Development Mobile Application Android Based for Sensor and Transducer

Y I Hatmojo¹ and S M Azis²

¹,² Electrical Engineering Education Study Program, Faculty of Engineering, Universitas Negeri Yogyakarta, Indonesia

Email: yuwono_indro76@uny.ac.id

Abstract. The aims of this research are: (1) producing a mobile applications android based for sensor and transducer field of study on vocational education; (2) know the quality of the product mobile applications android based for sensor and transducer field study on vocational education. The method used is the Software Development Life Cycle with the Waterfall model. The stages in Waterfall model are: (1) requirements definition; (2) system and software design; (3) implementation and unit testing; (4) integration and system testing; (5) operation and maintenance. The black box test results show the performance of Sensor application software can all function properly. While the results of the compatibility test show the application can run on various android systems (at least Android 4.2).

1. Introduction

Education is the most important foundation in supporting the progress of a country. Education is an activity to distribute knowledge, values and skills through an educational institution [1]. Education will be more focused if an institution has a focus on certain fields that are applied to students, one of which is vocational education. Vocational education has a main focus on equipping students with certain skills and abilities to be ready to enter the world of work [2]. In Indonesia, Vocational High Schools are vocational education at the secondary level that must produce graduates who are in accordance with skill in the industry needed [3]. Broadly speaking, the purpose of Vocational High School is to improve the skills of students in accordance with the field of expertise following the development of science, technology and art, as well as preparing a professional attitude at work. Steps to achieve these goals require appropriate and innovative learning methods and learning media.

According to [4] media is anything that is useful for delivering messages or information in the process of learning activities. Media has the meaning as an intermediary for a message from the source to the recipient of the message. According to [5] without media, the communication process will not run and learning will not be able to run optimally. Referring to the explanations of some experts above, learning media are all forms or things that function as knowledge intermediaries between educators and students so that learning objectives can be achieved optimally. According to [6] teachers and students have challenges and opportunities in the world of education if they can use media and technology efficiently and appropriately. The technology that has great opportunities in the world of education is the smartphone.

Learning media that using smartphones is known as mobile learning. According to [7], mobile learning can be run on various types of devices, such as smartphones, laptops, tablet PCs, media players, and game consoles. [8] 'mobile learning' allows students to learn learning materials anytime and...
Students are allowed to access and manage learning materials without time restrictions. Mobile learning can overcome the limitations of learning media because it can visualize components and tools that are difficult to get or expensive. According to [9] mobile learning has three main functions in learning, as an addition, a complement, and or a substitute. Mobile learning in addition, where students are free to choose and use it, students who use these devices will have more knowledge than those who do not use them. Function as a complement, it's means that the material in mobile learning is structured to strengthen the material in conventional learning. Mobile learning as a substitute, aims to enable students to access learning materials according to their time and daily activities. Mobile learning along with the development of the world of education, has begun to develop both in terms of learning media and learning systems. According to [10] in a publication on Statista.com, smartphone users in Indonesia in 2020 reached 196.7 million users. From the exposure to the data, it can be used as an opportunity factor for the use of smartphones in learning activities. However, there are still many schools especially Vocational High School that have not utilized smartphones as an optimal learning medium. Based on observations during distance learning in the Sensor and Transducer course at SMK SMTI Yogyakarta, the researchers found that the learning process was only through WhatsApp groups and the teacher only delivered material in the form of power point files. The limited learning media and supporting modules in the learning process resulted in a lack of interest in learning and student learning activity. This results in less effective learning so that the absorption of knowledge from each student is not optimal.

Therefore, researchers will develop an Android-based mobile application for the field of Sensors and Transducers in vocational education. Researchers in this development focus on basic competencies about proximity sensors, photoelectric sensors, and liquid level sensors that are adapted from the subjects of the Sensors and Transducers. The purpose of this study was to determine the design of an Android-based mobile application for the field of sensor and transducer studies in vocational education. Researchers will develop learning media using research and development methods with the Waterfall model.

2. Research Method

Researchers developed this application software using the ‘Waterfall Model’ or Software Life Cycle [11]. Figure 1 is an instructional waterfall models, in this study the focus is on making and functional testing of Android-based software applications.

