

# The development of Indonesian traditional bekel game in android platform

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**Abstract.** Bekel is one of traditional Indonesian game that is rarely played nowadays. Bekel is a game to test dexterity level using a bekel ball and 6 to 10 seeds. The game is played by throwing the ball up in the air, spreading the seeds randomly on the floor then picking the seeds up until the ground is clear. This game application is an adaptation of Bekel game focusing on the movements of the ball and the randomization of the seed positions. This game application has three levels of difficulty based on the basic rules of the actual Bekel game. The focus of the study is the free fall method of the ball and the random function of the seeds in the Android environment. The result show the Bekel application has sensitivity level of 71% for the ball movements and the probability rate of the random event occurrence is at 23%.

## 1. Introduction

Bekel is one of the traditional Indonesian games to test the level of dexterity. The name of Bekel is originated from the Dutch language, *bikkelen*, means fighting spirit. In some area, Bekel calls in different names such as bekelan, beklen, and bekles. The game is usually played by children using a Bekel ball and 6-10 seeds.

The way to play Bekel is, the ball is thrown up, while the ball is still up in the air, the player has to pick the seeds up then catch the ball again. Firstly, the seed is taken one at a time until the floor is clear. Then it will continue by taking two seeds at a time, then continue with three seeds and so on until the seeds are grasped at once in a single try. Afterwards, the player has to flip the seeds to the other side; then the seeds are taken one at a time, two at a time and continued until the seeds are taken at once. After finishing this step, continue with flipping over the seeds to the first side then pick the seeds up as before [1].

Traditional games have a simple concept to teach the children. However, nowadays, classical games are rarely played because of an online game that can be played individually by anyone and anywhere using a device such as a mobile or PC. The study certainly has an impact on the traditional games that began to lose its existence as a medium of entertainment in the past.

A previous research of the game bekel in 2014 was conducted by Alamsyah et al. they built and Android-based Bekel game with five steps and system implementation using Adobe Flash. The results obtained including the accelerometer for the ball movement that can move up and down also touch response to seed extraction that works [2].

Other research related to the traditional game has also been conducted by Juardi et al. on 2013. The research is in the development of Karapan Sapi game. Karapan Sapi game is based on an actual sport



from Madura, Indonesia. The resulted study is an educational game of "Karapan Sapi Race" with an interesting, entertaining and has "easy to play" gameplay [3].

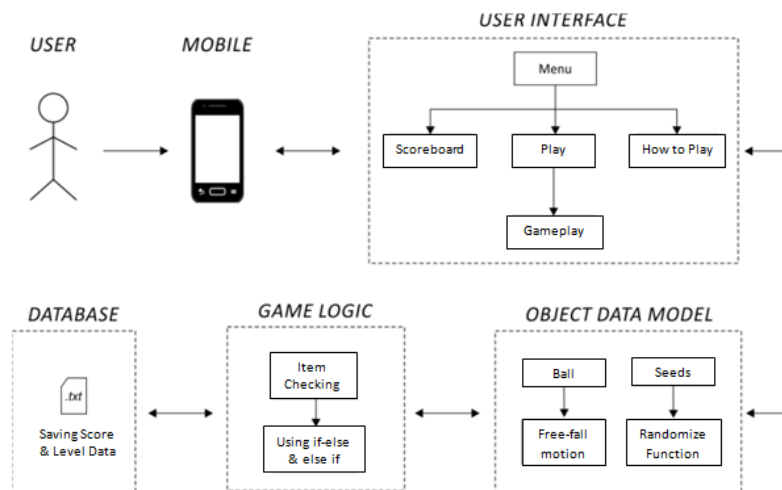
In 2013, Farizi et al. also researched Angklung, one traditional musical culture from Java. He builds a game simulator on an Android-based smartphone with Game Design and Technical Design phases. These phases then being implemented and developed using AndEngine in Java programming language. According to the unit and integration testing result, it can be concluded that the module unit of the game application has fulfilled the functional requirements of the development. The effect of performance testing shows an optimal performance when the game runs on a smartphone with a minimum processor of 600 MHz [4].

Numerous interactive game applications have been developed for Android. Android is a suite of software designed for mobile devices. [5], our previous interactive application also built in Android Platform, such as Augmented Reality for potential asset [12]. In this research, we develop a game adapted from Bekel game with some adjustments in order to be able to run on Android-based mobile devices as a means to restore the existence of one of the traditional Indonesian games via mobile devices. The complexity of the ball movements and the seed randomization is varied in the implementation of Bekel game application. Therefore, a method is required for the implementation of ball movements and the randomization of the seed positions so that the bekel game can be built.

## 2. Methodology

### 2.1. General architecture

The development of Bekel adaptation game consists of 4 main principles. Those functions are User Interface for the interface on the device screen, Object Data Model for ball movement and seeds randomization in the game, Game Logic for the game flow, and Database for the storage of the game score. The general architecture of the game can be seen in Figure 1.



