SIMULATION INTRODUCTION PERIODIC SYSTEM OF CHEMICAL ELEMENTS PERIODIC TABLE USING AUGMENTED REALITY TECHNOLOGY(CASE STUDY: MODELING CHEMICAL BONDING) BASED ANDROID

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ABSTRACT

SMA N 1 Bayang Utara is one of the Senior High Schools at West Sumatra. This school consists of 3 classes of X class, which all of student receive chemistry subject matter. Basically, chemical is not a new subject for students. It's cause of at the junior high school level, students are introduced to this subject, but with different scope and level of understanding. The learning method that used for this subject at SMA N 1 Bayang Utara is a lecture method, where the teacher explains the material verbally to all of students.

Based on this, the media's learning like books are not able to present properly the shape of the atomic structure, arrangement of electrons surrounding it, and how the elements forming chemical bonds. Students need a learning media like a system that they can interact visually, so that an augmented reality system is proposed. The author intends to build a simulation application for recognition of elemental atomic structures on the periodic table as a medium for introducing interactive atomic structure models.

Based on analysis and testing at SMA N 1 Bayang Utara, the conclusions is the students being in a very positive attitude towards the first goal of this research to build a 3D multimedia simulation of Chemical Atomic Structures that can provide the clear information about the explanation of each element in each atom studied.

Keywords: Periodic Table, 3D, Chemistry, Unity, Augmented Reality

1. PRELIMINARY

1.1. Background

SMA N 1 Bayang Utara is one of the Senior High Schools at West Sumatra. This school consists of 3 classes of X class, which all of student receive chemistry subject matter. Chemistry is one kind of subjects tested on the national exam and become a determining factor for the students' graduation junior and senior high school levels. For that, all students are required to understand the material presented in accordance with the standards of competence which has been established. At the high school level, chemistry subject given to students from X class. chemistry subject taught in X class are Periodic Table of Elements and Atomic Structure, chemical bond, Nomenclature of Compounds and Reaction Equations,the function and composition of compound Hydrocarbon in daily life.

Basically, chemistry subject is not a new subject for the students. This is because at the junior high school, students have been introduced to the lesson in the scope and the different levels of understanding. The learning method used for chemical subjects in SMA N 1 Bayang Utara is a lecture, which is the teacher explains the material orally to all students. The media used in teaching and learning is only textbooks chemistry subjects. To determine the level of student understanding of the subject,methods and media used, it has been given the questionnaire to 54 students of X class SMA N 1 Bayang Utara. In a total, 64.8%, or about 35 students lack understanding and confusion with the elements in the periodic table. And 88,9% or about 48 students difficult to understanding incorporation of chemical elements in the periodic table.

Based on interviews with teachers of chemistry, students who have been given materials Elements and Atomic Structure and Chemical Bonding should be able to classify the elements according to the classes by knowing the atomic structure, the arrangement of electrons in an atom and its relation to the position of elements on the periodic table. Based on this, learning media such as books are still not able to represent the shape of atom structure and the arrangement of electrons surrounding it, and how the element forming chemical bonds. Students need a media of learning which is they need a system that can interact visually thus proposed an augmented reality system. Several studies among them conducted by Dikirahman (2014) and Nikko Primanda Hafidha Revelation (2014) creating learning media using Augmented Reality (AR) -based desktop and android.

Referring to the two studies, the authors intend to build a simulation application introduction of the atomic structure of the elements in the periodic table as a media for introduce a model of atomic structure that is interactive by using Augmented Reality (AR) android-based, graphical and 3 dimensional (3D) which is presented in a periodic table that will be made a marker. Its purpose to make students easier to visualize the shape of the atomic structure, the arrangement of electrons in an atom and element in the periodic table.

1.2 Purpose and Objectives

The purpose of this research is to build an applications for the simulation Atomic Structure of Periodic Table by implement Augmented Reality technology.

The objectives of the study are:
1. Help students understand the shape of the atom's structure, arrangement of electrons in an atom and identify the elements by group in the periodic table
2. Make it easy for students to combine chemical elements in forming chemical bonds.

2. CONTENT OF RESEARCH

2.1. Theoretical basis

2.1.1 SMA Negeri 1 IV Bayang Utara

SMA Negeri 1 Bayang Utara is one of 23 senior high schools in Pesisir Selatan, which is located about 24 km from the capital city of Pesisir Selatan, and about 77 km from the capital city of West Sumatra province.

2.1.2 Andorid

According to Silvia, Haritman and Muladi Android is a comprehensive platform open source and is designed for mobile devices [1]. Android system uses a database to store the necessary information to remain stored even though the device is turned off.

