

Implementation of ORB and Freak Algorithm in English Applications for Learning Objects Around

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Abstract. Nowadays children's interest in learning English is still low, so it is necessary to provide interesting and innovative learning media. Learning English can be started by studying the objects around them with a method that does not make children glued to their gadgets. This study aims to create an English learning application that can introduce, add, and memorize the vocabulary of surrounding objects for children but involves the role of a more mature person. The Rational Unified Process is used as a system development method in this research. RUP consists of perspective and core processes as well as a lifecycle phase. The aspect that is the focus of this research is the object guessing feature by applying the ORB algorithm and the Freak algorithm in matching images in the form of a quiz. The ORB algorithm is used for keypoint detection in an image. Freak binary algorithm descriptor that uses pattern sampling and method of selection pairs used by BRISK. Optimizing the role of parents in this quiz is in adding objects to the quiz. The results of this study are an android-based application consisting of aspects of recognizing existing objects such as dictionaries and aspects of practice in the form of guessing objects that are around. in the form of a quiz. This quiz is completely controlled by an older person. The hope is that there is an active role for parents or people who are more mature in the learning process and not make children passive.

Keyword: English; children; Freak, ORB; android apps

1 Introduction

Learning foreign languages, especially English for children, needs to be done to compete globally in the future. In early childhood, learning English includes all language competencies, namely listening, speaking, reading and writing [1]. English language skills cannot be separated from vocabulary, the more vocabulary an individual has, the easier it will be to learn a language.

Nowadays the role of parents is very minimal in the learning and teaching process, especially in online or independent learning at home. It should be realized that in the teaching and learning process parents have roles including assisting, establishing communication, supervising, encouraging and motivating and directing. [2]. This is due to several factors including the presence of smartphones with various technologies in them. The presence of smartphones indirectly triggers various views, including the need for the role of parents in the teaching and learning process so that the role taken by parents is only limited to facilitating their children.

Concentration is an important factor related to the ability to focus on the material and the learning process itself. If the child/student cannot concentrate in learning, then the child does not enjoy the learning process that is being carried out [3]. One way for children to enjoy learning is to prepare interesting learning media, namely image media. Picture media can improve student learning outcomes [4]. The image itself does not necessarily visualize something that cannot be seen or is difficult to see, so it is better if the object is taken in a real environment with the help of existing devices and processed to be an interesting and innovative learning media. Processing of images taken in a real environment and matched to existing data requires image processing. Digital image processing (Digital Image Processing) is a discipline that studies image processing techniques. The image referred to here is a still image (photo) and moving image (derived from a webcam). [5]

An important step in recognizing images is the search for the feature/keypoint detector and its descriptor. Image texture consists of dots that have unique characteristics that are considered capable of being used as differentiators [6]

2 Methodology

The methodology used in this research is divided into 3 stages, namely identification and analysis of problems, data collection, and problem solving with software development using the Rational Unified Process (RUP).

2.1. Problem identification and analysis

The problem identification process consists of 3 steps, namely finding problems that will occur and being appointed as research topics and analyzing these problems to find the main source of the problems that occur so that solutions can be found.

2.2. Data Collection

The data collection process consisted of observations on existing applications and literature studies on previous research. The research that is used as a reference is research on the design of Balinese carving recognition applications using the ORB method [7] and testing the temple site image detection algorithm on the android application [6]. Based on these two studies, it can be concluded that the use of ORB and Freak algorithms produces the best combination for matching applications on Android.

2.3. Solution to problem

ORB is a fairly fast BRIEF-based binary descriptor. ORB has good resistance to noise and rotational invariant properties. ORB performance results in 2 times efficiency compared to SIFT in various situations. The ORB algorithm is a combination of two popular techniques, namely, FAST (Features for Accelerated Segment Test) and BRIEF (Binary Robust Independent Elementary Features) for keypoint descriptors [8]. The implementation steps of ORB are:

- 1) Calculate the moment invariant on the keypoint with the formula:

$$m_{pq} = \sum_{xy} x^p y^q I(x, y) \dots\dots(1)$$
- 2) Determination of the centroid moment and angle with the formula:

$$C = \frac{m_{10}}{m_{00}}, \frac{m_{01}}{m_{00}} \dots\dots(2)$$
- 3) Calculating patch Orientation angle

$$\theta = atan2(m_{10}, m_{01}) \dots\dots\dots(3)$$
- 4) Generating descriptor value

$$\tau(p; x, y) = f(x) \left\{ \begin{array}{l} 1, \\ 0, \end{array} \begin{array}{l} p(x) < p(y) \\ p(x) \geq p(y) \end{array} \right\} \dots 4$$

Freak is one of the binary descriptor algorithms that have similarities with the BRISK and ORB algorithms which consist of 3 constituent components, namely sample patterns, orientation compensation and sampling pairs. The pattern of this algorithm is to check all pairs and for each pair (p1,p2). If the intensity at point p1 is greater than the intensity at point p2 then we write 1 in the binary string and vice versa. The freak algorithm uses a cascade approach to speed up matching two descriptors, where only the first 128 bits will be compared if the distance is smaller than the threshold then the process continues to compare the next 128 bits. This mechanism can result in faster matching so that in the first 128 bit comparison it can discard more than 90% of the non-matching candidates.

