



Augmented Reality Using Brute Force Algorithm for Introduction to Prayer Movement Based

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Abstract.

Proposed: Prayer is compulsory to worship for Muslims around the world. Prayer is a mandatory commandment from Allah SWT. However, the companions and the *Madzhab* of Islam have a different opinion but remain Saheeh as long as it does not stray away from the teachings of the Prophet and Al-Quran. This prayer movement consists of the prayer movement of the *Madzhab*, Imam Shafi'i, Imam Hanafi, Imam Hambali, and Imam Maliki. The Marker used 9 pieces with pictures of each movement. One marker has several shapes of the movements that are several object targets are listed in it.

Methods: The Brute Force algorithm used is to match the String value. The Brute Force algorithm can recognize well any String value that is matched to the marker and data from the database. This algorithm is applied to Augmented Reality technology. This app is built using Augmented Reality technology that combines real-world and virtual worlds.

Results: This technology is well recognized applied from the Brute Force algorithm, which can validate the match result String value between the database and marker.

Novelty: This technology uses the camera to find suitable markers in order to display 3D objects if the marker and the database match. So that this built system can facilitate many circles in learning the prayer movements based on the prayer movement version of islamic high priest.

Keywords: *Augmented Reality*, Prayer Movement of the four Madzhab, *Brute Force*

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INTRODUCTION

A series of movements and utterances that begin with takbir and end with salam as a form of worship to Allah SWT is called prayer. The unity between this movement and utterance which is implemented at a certain time and has certain conditions and pillars as well. Prayer is a pillar of Islam and Muslims must do it as Allah SWT says. in surah Al-Baqarah verse 45 which reads:

وَاسْتَعِينُوا بِالصَّبْرِ وَالصَّلَاةِ وَإِنَّهَا لَكَبِيرَةٌ إِلَّا عَلَى الْخَاشِعِينَ

“And ask for help (to Allah) with patience and prayer. And (prayer) is severe except for those who are humble.” (Q.S. Al-Baqarah: 45).

The movement in prayer is a special movement in the gesture attached to a Muslim. The movements in prayer are the movements that each have the best proportions for the anatomical arrangement of the human body [1].

In Islam there are several differences in the prayer movement based on the madzhab found in Islam. The famous sects in Islam are the Syafi'i Madzhab, the Hanafi Madzhab, the Hambali Madzhab and the Maliki Madzhab. These sects are led by the great Muslim Imam so that his followers follow their respective Imams in various matters, including the prayer movement.

Every movement that is owned by each school has a characteristic in every movement. The difference in prayer movement based on the Four Schools will be easily recognized because the movement is something

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that is easily recognized in accordance with the name of the movement that has been marked in accordance with the intended movement. For the introduction of the movement, a media that can display the movement along with the name of the school is used.

Media that can be used is to use one of the technology media is Augmented Reality technology that can display movement so that the recognition of movement that matches the name it has can be easily understood and remembered. Augmented Reality uses 3D objects so that visible movements can be more detailed and move according to predetermined movements. Based on this background, writer hope the ummat can make a different between prayer's movement belong to four Madzhab of Islam and make a knowledge of Islam easier to understand.

Meanwhile, to implement movements between schools so that they are not confused, a brute force algorithm will be used as the process of adjusting the matching of the destination marker and the marker database to the marker that matches the name of the intended school.

After the description above, it will be developed an application based on Android to make it easier to use and Augmented Reality will be used as a Viewer of the 3D object of prayer movement based on the opinion of the 4 high priests of Islam. This application will display 3D objects with prayer movements based on Four madzhab. Meanwhile, to implement the inter-madzhab movement so that not confused, the AR camera used to recognize markers uses Brute Force method so that the movement that can be recognized is in accordance with the marked marker wanted. Basic of the new research question, statements of the new scientific article and main research problems (novelty).

This algorithm has several advantages in it, namely: This algorithm produces a standard algorithm for computing work on the addition or multiplication of N numbers, or the max and min elements on the table. This algorithm is easy to understand and simple. This algorithm can solve significant problems such as sorting, string matching, matrix multiplication, and searching. This algorithm can solve most problems [2].

Besides having the advantages of this algorithm also has several disadvantages, namely: This algorithm is not as creative as the other problem-solving methods. The algorithm produced is rarely effective or efficient. This algorithm runs slowly [2].

In the brute force algorithm, to do an algorithm string matching using the terms pattern and text. The pattern sought is called text and the pattern that is matched is called the pattern [3].