2.1.3 Multimedia

According to Vaughan (2004, p1): Multimedia is any combination of text, images, sound, animation and video are delivered by computer or other electronic means or by digital manipulation [2]. But in general, multimedia can be defined as the use of computers to process some of the media used as a media or an interactive system that allows users to interact with the system and obtain better quality of reception of the information.

2.1.4 Vuforia

Vuforia is Augmented Reality Software Development Kit for mobile devices enables the creation of Augmented Reality applications. Vuforia using Computer Vision technology to identify and track the planar images (Fig Target) and simple 3D objects such as boxes, in real -time.Formerly known as QCAR (Company Qualcomm Augmented Reality). This use of Computer Vision technology to identify and track the planar images (Target Image) and simple 3D objects such as boxes in realtime [3],

2.1.5 Periodic Table of the Elements

Periodic table of elements is a way to organize and classify elements, which elements are similar in character placed in the same group [4]. All the elements are arranged by their atomic numbers. The atomic number is the number of protons per atom.

2.1.6 Atomic structure

The atomic structure is the basic unit of matter consisting of atomic nuclei and negatively charged electron cloud surrounding it. Atomic nucleus contains mixture of positively charged protons and electrically neutral neutrons (except hydrogen-1 that no neutrons). Atom which releases electrons turn into positive ions, atoms that absorb electrons turn into negative ions [5].

2.1.7 C Sharp

LanguageC #is new programming language created by Microsoft (developed under the leadership of Anders Hejlsberg which incidentally also has created a wide variety of programming languages including Borland Turbo C ++ and Borland Delphi [6],

2.1.8 Unity

Unity is a software or computer program that is currently popular among game developers and game makers.user can do everything with a simple drag-and-drop motion connected with the script, assign a variable, or create multi-part complex assets. [7]

2.1.9. blender

Blender is a free application and open source 3D creation suite. Supporting the whole of the 3D pipeline-modeling, rigging, animation, simulation, rendering, compositing and motion tracking, and even video editing and make the game [8]. Blender features include 3D modeling, UV unwrapping, texturing, raster graphics editing, rigging and skinning, fluid and smoke simulation, particle simulation, soft body simulation, sculping, animating, match moving, camera tracking, rendering, editing and compositing vieo.

2.1.10. Unified Modeling Language (UML)

Unified Modeling Language (UML) is a family of graphical notation that is supported by meta single model, which enables the description and design of software systems, especially those built using an object-oriented program. UML was born out of the merger of many object-oriented graphical modeling languages that developed rapidly in the late 1980s and early 1990s. Since its presence in 1997 [9].

2.2. analysis

2.2.1. System Architecture Analysis

In the system architecture to be built consists of several components, namely: the user is a student who will use simulation application introduction periodic system of chemical elements in the periodic table, the user directs the camera toward the marker so that the marker can be captured by the camera.

Then from the image obtained from the camera smartphone tracking marker system to identify markers that are used by the user. Smartphone rendering 3D objects on top of markers have been identified. Figure 2-1 shows the description of the system to be built.
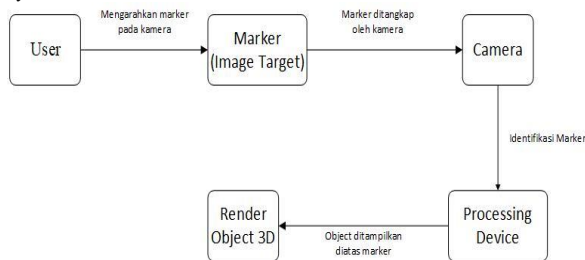

Figure 2.1 System Architecture Analysis

2.2.2. Hardware Requirements Analysis

Hardware requirements needed to build applications that will built form a laptop with the minimum specifications that can be used. The following hardware requirements specification, can be seen in Table 2-1.

table 2-1 Specification of hardware requirements needed

No.	Hardware	Specification
1	processor	Intel Core i5 2450M 2.5GHz
2	Hard Drive	750 GB
3	RAM	4096 MB
4	VGA	NVIDIA GEFORCE GT 630M 2GB

Hardware requirements needed to build applications that will be built in the form of smarthphone with the minimum specifications that can be used. The following hardware requirements specification can be seen in Table 2-2.

Table 2-2 Specifications Smartphone hardware requirements needed

No.	Mobile devices	Specification
1	processor	MSM8974AC Qualcomm Snapdragon 801 Quad-core 2.5 GHz Krait 400
2	RAM	3 GB
3	Internal memory	32 GB
4	Camera	20.7 MP
5	Operating system	Android 4.1 Jelly Bean

2.2.3. Software Requirements Analysis

Analysis software requirements consist of the minimum specifications required to build the application. There are the minimum specifications of the software used in developing Augmented Reality applications can be seen in Table 2-3.