**Figure 1.** General Architecture.

### 2.2. Object data model analysis of ball and seeds

Free fall motion can be implemented as movement method on ball object. Initially, the ball will be given mileage to reach a certain height. When the ball reaches a predetermined height limit, then the free fall method plays a role in adjusting the ball path until the ball reaches the initial position.

The random function will be applied as the seed position randomization so that the seeds appear in a random position on each game. The location of the seeds is deliberately made random to avoid the player memorize the position of seeds scattered on the game board.

*2.2.1. Logic description of ball object motion using free fall motion.* Free fall motion is the motion of falling objects in the vertical direction of a particular height without the initial velocity ( $v_0 = 0$ ), so the movement of the object is only affected by the earth gravity [6].

Free fall motion (FFM) is included in accelerated uniformly accelerated motion (UCM). The acceleration experienced by this object is due to the gravitational pull of the earth. Since the condition of free fall motion is its initial velocity is zero, then UCM equation applies as follows:

$$v = v_0 + at \quad (1)$$

$$s = v_0 t + \frac{1}{2} at^2 \quad (2)$$

$$v^2 = 2as \quad (3)$$

Since the initial velocity of free fall motion is ( $v_0$ ) = 0 so that in formula  $v_0$  is omitted,  $s$  in the above equation replaced by  $h$  which states the height and acceleration experienced by the object is the acceleration of earth gravity, then applies the formula [7]:

$$v = gt \quad (4)$$

$$h = \frac{1}{2} gt^2 \quad (5)$$

$$v^2 = 2gh \quad (6)$$

Where:

$v$  = Object final speed(m/s).

$t$  = Time(s).

$h$  = Object height(m).

$g$  = Gravitational acceleration (m/s<sup>2</sup>).

From the equation of falling time, it can be seen that the free-falling object time is only affected by two factors, namely height ( $h$ ) and earth gravitational acceleration ( $g$ ). Other quantities do not jeopardize its fall time, which means that despite the different weights, two objects that fall from the same distance and in the same place will fall at the same time. But if the objects do not fall together then it is due to the air friction [8]. Pseudocode of the free fall motion used in this application can be seen in Figure 2.

*2.2.2. The description of a random function.*

The random function is used to randomize the seed position during the game. Random function is formed from a random number. A random number is a number taken from a set of numbers, where each element of the set of numbers has an equal chance of being drawn [9]. The process of picking random numbers itself is a random event, meaning the events where processes and outcomes cannot be predicted.

Java provides two approaches in generating random numbers through the `java.lang.Math` and `java.util.Random` classes. `java.util.Random` class can be used to get a better result of the random number. This class provides a more practical approach and supports other types except for double, including the Gaussian distribution [10]. `Random` Class contained in the `java.util` package is a pseudo-random number generator using an algorithm derived from *The Art of Computer Programming* by Donald Knuth [11].

In Bekel game, the seed positions are randomized as a variation of the game. Seed randomization used a random function to ensure every appeared seed is not monotonous with the same position on each level. A random function that is used also come with the provisions of the randomized seed that will appear in the coordinates which are restricted in length and width. It is to prevent the appearance of randomized seeds beyond the 450 x 350 pixel board's resolution. Pseudocode of random function for seed position can be seen at in Figure 3.

---

```

begin
Set x as object.
Declare ballPos in initial-position.
Declare highBall as height.
Declare gravityBall as gravitation.
if (x = clicked){
  if (x = drag) {
    if (ballReturn == false) {
      if (highBall <= 0)
        ballReturn = true;
      else {
        ballPos -= highBall;
        highBall--;
      }
    }
    else if (ballReturn == true) {
      if (ballPos >= 0) {
        ballReturn = false;
        ballClicked = false;
        ballPos = 0;
        highBall = 25;
        gravityBall = 1;
      }
      else {
        ballPos += gravityBall;
        gravityBall++;
      }
    }
  }
  showBall(g, world);
}
}

if (x = touch) {
  if (ballReturn == false) {
    if (highBall <= 15)
      ballReturn = true;
    else {
      ballPos -= highBall;
      highBall--;
    }
  }
  else if (ballReturn == true) {
    if (ballPos >= 0) {
      ballReturn = false;
      ballClicked = false;
      ballPos = 0;
      highBall = 25;
      gravityBall = 1;
    }
    else {
      ballPos += gravityBall;
      gravityBall++;
    }
  }
  showBall(g, world);
}
end

```

---

**Figure 2.** Pseudo-code of the free fall motion.

---

```

begin
Determine the randomization limit coordinate.
Declare batasX as coordinate-limitX.
Declare batasY as coordinate-limitY.
while (biji.israndom()) do
  batasX = biji_random(maxX-minX) + minX
  batasY = biji_random(maxY-minY) + minY
end

```

---

**Figure 3.** Pseudocode of random function for seed position.

### 2.3. Game logic

In game logic, item-checking function is utilized to determine whether the players play the game right or not. Item checking is a function used as a trigger between interconnected items, in this case, the ball movements, the number of seeds on the board, the number of seeds taken and the number of lives available. This function is performed if the ball moves.