Based on the word of Allah Almighty which means "And pray for them" (Surah At-taubah: 103) then prayer according to language is prayer with goodness. Deeds and sayings that begin with takbir and end with greetings with certain conditions are the understanding of prayer according to the terms of the Jurists [4].

Pillars of prayer, according to Ust. MZ Labib and Ust Maftuh Ahnan are as follows [5]:

- 1) The intention in the heart, according to the prayer that is done;
- 2) Stand for those in power;
- 3) Takbiratul ihram (reading Allahu Akbar);
- 4) Reading the surah al-Fatihah;
- 5) bowing and thuma'ninah;
- 6) Iktidal and thum'ninah;
- 7) Prostrate twice and thuma'ninah;
- 8) Sitting between two prostrations as well as thuma'ninah;
- 9) Sitting end tasyahud;
- 10) Read the final tasyahud;
- 11) Read the prayer of the Prophet's blessings at the end of the tasyahud.
- 12) First greetings.
- 13) Orderly, which is not interrupted.

Augmented reality or translated into Indonesian Additional Reality, is a technique that combines two-dimensional and three-dimensional virtual objects into a real scope [6].

Augmented Reality technology has advantages, including Easy to use, easy to use with other media, simple object modeling, effective and interactive [7].

Marker Based Tracking

Marker-based tracking is an AR that uses markers or two-dimensional object markers that have a pattern that the computer will read through a webcam or camera connected to the computer, usually a black and white illustration with a thick black border and a white background [1]. Markerless is a tracking method where the markerless method does not require users to print a marker to display digitals. In this case, the recognized marker takes the form of the device's position, direction, and location [1].

Image segmentation process is an image processing method to change the value of an image so that it is easy to process and analyze. The way segmentation works is to give a unique sign to each image value in it so that it is easy to process, such as curves, lines or boundaries. This method will produce a segment of an image that has been extracted into several characteristics that characterize the image [8].

The image segmentation process functions to divide the regions on an image into regions that each have in common between texture, color, depth or other features [9]. This software is a game developer that can develop applications in the form of two dimensions or even three dimensions. Unity has a variety of support features for application development such as the character rendering process so that it can move in realtime [10].

This software is not only for game development found on PCs but with the features it has, Unity is able to develop applications on Android Macs and others [10]. This software is a character or shape developer from a two-dimensional movement or three-dimensional object. Blender is used for modeling and various character or object creation activities that will be further developed on the appropriate platform [2].

METHODS

AR Process Design

In this discussion, an application that will develop an introduction to the prayer movement based on the Four Prayers will be developed. The movements of four madzhab prayer movements are *Takbiratul Ihram* that movement is right hands on the left hand and both on the stomach, *I'tidal* that bending, *sujud* or prostration, sit between two prostrations, state finger before index finger lifted when *tahiyat*, state finger when *syahadat*, first *salam*, second *salam*.

This process uses augmented reality technology that is able to display moving three-dimensional characters in the form of characters that move according to the Four Prayers' movements from markers in the form of images of characters who are praying. The screen will display 3D objects when the AR camera is pointed at the image marker of the character being prayed. There are 21 markers needed to display 21 prayer movements from each school.

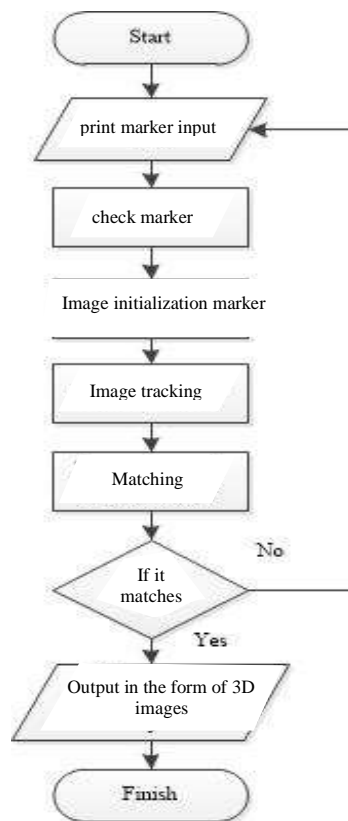


Figure 1. AR process flowchart

Design of Brute Force Algorithm Processes

The process of checking the prayer movement marker is based on the four Muslim prayer movements using the Brute Force algorithm. The process will find and match the pair of AR camera catches markers with markers stored in the QCAR marker database in the system, there are images that have been registered when they are paired with reference markers to display object animations. This is done by matching the name in the form of a string in the database with a name that matches the object that appears on the AR camera.