![Figure 1. Waterfall Model](image)

The following are the steps of development software application using waterfall model.

2.1. Requirements Definition

This step aims to find out the problems, objectives, and application needs through observations in the subjects of sensors and transducers in the Mechatronic Engineering department, SMK SMTI
Yogyakarta. Interviews were conducted with subject teachers and students who taking sensor and transducer subjects. According to subject teachers, Sensor and Transducer learning media are still limited and have not been able to increase student activity in learning, so that the absorption of knowledge from each student is not optimal. Situation analysis, analyzing the state of learning activities and students during learning. Media analysis is seen from the learning media used by teachers in teaching. While the analysis of supporting data is based on an analysis of learning tools such as syllabus, job sheets, and supporting modules. After that, the results obtained are defined and use as general application specifications.

2.2. System and Software Design
This stage is an android-based sensor and transducer application software planning. The steps taken are designing the application layout and information architecture. The process of making the layout design is using vector-based graphic design software, namely CorelDraw X7. All media elements in the application are made by the author himself. Application design is made by considering the needs and results of the Requirement Definition stage.

2.3. Implementation and Unit Testing
At this stage the results of software requirements and design will be realized in the form of a program into a mobile application, by processing the elements of the media used. The media elements in this application are text, images, videos, animations, and simulations. In this android-based sensor and transducer application software, there are Simulation media elements that are rarely found in other applications. The simulation aims for users to interact directly with the media, so that students interest and activeness in learning will increase. The process of managing media elements using Corel Draw X7 and Adobe Animate software with Android SDK version 32.0.

2.4. Integration and System Testing
At this stage, the completed program will be integrated and tested. Testing is divided into two stages, Black box test and Compatibility Test. The black box test in making an application is carried out to determine the performance or functionality in terms of some aspects. Black box testing in this development is reviewed from the interface aspect and function suitability [12]. While the Compatibility test according to ISO 25010 [13] rules, this test aims to determine the performance of the system if it is run from one device with different Android versions and screens.

2.5. Operation and Maintenance
At this stage, the Android-based sensor and transducer application software is directly operated and maintained. This stage makes it possible to make corrections for errors in each of the previous stages. This stage is usually the longest life cycle phase of an application software.

3. Result and Discussion
3.1 Stage of Requirements Definition
The results obtained at this stage through observations and interviews about the conditions and needs of users, are:

(1) The limitations of learning media and supporting modules used by teachers in the subject of Sensors and Transducers. There is no learning media that is used specifically for Sensor and Transducer subjects.

(2) In the process of Distance Learning (PJJ), the delivery of material by the teacher is still monotonous and less interesting. So that the interest and activeness of students in learning is still low, this causes the absorption of knowledge from each student to be not optimal.

(3) All students already have smartphones with most of them using the Android operating system, but teachers only use smartphones to discuss through WhatsApp Groups and sometimes do Video Conferences.
3.2 Stage of System and Software Design

The results at this stage are in the form of designing the layout and information architecture of an Android-based mobile application for the sensor and transducer field. The layout design describes the placement and content of each page. Making this layout design using CorelDraw X7 software, the layout design is shown in Figure 2. Every page and menu in the application software needs a layout design, so that application content can be neat and consistent.

![Figure 2. Layout Design](image)

Information architecture (IA) shows an outline of information in a mobile application, starting from the main menu, sub-menu, sub-sub-menu, etc. The main purpose of IA was to make it simple and structured to navigate. The information pattern is in the form of a hierarchy, as shown in Figure 3. The top order of the hierarchy is the main menu in the application, there are 7 main menus in the mobile application for this sensor and transducer field. The next hierarchy is the content and features contained in each menu.

![Figure 3. Information Architecture](image)
3.3 Stage of Implementation and Unit Testing

Media elements in this mobile application are text, images, videos, animations, and simulations. The initial stage of creation is to create an interface that refers to layout planning and create drawings as needed. Making interfaces and image components using vector-based Corel Draw X7 software, as shown in Figure 4. The designs that have been created are saved in .png format so that the image has a transparent background and is easy to combine with other media elements.