Item Checking function is utilizing if-else and else-if structure to execute a statement if one of the expressions gives true value and also includes another alternative if the evaluated expression gives a false value. In another word, item checking is a game rule that determines the player to win or lose (game over).

The process of item checking is also affected by the difficulty level of existing games. The difficulty level of the game is designed based on the number of seeds used. The more seeds to collect in the game, the more difficult the players are to win. In Bekel game application, there are three types of the difficulty

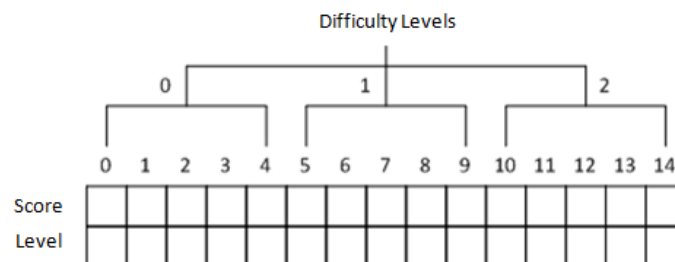
level of the game. Explanation of the number of available seeds and the level of taking on each level of the game can be seen in Table 1.

**Table 1.** Difficulty level

Difficulty levels	Number of seeds	Number of taking
Easy	6	6
Normal	8	8
Hard	10	10

**2.4. Database**

The database is containing the score’s value and level data. The data is stored and will be displayed on the scoreboard interface menu. For storage, scores and levels are only saved to the database if the player's total score is higher than the previous scores. Score and level storage are done when the game ends. As for the reading, when initialization, the application will read the stored file of players score and level. If the file is found, then the contents of the file will be saved to the storage variable to be displayed. If the score file is not found, then the storage variable will be filled with the default value. The design of scores table can be seen in Figure 4.



**Figure 4.** Game scoreboard storage block.

**3. Result and analysis**

When the player starts the application, the audio will automatically turn on, and the music will play. Players can choose to mute the sound by pressing the button on the top right. To start the game, the 'play' button has to be clicked. Afterwards, will appear select grain to be used and difficulty levels displays. Main menu and item selection menu displays can be seen in Figure 5 and Figure 6 respectively,

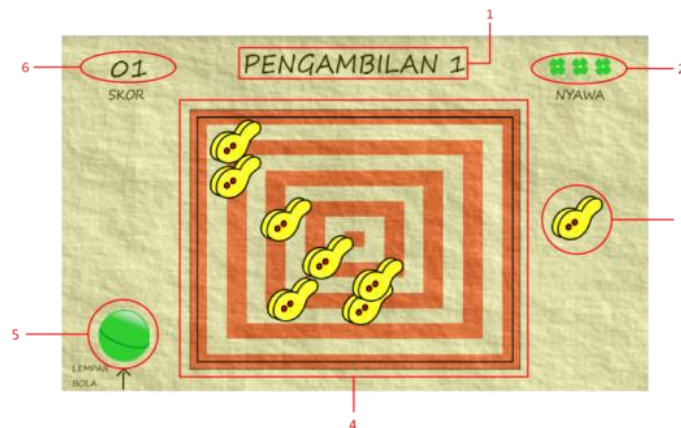


**Figure 5.** Main menu display.



**Figure 6.** Item selection menu display.

When the player selects the difficulty level on the Item selection menu displays, then the system will show the Game Arena display. The Game Arena display can be seen in Figure 7.



**Figure 7.** Game arena display.

The numbering description in Figure 7 is (1) the round of taking (2) the player's life (3) the taken seed (4) the game board (5) drag the ball (6) the player's score. Some testing has been conducted to find out whether the game application can run well or not, such as methods testing, test respondents, and test cases.

### 3.1. Testing

**3.1.1. Ball movements.** The ball movements testing is conducted to assess how much the percentage of the ball object movements succeed when it is moved. The parameter of the object movements and its sensitivity level of the ball moved to reach its maximum height limit by the dragging action. If the ball is moved only in short range then considered as failed, otherwise it is succeeded. The test is performed with the ball being driven 100 times by the tester.

The test results of sensitivity level on the ball object are at 71% where 71 times the ball movements successfully done and 29 times the movements of the ball were failed. The existence of the ball movements that failed to be performed is classified as bugs which is caused by the weak system of the coordinate range settings on the ball movements that has been designed. The x,y coordinate range setting plays a significant role in the implementation of the ball movement method. The improvement in this area is a must for the further research.