Algoritma of Brute Force is sequential search which is searching for string value and compare between other string.

```

k = integer;
k ← 1
while (k < n) and (ak ≠ x) do
  k ← k+1
endwhile
{ k=n or ak = x }
If ak = x then
  idx ← k
else
  idx ← -1
endif

```

The process of checking the prayer movement marker is done by comparing the string value in the database name with the character name of the object that appears when the camera is directed to a marker that matches the database name that matches the character of the object.

Example :

Pattern = takbir_Syafii.jpg

Text = takbir_Syafii

Result :

Step 1																	
Pattern	T	a	k	b	i	r	_	S	y	a	f	i	i	.	j	p	g
Text	T	a	k	b	i	r	_	S	y	a	f	i	i	.	j	p	g
Index	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

Matches, then the next step will be executed, namely the appearance of the object 3D on the screen. If it doesn't match then the Text will shift one step to the right until all the values in the Text match and match the values in the Pattern.

Analysis of the prayer movements of the Four Madzhab namely Imam Hambali, Imam Maliki, Imam Hanafi and Imam Shafi'i. The movement comes from our reference Bidayatul Mujtahid wa Nihayatul Muqtashid by Ibn Rushd. The motion is applied to a three-dimensional object designed using the Blender application. In this design process, it begins with making characters in the form of male human characters and Muslim clothing designs that are in accordance with the application theme, namely prayer.

Then every movement that has been designed will be sent to the Unity application for matching 3D objects with registered markers. Previously, the marker had been prepared in the form of a two-dimensional image in the form of writing and a unique logo that would be used as a marker reader in the system to display the prayer movement on a 3D object. The number of markers is adjusted to the number of movements on the 3D object that will be displayed in the application. The number of markers is 9 markers and there are 32 3D objects. The marker will be registered on the Vuforia website to get a license and marker registration so that the original marker and the marker on the system can sync and display 3D objects.

The application of the Brute Force algorithm uses the Euclidean Distance formula to get the closest point so that the 3D object will appear on the screen when the marker is matched with the camera.

Interface Design

In designing the interface, an interface design is done that can help the user to carry out the processes contained in the system. The application used is Unity and installed on a Smartphone. The test phase begins with testing the camera and markers until all markers are recognized.

The placement of 3D objects and the size of the object on the marker is determined by the scale, rotation and position features. All 3D objects on the marker have the following three values:

Object	Scale	Rotation	Position
X	0.1	-90	0
Y	0.1	180	0.15
Z	0.1	0	-0.3

Next is the interface design in Unity. The design carried out is the design of the main menu page at the opening of the application. The following is the main menu design.

The main menu consists of several buttons, namely the Movement Menu button, the About Application button, and the Exit button.

Next is the design of the interface for the options menu. The following is a design menu of options. If one of the buttons above is pressed, it will bring up a menu of prayer movement options based on the Four Madzhab.

Brute Force algorithm will be active to match the name of the database with the name of the object that will display the 3D object on the screen. The string value in the database is obtained by writing the OnTrackingFound() function in the program list. The database name string will be marked by the variable mTrackableBehaviour.TrackableName. While the object name string value is shown from the tag name that is accessed in the 3D image stored in it. The Brute Force Algorithm will match both String values. If both

match, the screen will display a 3D object with the caption “Base Match”, but if not, the screen will not display a 3D object.

RESULT AND DISCUSSION

Dimensional Object Design

In this application 3D objects are used to apply movements to the reference book to provide movement effects that correspond to the reference. 3D objects are designed using Blender software and motion animation effects are also performed in this software.

The object is designed in the form of human characters, male sex and Muslim clothes in accordance with the theme of the application, namely prayer. Following are examples of 3D design and animation effects in Blender software.



Figure 2. 3D object standing position

Marker

Markers used are .jpg extension images which are then printed so that they become hard files which will be used to match markers that have been planted on the system. Markers that are used as hardfile or print will be used as a viewer of 3D objects on the AR camera. Markers registered in the system are markers that contain 3D objects so that when both markers are matched, 3D objects will appear on the AR camera.

The application of the Brute Force algorithm starts with knowing the name of the marker that is registered on the system in the form of a String. Then the String value will be matched with the String value contained in the database name. The following are examples of markers used.