Table 2-3 Requirements Analysis Software for running applications

No.	Software	Program name
1	Operating System (OS)	Windows 7 64-bit
2	Software Builders	2017.2.0f3 Unity, Blender
3	Software Design	Photoshop, Corel Draw X7, 3D Coat

2.2.4. User analysis

User needs analysis describes the various conditions that must be completed to use Augmented Reality applications of the chemical elements. There are the specifications of the user's needs can be seen in Table 2-4 and Table 2-5.

Table 2-4 User Needs

Users or User	Students SMA N 1 Bayang Utara
User experience	1. Can use Android Smartphone 2. Can use Augmented Reality applications
Users Physical characteristic	1. Do not have physical barriers 2. Motor not too stiff 3. Using your right hand and the left
Training for Users	1. Training in procedures for running the Augmented Reality Applications

Minimum Specifications Table 2-5 Device Smartphone User Needs

No.	Mobile devices	Specification
1	processor	Dual Core 1 GHz
2	RAM	512 Mb
3	Internal memory	1 Gb
4	Camera	2 MP
5	Operating system	Android 4.1 Jelly Bean

2.2.5. Use Case

Use case modeling is modeling system from the end user view. Use case works by describing the type of interaction between the user of a system with its own system through a story of how a system is used. Use case also be used to shape the behavior (behavior) system that will be created. A use case illustrates an interaction between the user (actor) with the existing system. Use case simulation applications introduction of the periodic system of chemical elements in the periodic table in SMA N 1 North shadow can be seen in Figure 2-2.
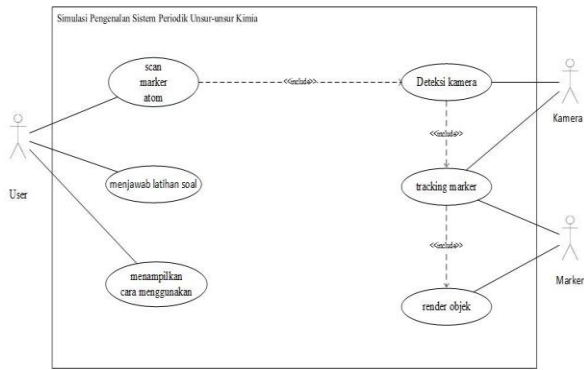
Figure 2-2 Use Case

A. Identification Use Case

Table 2-1 Table Identification Use Case

No.	Use Case	Description
1	Scan marker atom	Functional atom to scan marker
2	Answering exercises	Functional for exercises
3	Showing the way use	Functional to see how to use the application
4	detection camera	A function to detect the availability of camera
5	Tracking markers	A function to detect the presence of the camera
6	rendering objects	Functional for displaying objects on the screen

2.2.6. Activity Diagram

Activity diagram is something that represents a wide range of flow activity in the system that is being designed, how each plot starts, decision that might occur, and how they ended. Activity diagrams can also describe parallel processes that may occur in several executions.

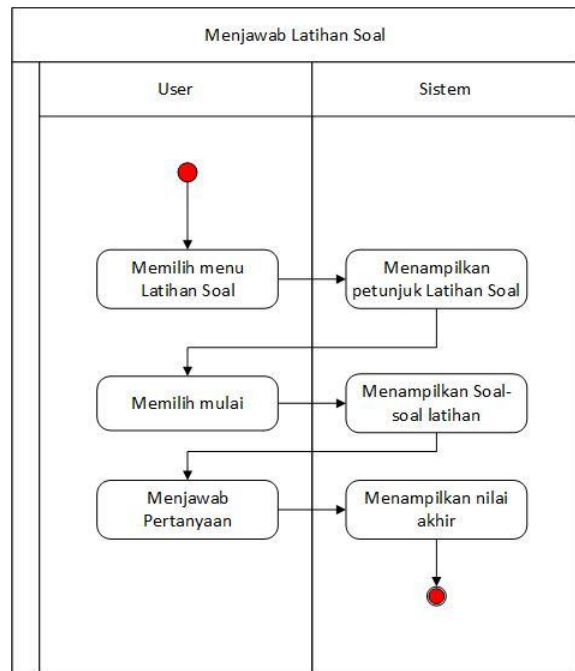**1. Answering Exercise Activity Diagram**