![Figure 4. Interface Design](image)

After designing the interface components and images, then processing various media elements according to the design stage. In this stage used Adobe Animate CC 2017 software to program and process all media elements, as shown in Figure 5. The programming language used in the Adobe Animate CC 2017 software is Action Script 3.0 which is a development of the previous version of Adobe Flash software. The file is exported using Android SDK version 32 as a builder program, so that it can be used on Android.

![Figure 5. Processing Media Elements](image)

The developed mobile application consists of 7 main menus, namely: info menu, hint menu, competency menu, material menu, simulation menu, evaluation menu, and reference menu. The menus are displayed on the main page that can be selected by the user, the display of the mobile application is
shown in Figure 6. The info menu ("info") contains the developer bio and a button to exit the application. The hint menu ("petunjuk") explains the function of the buttons and the content of each part of the application. The competency menu ("kompetensi") explains the learning objectives and competencies in the application. The material menu ("materi") page contains several media elements, namely text, images, animation, sound and video. The simulation menu ("simulasi") is used to support the material, in this menu the user can interact directly with the media by selecting and sliding objects to be simulated. The evaluation menu ("evaluasi") contains multiple choice questions as a test of user understanding of the material in the mobile application. The reference menu ("referensi") contains a bibliography of teaching materials. This learning media has a final file form in *.apk format that can be run on smartphones with the Android operating system.

![Figure 6. Interface Mobile Application](image)

### Table 1. Black Box Test Data

| No. | Statement                                                                 | Description |
|-----|---------------------------------------------------------------------------|-------------|
|     |                                                                           | Working     | Not Working |
| Interface Aspects  |                                                                           |             |             |
| 1.   | The Sensor application software logo animation is displayed when the application is run | 1           |             |
| 2.   | The main page of the application displays seven menus                     | 1           |             |
| 3.   | The material page displays a choice of 4 sub menus on each material topic | 1           |             |
| 4.   | Videos are presented in the supporting video sub menu in the material menu | 1           |             |

3.4 **Stage of Integration and System Testing**

3.4.1 **Black Box Testing**

Black box testing in making application software is carried out to determine the performance of the Android-based Sensor learning media in terms of some aspects. Black box testing in this development is viewed from the aspect of the interface and the suitability of the function according to Pressman. Table 1 is the result of the test data obtained. The data obtained are in the form of two nominals between 0 or 1, the number 0 represents "Not Working" and the number 1 means "Working". The meaning of "Not Working" is that the test step fails or does not show results, and "Working" means that the test results match the statement under test.
Table 1. Functional Suitability Test Data

| No. | Statement                                                                 | Description |
|-----|---------------------------------------------------------------------------|-------------|
| 5.  | Questions and answer choices are presented for each evaluation option     | 1           |
| 6.  | The score results on the questions are displayed at the end of the evaluation session | 1           |

**Aspects of Functional Suitability**

| No. | Statement                                                                 | Description |
|-----|---------------------------------------------------------------------------|-------------|
| 7.  | A pop up in the form of developer profile info is displayed if the info icon is pressed | 1           |
| 8.  | The help page is displayed if the hint icon is pressed                     | 1           |
| 9.  | The competency page is displayed if the competency icon is pressed         | 1           |
| 10. | The material selection pop up is displayed if the material icon is pressed | 1           |
| 11. | The simulation page is displayed if the simulation icon is pressed         | 1           |
| 12. | The evaluation page is displayed if the evaluation icon is pressed         | 1           |
| 13. | The reference page is displayed if the reference icon is pressed           | 1           |
| 14. | Goes to the main page when the home button is pressed                      | 1           |
| 15. | Returns to the previous page if the previous button is pressed             | 1           |
| 16. | Returns to the next page if the next button is pressed                     | 1           |
| 17. | Animation or video will run if the play button is pressed                  | 1           |
| 18. | Animation or video will stop if stop button is pressed                     | 1           |

The statement on the interface aspect shows that the appearance of each menu presented is in accordance with the statement, and the function suitability aspect is used to test the buttons and commands in the application. Table 1 shows the recapitulation of the scores obtained from the black box test, the interface aspect gets an average score of 1, while the function suitability aspect gets an average score of 1. Based on the data obtained, it can be concluded that the performance of the Android-based Sensor application software can all function properly.