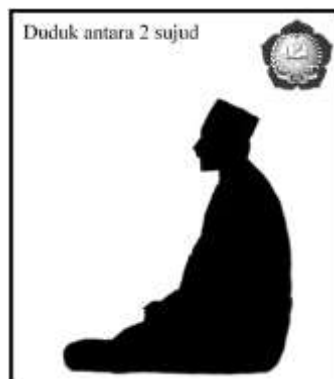


Figure 3. One of the print markers

System planning

3-dimensional objects that have been designed using Blender software will then be embedded into markers that have been registered in the database. After both of them are ready to be used then the layout design, additional features and interface design are done in Unity software. In the Unity software 3D design and layout will be done so that it can be adjusted to the display object in the interface design. After all features are completed in the Unity software, they are made into an .apk format so they can be installed on the Smartphone.

Application of Brute Force Algorithm

At this stage the application of the system design will be performed on an android smartphone as a publishing platform for the application. Following the application of the Brute force algorithm in this application.

This algorithm uses the Brute Force algorithm to find the appropriate String value for the two values to be matched, ie the database name and the object name when the camera is directed to a marker to display 3D objects on the Smartphone screen.

3-dimensional objects that have been designed using Blender software will then be planted into markers that have been registered in the database. After both are ready to use, then the next step is to design the layout, additional features and interface design that is done in the Unity software. In Unity software, the design and layout of 3D objects will be carried out so that they can be adjusted to the display object in the interface design.

The layout design of 3D objects in Unity is carried out to adjust the size and location of 3D objects, besides that, interface design is also carried out so that users can use the additional features provided. Here's the layout and size of the Unity software.

Brute Force algorithm will be active to match the name of the database with the name of the object that will display the 3D object on the screen. The string value in the database is obtained by writing the OnTrackingFound() function in the program list. The database name string will be marked by the variable mTrackableBehaviour.TrackableName. While the object name string value is shown from the tag name that is accessed in the 3D image stored in it. The Brute Force Algorithm will match both String values. If both match, the screen will display a 3D object with the caption "Base Match", but if not, the screen will not display a 3D object.

This algorithm uses the Brute Force algorithm to find the appropriate String value for the two values to be matched, namely the database name and the object name when the camera is pointed at the marker to display 3D objects on the Smartphone screen. When the marker is matched with the marker in the database, the AR camera will display a 3D object. After the 3D object appears on the smartphone screen, the user will proceed to the next step to another marker. The script for applying the Brute Force algorithm to the application can be seen in the following script.

```
VAR = mTrackableBehaviour.TrackableName;

Teks = TextBrute1.tag;

int j;
int check = 0;
for (int i = 0; i <= VAR.Length - Text.Length; i++) {
    j = 0;
    while (j < Text.Length && VAR [i + j] == Text [j]) {
        j++;
    }
    if (j >= Text.Length) {
        check++;
    }
}
if (check > 0) {
    TextTargetName.GetComponent<Text> ().text = "Database cocok";
} else {
    TextTargetName.GetComponent<Text> ().text = "Tak Berhasil!";
}
```

}

In the script above, the vAr variable in the form of the database name and the text in the form of the object name will be matched with the Brute Force algorithm. When the selection button to the AR camera is pressed, the camera will detect the marker that has been paired with the marker in the database. When the marker finds a marker that matches its partner, the 3D object will appear on the AR camera with the caption "Base Match".

Design Results



Figure 4. Results of applying brute force

In the picture above, it can be seen that if the camera is directed to the print marker, the marker will look for a dot that matches the pattern held by it. If the two markers match, the marker will display a moving 3D object on the smartphone screen. The application will provide information that the marker is well recognized. Novelty in this paper is the use of smartphone-based Augmented reality technology that is easy to use for learning that requires direct body movement without having to practice it.

CONCLUSION

Brute Force algorithm can identify the string value on the marker so that when the second paired pattern matches, the 3D object contained therein can appear on the screen. The prayer movements that are discussed are 9 types of movements, which in each movement there are movements of several versions of the schools. Total movements are 32 movements. The movements are summarized into an application that is summarized using Augmented Reality technology. This application displays the movement of prayer with 3D objects that move well so that it is easy to understand. This application can also recognize markers well so that all 9 markers can be recognized and display 3D objects in accordance with the database. All markers have sensitivity at the same distance so that a good scan is located at a distance of 13 cm and a minimum at a distance of 4 cm with good lighting, when at a distance of 14 cm the object only looks 10% on the camera screen.

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