### 3.1.2. Seeds randomization function

In the random process where the length and width have been limited, sometimes random combinations can also produce the same coordinate point so that if the seeds appear on the board, there is a circumstance wherein the naked eye is only 1 visible seed but when the seed is taken it turns out to be 2 or more. This is called an 'unpredictable' random event.

In "unpredictable" random circumstances events require a test to calculate how likely the occurrence of random events in a game application is created. It aims to find out how significant the impact of random event conditions on the performance of seed randomization function.

The possibilities of 'unpredictable' random event was tested with 30 times repetition of seed randomization function on the board game. The results obtained are 23 times the normal seed condition and seven times the state of random event occurs. The result shows that the probability rate of the random event occurrences is 23%. Although the rate of the probability of random event occurrence is considered as a small category still the random event is one of the shortcomings of this game application which in the future must be improved.



### 3.2. User interface testing.

The testing of Bekel game application user interface was conducted on 20 respondents by filling out the questionnaire. The trial of respondents undertaken to determine whether the game is made feasible to play or not. The result of this application user interface assessment can be seen in Table 2.

**Table 2.** The result of application user interface evaluation.

No.	Evaluation targets	Evaluation scores				
		Excellent	Good	Fair	Bad	Very bad
1	Application design in general	4	15	1	-	-
2	The displays of ball, seeds, and gameboard	2	18	-	-	-
3	Item colors	3	14	3	-	-
4	Game animation display	2	15	3	-	-
5	Menu button design	1	16	3	-	-
6	Audio	1	16	3	-	-

Then obtained the overall value of the user interface aspect as follows:

$$S_{\text{total}} = \frac{4.15+4.1+4+3.7+3.9+3.9}{6} = 3.93 \quad (7)$$

From the overall value equation, obtained value of 3.93 for the user interface aspect. It can be concluded that the user assessment result of the Bekel game interface aspect is Fair.

### 3.3. System testing

The result of this game application difficulty level can be seen in Table 3.

**Table 3.** Result of system testing

No	Respondents	Game difficulty levels					
		Easy		Normal		Hard	
		S	L	S	L	S	L
1	R1	x	x	48	6	13	1
2	R2	12	3	x	x	x	x
3	R3	23	4	32	4	6	1
4	R4	x	x	x	x	16	2
5	R5	33	6	25	3	57	5
6	R6	23	3	x	x	x	x
7	R7	29	5	36	5	64	7
8	R8	19	3	x	x	x	x
9	R9	25	3	x	x	x	x
10	R10	14	3	11	1	13	1
11	R11	24	5	x	x	x	x
12	R12	30	6	37	5	36	4
13	R13	17	3	x	x	9	1
14	R14	x	x	x	x	23	3
15	R15	18	4	8	1	24	2

16	R16	x	x	16	3	x	x
17	R17	36	6	43	6	x	x

In table 3, S is the total player score while P is the level of seeds taking achieved by the players. Based on the assessment result, it can be concluded that the average succeeds rate of the game difficulty level of 20 respondents are as follows:

- Easy level average achievement rate is 4.1 out of 5 in 6 levels.
- Normal level average succeeds rate is 3.8 out of 5 in 8 levels.
- Hard level average succeeds rate is 2.8 out of 5 in 10 levels.

From the data above, it can be concluded that the success rate of Bekel game application has a has a medium-high level of difficulties.

#### 4. Conclusion and future research

In accordance with Bekel game application system analysis and testing can be drawn some findings in this study as follows:

- The ball-catching movement after the seeds are taken has not been able to be implemented in this Bekel game applications.
- The testing conducted to the ball movement is obtained the sensitivity level of 71% of a total 100 times the ball being moved. While the test result on the percentage of the possibility of random events in the random function is at 23% and considered as a low category and often occurs in random functions because every element of the set of random numbers has an equal opportunity to be drawn so that the results cannot be predicted.
- The testing results of game difficulties of 20 respondents are as follows. Easy level average succeeds rate 4.1 out of 5 in 6 levels; normal level average succeeds rate is 3.8 out of 5 in 8 levels, and hard level average succeed rate is 2.8 out of 5 in 10 levels.
- In general, Bekel traditional game has many variations on the levels. The authors only adapt the basic level of Bekel game called the Mi round into the application.

Based on the conclusions drawn from this research, the future study is as follows:

- In future research, the ball-catching movement after the seeds taken can be implemented into the application by expanding the touch area of moving object.
- The ball movements can be developed using swipe gesture by implementing speed function so that the ball speed can be adjusted by players desire.
- The random function used for the seeds can be upgraded by giving a distance limit to every item to be randomized so that the seeds will not be overlapped at the same coordinates.

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