Figure 2-3 Activity diagrams answered exercises

2.2.7. sequence Diagram

Sequence diagrams describe the behavior of objects in use case by describing the life time of the object and the message that is sent and received between objects.
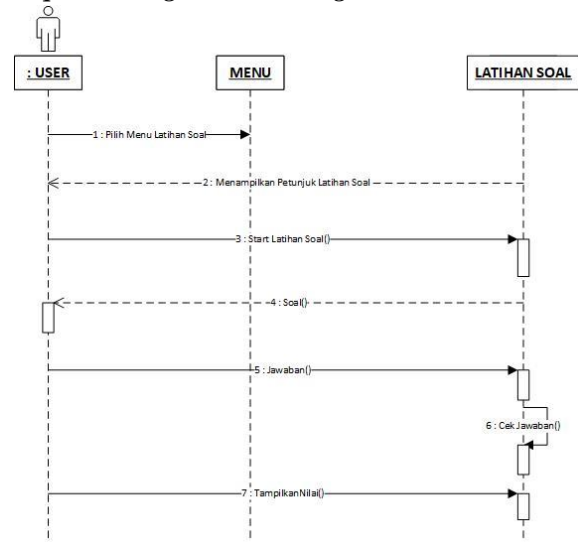
1. Sequence Diagram Answering Exercises

Figure 2-4 Sequence Diagram Answering Exercises

2.2.8. Class Diagram

The class diagram is the most common diagrams used in all object-oriented modeling. Modeling indicates grade classes in the system and the relationship between the classes, attributes and operations in the operation of the classes.
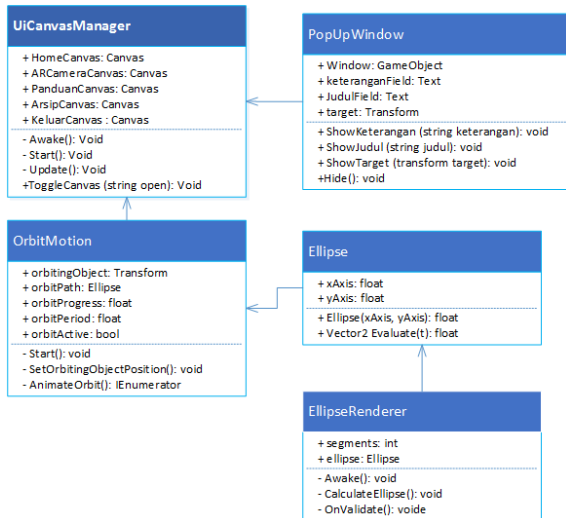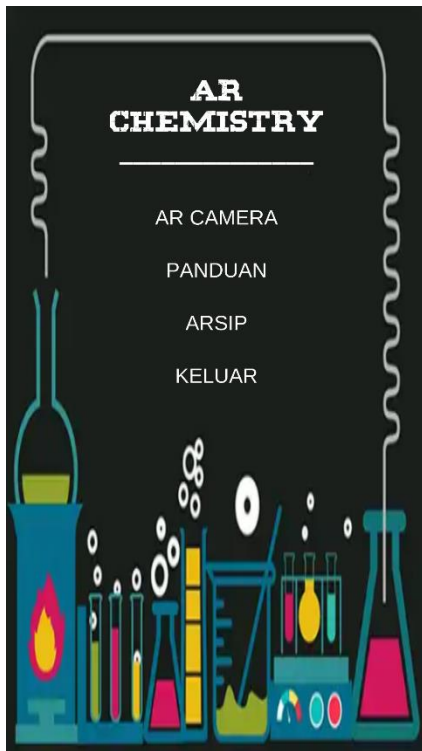
Figure 2-5 Class diagram