### 3.4.2 Compatibility Test

Researchers conducted compatibility testing by installing, running, and installing application software on various versions of the Android operating system and screen sizes. The selection of smartphone devices used in the test is based on different Android versions and screen sizes.

**Table 2. Compatibility Test Data**

| No | Device         | Screen Resolution | Android Version | Successful | Failed |
|----|----------------|-------------------|-----------------|------------|--------|
| 1  | Asus Zenfone C | 480 x 854         | 4.4.2           | ✓          |        |
| 2  | Xiaomi 5A      | 1080 x 1920       | 7.1.2           | ✓          |        |
| 3  | Asus Max M1    | 720 x 1280        | 8               | ✓          |        |
| 4  | Asus Max Pro M1| 1080 x 2160       | 9               | ✓          |        |
| 5  | Realme 5       | 1080 x 2340       | 10              | ✓          |        |

Based on the data obtained as shown in Table 2, it can be concluded that the compatibility of the Android-based Sensor application software can all function properly on five different devices and with different screen resolutions. This conclusion means that the Android-based Sensor application software
can be used for various versions of Android with a minimum specification of Android version 4 which has a screen resolution of 480 x 854.

3.5 Stage of Operation and Maintenance
Maintenance includes repairing and monitoring the application if errors are found during the development stage. In the implementation and unit testing stages, the researcher conducted several experiments, especially when testing the Simulation menu. The program code on the Simulation menu must be adjusted to the animation that will be displayed, then the application software needs to be tested via debug software or directly installed on a smartphone.

4. Conclusion
Research on the development of android-based mobile applications for sensor and transducer field studies in vocational education has the conclusion that the design of sensor learning media uses the Waterfall development model, the stages in this development starting from the definition of requirements, system and software design, implementation and unit testing, integration and system testing, operation and maintenance. The final result is a file with *.apk format that can be run on smartphones with the Android operating system. This Android-based Sensor mobile application consists of 7 main menus, namely the info menu, hint menu, competency menu, material menu, simulation menu, evaluation menu, and reference menu.

References
[1] D. dkk Siswoyo, Educational Sciences, First. Yogyakarta: UNY Press, 2013.
[2] H. Sofyan, Vocational Technology Education. Yogyakarta: UNY Press, 2018.
[3] Regulation of the Minister of Education and Culture, “Regulation of the Minister of Education and Culture Number 34 of 2018 concerning National Standards for Vocational High School Education/Vocational Madrasah Aliyah.” 2018.
[4] A. Arsyad, Learning Media, 1st ed. Depok: PT RajaGrafindo Persada, 2019.
[5] Daryanto, Learning Media has a very important role in achieving learning objectives. Yogyakarta: Gava Media, 2016.
[6] H. Praherdhiono, “Technology in Learning Media,” 2017. https://teknologipendidikan.org/teknologi-pada-media-pembelajaran-2/ (accessed Mar. 12, 2021).
[7] I. Aripin, “Mobile Learning Concepts and Applications in Biology Learning,” J. Bio Educ., vol. 3 No 1, 2018.
[8] M. Ally, Mobile Learning Transforming the Delivery of Education and Training. Athabasca University: AU Press, 2009.
[9] H. Kurniawan, “Mobile Learning Media Using Android (Case Study: Information Systems Department IIB Darmajaya),” Explor. – J. Sist. Inf. dan Telemat., vol. Volume 8, p. 48, 2017.
[10] H. Nurhayati, “Number of smartphone users in Indonesia from 2015 to 2025,” statista.com, 2021. https://www.statista.com/statistics/266729/smartphone-users-in-indonesia/ (accessed Mar. 19, 2021).
[11] I. Sommerville, Software Engineering: Ninth Edition. USA: Pearson Education, 2011.
[12] R. S. Pressman, Software engineering: A practitioner’s approach. New York: McGraw-Hill, 2010.
[13] ISO/IEC, “ISO 25010,” 2011. https://www.iso.org/obp/ui/#iso:std:iso-iec:25010:ed-1:v1:en:en (accessed Jun. 14, 2021).