2.4. Software Development

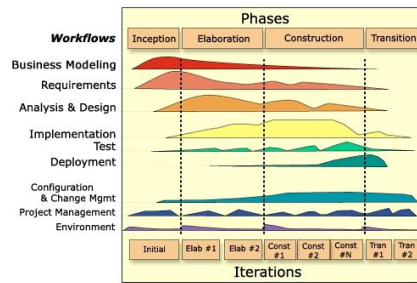


Figure 1. Rational Unified Process (RUP)

The development of English learning applications uses the Rational Unified Process (RUP) development methodology. RUP is a system development methodology consisting of 2 dimensions, namely horizontal and vertical dimensions with iterations in each process. The following explanation is an explanation of the dimensions of the RUP:

- a. The horizontal axis on the RUP represents time and aspects of the process life cycle. This dimension represents the dynamic aspect of the process which consists of phases, iterations and milestones. The phases in this dimension consist of inception, elaboration, construction and transition, each of which allows iteration to occur.
- b. The vertical axis represents core process disciplines, which group activities logically by nature [9]. Activities in this dimension consist of core processes and supporting processes

Each phase has a different workflow according to needs. In addition, because the project is made on an independent scale or small group, the work flow support is not used. The iteration is carried out at each phase of the horizontal dimension to ensure that the application is made according to the needs.

3 Result and Discussion

Based on the results of the problem identification, it was found that there was a need for an English learning application that was not only used independently by children but needed assistance and management by their parents by applying the concept of exploring the surrounding environment. It is hoped that with this application the role of parents in the

independent learning process at home will be more optimal. RUP is a methodology used in application development by applying the ORB algorithm as keypoint detection and Freak as an algorithm for binary descriptors. It aims to create an image processing-based application to match image data taken by children with images taken by parents as an exercise to increase English vocabulary. Berikut adalah tahapan yang dilaksanakan dalam penelitian ini:

- 1) The inception phase consists of identification of business processes and analysis of user requirements. This phase resulted in several things including: The application made has a simple dictionary feature, and quizzes as an exercise. Children are required to capture pictures around them to guess the name of the object in English. Quiz created is multiple choice
 - a. The question management process can only be done by parents or older adults by first registering and verifying the account via email
 - b. Entities or users of this application consist of 2, namely children and parents.
 - c. To use this application, you need an Android smartphone that has a camera of at least 2 MP with the lollipop operating system
 - d. The test plan is only carried out internally using blackbox testing
- 2) Elaboration Phase
 - a. In this phase, the design of the application is generated. The design tool used is using UML diagrams with the software used is Star UML. The UML is an industry-standard language that allows us to clearly communicate requirements, architectures and designs [10]. Here is the use of the application that was made

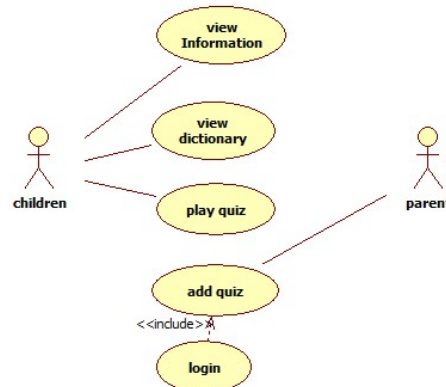


Figure 2. Use Case

- b. The application made consists of various features including viewing information, viewing simple dictionaries and playing quizzes, as well as features for parents for managing questions in the application database. In this phase, it is expected that the design has reached 70-80% which if needed will be iterated if there is a change
- c. Algorithm Implementation

The ORB algorithm used has several stages, namely as follows:

 - 1) The process of changing the image to grayscale
 - 2) Determine the I_p value, where $I_p = 100$ and the threshold value where the value is set to 25

- 3) Comparing I_p with points around with a radius of 3 using formula 1, so that I_p is compared with I_1, I_5, I_9, I_{13} if the conditions are met proceed to the next stage if not then testing is carried out on all points $I_2, I_3, I_4, I_6, I_7, I_8, I_{10}, I_{11}, I_{12}, I_{14}, I_{15}, I_{16}$ with radius 3.

$$I_n = \begin{cases} I_n \leq I_p - t \text{ (darker)} \\ I_p - t < I_n < I_p + t \text{ (similar)} \\ I_p + t \leq I_n \text{ (brighter)} \end{cases} \dots(1)$$

- The results of the calculations can be seen in table 1

Table 1. calculation results comparing I_p with I_n

I_n	Intensitas	hasil Uji	I_n	Intensitas	hasil Uji
1	230	brighter	9	71	Darker
2	225	brighter	10	80	Similar
3	214	brighter	11	183	brighter
4	202	brighter	12	210	brighter
5	180	brighter	13	215	brighter
6	170	brighter	14	209	brighter
7	130	brighter	15	221	brighter
8	70	darker	16	221	brighter