2.3. Research result
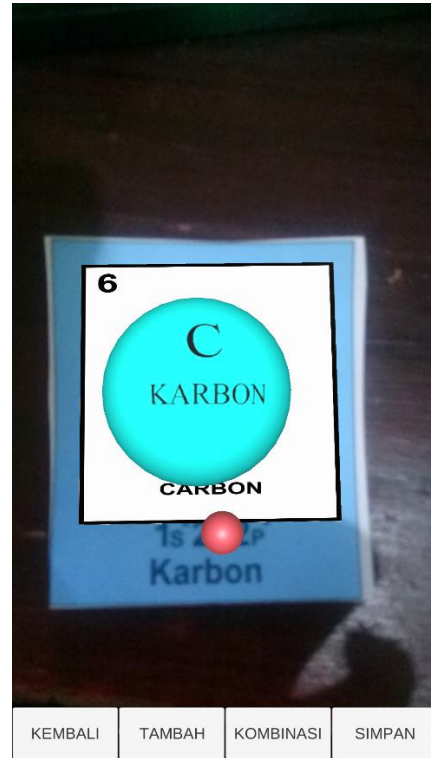### 1. Main page

Figure 2-6 Home

2. AR Camera

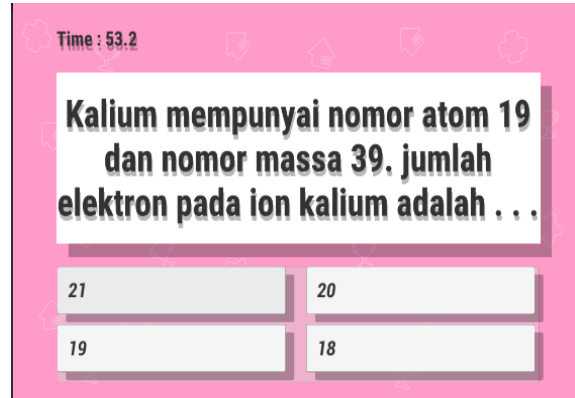
Figure 2-7 AR Camera

3. Answering Exercises

Figure 2-8 Answering Exercises

2.4. Testing Software
2.4.1. User Acceptance Test

User Acceptance Test is the media that used to provide an assessment of applications that are built by doing questionnaires, interviews or observations. In the case of this study I used a questionnaire method that contained 5 questions to students who would fill out the questionnaire.

1.4.2. Testing Test Case Design

Testing of design case tests is doing in built environment by a group of users, by conducting several tests on the application. The test methods in testing case design are using black box testing methods, because black box testing focuses on

functional requirements of software and tries to find incorrect or missing functions, find errors on the interface, find errors in the data structure or access to external databases, and performance errors in the application program being tested [9].

1.4.3. Alpha testing

Based on the results of the application testing that has been done, it can be concluded that the application of the Simulation of Introduction Chemical Elements of Periodic System in the Periodic Table Using Augmented Reality Technology that was built has been running as expected and accepted by application users, based on this, to maintaining the application to received and used by users, it will be further developed on the application of Simulation of Introduction Chemical Elements of Periodic System in the Periodic Table Using Augmented Reality Technology.

1.4.4. Beta testing

Beta testing is held in the user's environment, this test is direct in the real user's environment. Users make an assessment of the application, the method used are the interview method and questionnaire, the interview method is conducted only with Chemistry subject teachers, while the questionnaire method is done by X class students at SMA N 1 Bayang Utara, which amounts of 54 people. From the results of interviews and questionnaires, it was concluded that was the application that was built in accordance to the goal or not.

In searching the percentage of each answer can use the Likert scale formula [10] as follows:
P = (S / Score base) x 100%
Information:
P = percentage value
S = Total Weight × frequency = Σ frekuensi
The highest ideal score = Weight x the number of respondents = 5 x 54 = 270

Based on the Beta Testing has been done before by using interviews and questionnaires, it can be concluded as follows:

1. *respondents Strongly Agree to use simulation application Introduction Periodic System of Chemical Elements in the Periodic Table Using Augmented Reality Technology.*
2. *respondents Strongly Agree that the application Simulation Introduction Chemical Elementsof Periodic System in the Periodic Table Using Augmented Reality Technology can help students learn the material structure of atoms and chemical bonds.*
3. *respondents Strongly Agree that the application Simulation Introduction Chemical Elementsof Periodic System in the Periodic Table Using Augmented Reality technology is easier for students to know the model of the structure of atoms in the periodic table.*
4. *that the respondents agree that the application user interface Simulation Introduction Chemical Elementsof Periodic System in the*

Periodic Table Using Augmented Reality technology is exciting.
5. *respondents Strongly Agree to use simulation application Simulation Introduction Chemical Elements of Periodic System in the Periodic Table Using Augmented Reality technology is applied in a particular subject Atomic Structure Chemistry and Chemical Association.*

3. COVER

2.1. Conclusion

Based on the results of research conducted in this final project, the following are the results of the research that has been made, it can be concluded that:

1. *After testing by distributing questionnaires, it is concluded that the senior high school students are in a very positive attitude towards the first objective of this study is build a 3D multimedia simulation of Atomic Structure Chemistry can give a clear Opera- about the particulars of any elements that exist in every atom being studied.*
2. *Applications that used more interesting than just learning by book as a media of learning.*

3.1. Suggestion

Based on all the results that have been obtained in this final assignment, author has an suggestion to enhancement Simulation Applications Introduction Periodic System of Chemical Elements in the Periodic Table in the future, as follows

1. *Improving the quality of the user interface in order to become more interactive applications.*
2. *Add a Subject Matter Periodic System of Elements*
3. *Making an application is dynamic*
4. *Develop 3D applications becomes lighter*

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