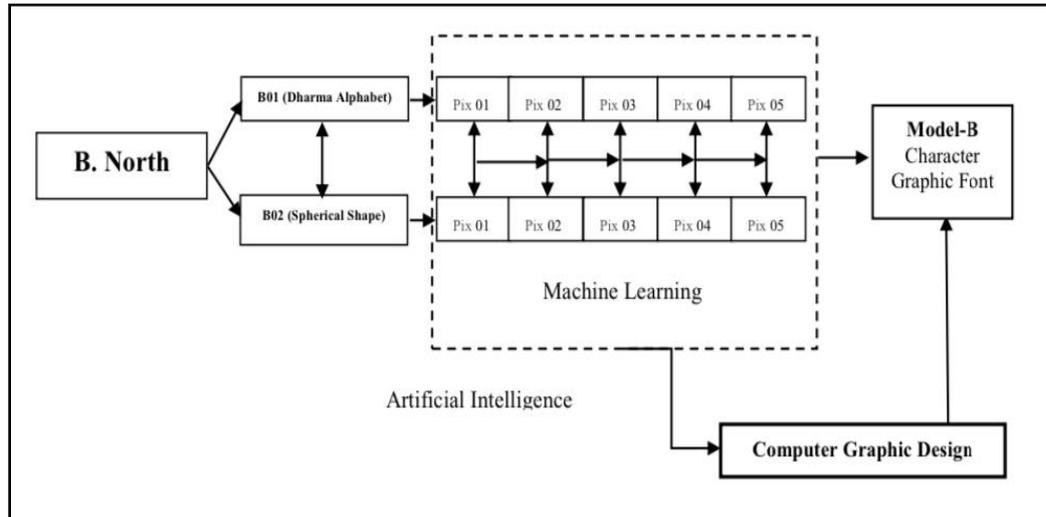
```
Model: "sequential_8"
-----
Layer (type)                Output Shape              Param #
-----
conv2d_15 (Conv2D)          (None, 126, 126, 128)    3584
max_pooling2d_14 (MaxPoolin (None, 63, 63, 128)      0
g2D)
conv2d_16 (Conv2D)          (None, 61, 61, 128)    147584
max_pooling2d_15 (MaxPoolin (None, 30, 30, 128)      0
g2D)
dense_16 (Dense)            (None, 30, 30, 16)      2064
flatten_8 (Flatten)         (None, 14400)           0
dense_17 (Dense)            (None, 2)                28802
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As for the architecture, the design process and development of the prototype font set in accordance with the important steps to lead to the Thai font set in 4 regions of Thailand consists of the architecture of the prototype font set and the architecture of the prototype font design process using artificial intelligence as shown in Figures 3 and 4. In addition, the examples of the original fonts and the original graphic fonts of the wisdom and identity of the Thai Alphabet art consists of the prototype letters of the wisdom and identity of the Thai Alphabet art and the prototype graphic font set of the wisdom and identity of Thai Alphabet art as shown in Figures 5 and 6.

From Figure 3, from the evaluation results from the experts to develop the prototype font of Thailand by developing an applied graphic font with artificial intelligence technology based on the big data of wisdom and identity of the Thai Alphabet art. The researcher has brought the

data into the process of creating a prototype letter set according to the pattern specified in the sequential structure.

Figure 3 Architectural process for creating prototype fonts



By designing a process architecture for developing applied graphic fonts with artificial intelligence technology based on big data of wisdom and identity of Thai Alphabet art, divided into 4 groups as follows:

Group A represents the wisdom and identity of the Northeastern region. It consists of 2 variables: (A01= Handicraft) and (A02= Architecture).

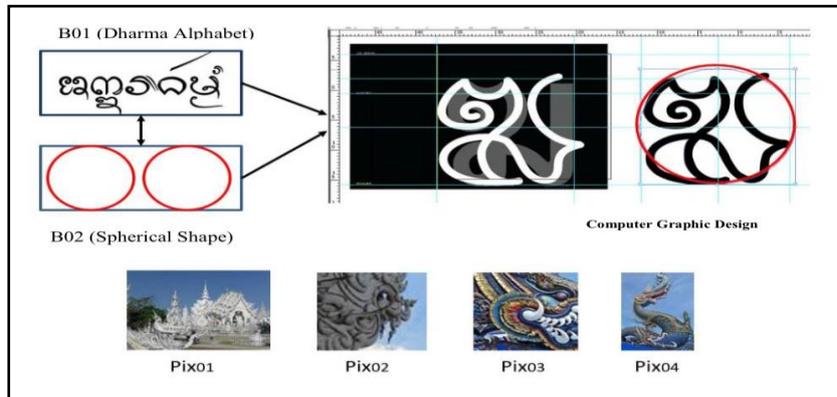
Group B represents wisdom and northern identity. It consists of 2 variables, namely (B01 = Dharma Alphabet) and (B02= Spherical Shape).

Group C represents wisdom and identity of the central region. It consists of two variables: (C01= Architecture) and (C02= Artistic Elements).

Group D represents the wisdom and identity of the southern region. It consists of 2 variables: (D01= Architecture) and (D02= Performing Arts).

The results of in-depth interviews from experts were separated into groups to be introduced into the design process by using artificial intelligence technology to obtain a prototype font set can be shown in Figure 4.