- Results of grayscale values around the test point and conversion to binary

Nilai grayscale titik uji							Konveris ke citra biner						
223	228	221	225	214	236	238	1	1	1	1	1	1	1
219	221	224	221	223	214	224	1	1	1	1	1	1	1
209	200	190	150	180	210	202	1	1	1	1	1	1	1
215	150	160	100	170	200	180	1	1	1	1	1	1	1
210	140	71	70	65	201	170	1	1	0	0	0	1	1
200	183	73	72	73	130	190	1	1	0	0	0	1	1
190	170	74	71	70	65	180	1	1	0	0	0	0	1

4) Calculating the moment invariant value at keypoint

Indeks								Jumlah	Jumlah	M00	M01	M10
	1	2	3	4	5	6	7	baris	Kolom			
1	1	1	1	1	1	1	1	7	7	7	7	7
2	1	1	1	1	1	1	1	7	7	7	14	12
3	1	1	1	1	1	1	1	7	4	7	21	21
4	1	1	1	1	1	1	1	7	4	7	28	16
5	1	1	0	0	0	1	1	4	4	4	20	20
6	1	1	0	0	0	1	1	3	5	3	18	30
7	1	1	0	0	0	0	1	3	7	3	21	49
										38	129	148

5) Centroid Value

$$C = \frac{129}{38}, \frac{148}{38}$$

So that the value of the centroid (3.39), (3.89), then obtained the corner angle is

$$\theta = \text{atan2}\left(\frac{3.39}{3.89}\right) = 1,724^{\circ}$$

6) ORB algorithm results with matching feature to see provisional results

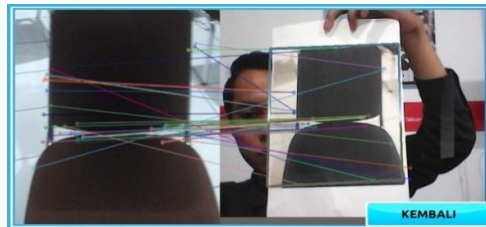


Figure 3. Matching using the ORB . Algorithm

7) Ignore point 6 because the matching process will use the Freak algorithm as a binary descriptor by iterating over all values. So that the most suitable value for the image above is obtained

3) Construction Phase

The activity at this stage is how to change the design into an application using certain software. The software used to make this application is to use Unity and the library uses opencv.

The application that was created was named GO-English which stands for Guess Object in English. The features of the application made consist of the Guess menu, scores, dictionaries, and information. The Guess menu is a quiz menu where players have to look for objects that are around to take pictures then the ORB and Freak algorithms will match them with the database. If the parent's access rights have entered the image, a multiple choice question will appear

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Figure 4. Application Main page and registration page to manage questions

In question management, parents are required to register first and verify registration. The verification process is carried out using email, where the application will send a link for verification in the registered email. Users are required to capture an image of an existing object and then give it a name using English. After that the user is required to fill in the wrong answer as a distraction for the child.

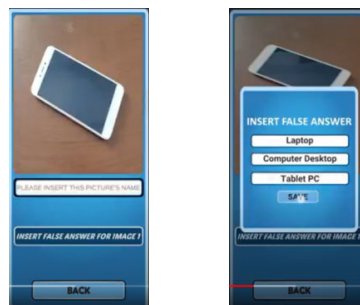


Figure 5. Entering quiz questions

To play this quiz, users, namely children, are required to look for objects around them to take pictures. If the image has been entered into the database, a question and answer option will appear for the object name in English. If the answer choice is correct, the application will display a notification that the selected answer is correct and will be counted. If the answer is wrong, a notification will appear that the answer is wrong and will not get a value. The display of the application made can be seen in the image below.



Figure 6. capture image

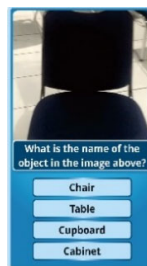


Figure 7. choose the answer

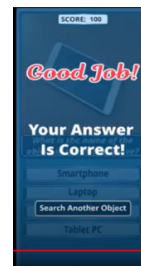


Figure 8. If the answer is correct a notification will appear

Testing of the developed software is carried out using black box testing and focuses on the registration and login features for parent users and object scan features for child users. Testing for registration is done by creating true and false scenarios to be input into the application and seeing the results if they are appropriate then the application is declared successful otherwise the repair process will be carried out

4) Transition Phase

In the last stage, the horizontal dimension of the RUP software development method focuses on how to document and deliver applications to consumers. The applications created will be entered into the Playstore so that they can be used by the general public. However, before publishing, it is necessary to make a manual book regarding the use of applications carried out in this phase

4 Conclusion

Based on the description above, it can be concluded that the application made is in accordance with the specifications that have been previously set. This application is expected to improve the function and role of parents in the independent learning process at home. Children as users become more interested in exploring the vocabulary of objects around them with the support of their parents, so that English is no longer a boring language to learn

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