Figure 4 The architecture of the prototype font design process using artificial intelligence



From Figure 4, the researcher divided the images into groups which group (B) represents wisdom and identity consisting of 2 important variables, namely Dharma Alphabet (B01) and Spherical Shape (B02) then collected data which are images (Pix) to enter the process of using artificial intelligence by creating a prototype using Machine Learning techniques from the image data set for further constructing a prototype of graphic font.

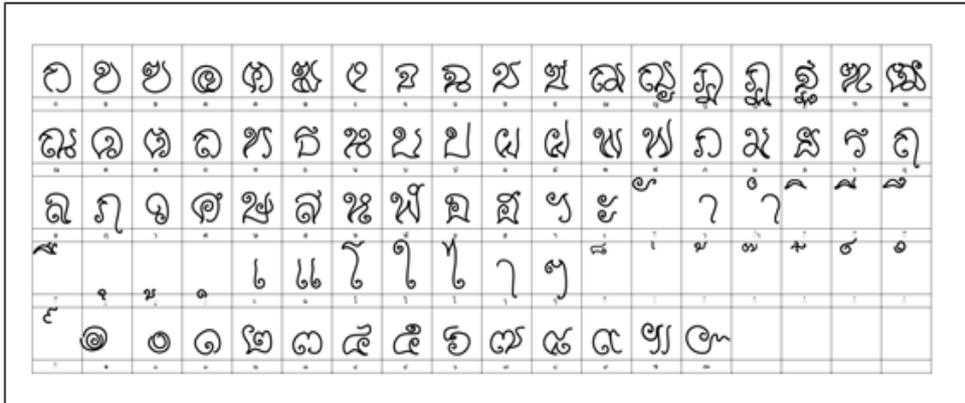
Next step is the entry into the original graphic character set design. This is to design a graphic character set by analyzing and displaying the results as a prototype as required. This will lead to the actual design of the original graphic character set as shown in Figure 5.

Figure 5 The prototype of the wisdom and identity of Thai Alphabet art



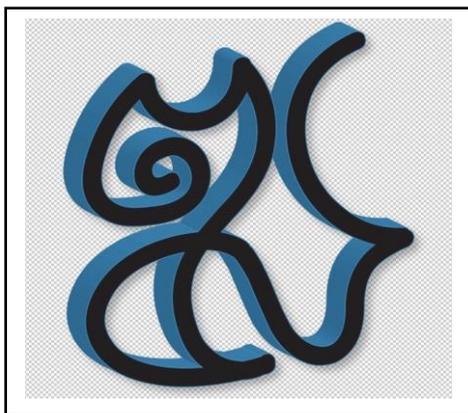
In Figure 5, from the process architecture for developing a prototype graphic font of wisdom and identity, the variables that are important consisting of the Dharma Alphabet (B01) and Spherical Shape (B02) characters were obtained. Then the letter to design a graphic character set was created to analyze and display the results as a prototype. This will lead to the next process of designing a graphic character set as shown in Figure 6.

Figure 6 The graphic font set prototype of the wisdom and identity of Thai alphabet art



From Figure 6, the design aspects of the process application were improved in the proportion of components which take into account the degree of curvature that is important according to the identity attributes in the derived variables which then the original character set was developed and modified so that it doesn't distort much from the original but it will also be beautiful. In particular, adding spatial, spacing, width and height, as well as line thickness at the letter “๓”, must be easy to handwrite as well. This will lead to the design of an applied graphic font with artificial intelligence technology based on the wisdom and identity of the Thai Alphabet as shown in Figure 7.

Figure 7 Example of letters “๓” for Thai font using artificial intelligence and big data



In Figure 7, Curves, or shapes, affect wisdom and identity in a way that is characterized by the flow of lines that create a sense of perspective based on local arts by region which causes awareness of the principles and processes of architectural design to design and develop graphic fonts based on the wisdom and local identity of each region as well. From the research, it was found that the wisdom and identity of Thailand are hidden in the alphabet which indicates the roots and culture of Thai alphabet art developed for each region. This



makes it interesting because of its unique identity, especially with its shapes that make it clear and easy to understand and, most importantly, these Thai characters can be used in digital advertising media including in product design as well as packaging boxes for various products. Hence this will make the digital advertising media and the products are more attractive, impressive and well connected.

Conclusion

In this research, the researcher designed a process architecture for developing an applied graphic font with artificial intelligence technology based on big data of wisdom and identity of Thai Alphabet art and designed a prototype font set by collecting data from the questionnaire on the 3 issues: 1) Arts and Crafts, 2) Dharma Alphabet and 3) Architecture. The survey results revealed the local identity that is important to that locality of Thailand and the process that is a step-by-step pattern in the development of applied graphic fonts with artificial intelligence technology that will be used to support industry sector to add value to products that are unique to each region. This will bring a creative economy and lead to the creation of commercial competitiveness for Thailand in the future.

Recommendations for the future research

The result of this research which is a set of applied graphic fonts obtaining from the design of process architecture developed with artificial intelligence technology based on big data of wisdom and identity of Thai Alphabet art can be further developed by increasing the number of experts (from 10 people), the number of specific samples in each region (from 50 people) and the number of pictures of identity, arts, traditions and culture in 4 regions (from the number of 4,000 images) to be more to be used in the computer learning process in order to make it more accurate for future research development. In addition, the further research on the number of identity variables that are important to the design of applied graphic fonts arising from the design of the process architecture could be explore with more than 3 variables used in this research in order to make the local identity more comprehensive and reflect the way of local community in each region of Thailand more clearly.

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