# Development of Android-Based Classroom Presentation System by using Android Set-Top-Box

Dita Oktaria[#1], Herman Tolle[*2], Aryo Pinandito[*3]

[#]*School of Computing, Telkom University*
*Bandung, Indonesia*

[1] ditaoktaria@outlook.com

[2]*Informatics Department* [3]*Computer Science Department,* [*]*Brawijaya University*
[*]*Malang, Indonesia*

[2] emang@ub.ac.id
[3] aryo@ub.ac.id

## Abstract

The integration of multimedia technology in classroom presentations offers significant benefits in delivering material effectively to students and enhancing the presenter's credibility. Traditionally, teachers faced issues like weak laptop battery life and unavailability of chargers. An innovative solution to this problem is the use of set-top-boxes, compact internet-enabled mini-PCs designed for specific purposes. With new-generation set-top boxes based on Android, users can develop their applications, opening new possibilities in presentation delivery. One effective solution involves creating a centralized system to manage presentation files stored on a server accessible through the set-top box. Through functional and non-functional testing, the system proves to meet desired needs. Users reported high satisfaction rates of 93%, and the application's response time was less than one second, confirming the efficiency of the Android Set-top-box. This technology not only enhances lesson delivery but also efficiently addresses classroom presentation challenges in a user-friendly manner.

**Keywords:** Android-Based Classroom, Online Presentation, Android Set-top-box

## Abstrak

Integrasi teknologi multimedia dalam presentasi kelas memiliki manfaat besar dalam menyampaikan materi secara efektif kepada siswa dan meningkatkan kredibilitas pembicara. Sebelumnya, guru sering mengalami masalah seperti daya baterai lemah atau ketiadaan charger pada laptop pribadi mereka. Solusi inovatif untuk mengatasi masalah ini adalah dengan menggunakan set-top-box, mini-PC internet yang kompak dan dirancang khusus. Dengan set-top-box generasi baru berbasis Android, pengguna dapat mengembangkan aplikasi mereka sendiri, membuka peluang baru dalam pengiriman presentasi. Salah satu solusi yang efektif adalah menciptakan sistem terpusat untuk mengelola file presentasi, yang tersimpan dalam satu server yang dapat diakses melalui set-top-box. Melalui uji fungsional dan uji non-fungsional, sistem ini terbukti sesuai dengan kebutuhan yang diinginkan. Pengguna merasakan tingkat kepuasan tinggi sebesar 93% dan waktu respons aplikasi kurang dari satu detik, menegaskan efisiensi Android Set-top-box ini. Dengan demikian, teknologi ini tidak hanya meningkatkan pengiriman materi pelajaran, tetapi juga mengatasi tantangan presentasi dalam kelas dengan cara yang efisien dan ramah pengguna.

**Kata Kunci:** Android-Based Classroom, Online Presentation, Android Set-top-box

## I. INTRODUCTION

**T**echnological advancements have significantly influenced the evolution of educational delivery methods over time. From the traditional approach of writing material on blackboards using chalk, the education landscape has transformed into a multimedia-rich environment where graphic presentation files are seamlessly displayed from computers to screens (e.g., PowerPoint presentations). Embracing multimedia technology for classroom presentations is widely acknowledged to enhance material delivery from presenters to students and elevate the credibility of presenters. This dynamic integration of technology into education has revolutionized the teaching and learning experience, fostering more engaging and effective ways of imparting knowledge to the next generation of learners [1]. As many as 73% of the 485 students studied indicated that graphic presentations could help increase their interest in the lesson [2]. In [3], Basaran and Mohammed evaluate the use of open source learning management systems (LMS). Lwande et al. [4] investigate the learning styles and cognitive trains in an LMS where it was shown that the LMS is able to facilitate online learning group. Kim et al. [5] compares the acceptance of student and faculty behavior for LMS. Tubagus et al. [6] develops a LMS-based blended learning model. The emergence of blended learning has a crucial impact of higher education institutions. Therefore, Alomari et al. in [7] studied LMS effectiveness as a new way of learning and teaching. LMS is also used in medical educations in [8]. Playfulness of LSM is reported in [9].

The results of the design and implementation of an Android-based classroom online presentation system using the Android Set-top-box in [10] are expected to facilitate the learning process in class, teachers can run one presentation file for different classes without bringing a laptop. In addition, the system built later is also expected to support the team-teaching learning method in sharing material content [11]. So that several tests will be carried out to evaluate the results of the system design and implementation, namely the usability and response time parameters.

To assess the user convenience and measure the system's usability, this study incorporates usability testing. Given that an online application should ideally exhibit a response time of less than 10 seconds, the application's response time is thoroughly tested to ensure it meets this requirement. To achieve seamless compatibility with the Android set-top-box's operating system, a native Android application development model is employed to build the system.

The research aims to design and implement an online presentation system that centrally manages lecture presentation material files on a single server while enabling online display via the Android set-top-box. Furthermore, performance testing is conducted, focusing on usability, response time, and portability parameters.

This paper is structured as follows: The first section provides an introduction to the primary focus of the study. Section II outlines the research methodology adopted. Section III presents the obtained results. Finally, concluding remarks are offered in section IV, summarizing the key findings and implications of the research.

## II. RESEARCH METHOD

This section provides the research method used in this paper. First, we describe the design of the developed system. We further provide the assessment method to evaluate the developed system.

### A. Proposed System

The design process is carried out after all system requirements are obtained through the requirements analysis stage. The first stage in system design is the general design of the system, then the next stage is the software design process. The general design stage of the system describes the principal processes [12]. While the software design process consists of the following stages:

#### 1) System architecture design

The design of the system architecture is done by representing the relationship of each of the components that make up the system. The system built in this research is an online presentation system that can manage presentation files centrally on one server and display presentations online via set-top-box. This system is used

as a teaching aid to make presentations in class. Users are expected to be able to manage presentation files so that they are stored more regularly, namely being able to group files based on courses and share files with members of the teaching team. Users are also expected to be able to access files online, so that users can upload a single file that can be used repeatedly and in different classes [13].

The system is divided into two, namely the system on the Android application and the system on the website application. The system on the Android application allows users to login, view course data and material data, and play material presentations in the form of video or PDF media, while material file management such as uploading and deleting is done on the website application.

*2)  Design of data communication with web service*

The design of data communication with a web service is made in the form of a flow chart as a representation of the flow of the data communication process from the server to the mobile application [14]. Data on the system is stored on the server in a database using MYSQL DBMS. However, the Android application cannot retrieve the data directly, so a web service is needed. The web service on this system is designed to be able to request and respond to data between Android applications and the database. The flow of communication when a user requests data is indicated by. After the user enters the username and password to login, the android application will execute the syntax function. The syntask function consists of 3 functions, namely doInBackground(), Execute(), and onPost Execute().

The username and password data entered by the user will be thrown into a php script via the doInBackgound() function. The PHP script will match the entered data with the username and password attributes contained in the Lecturer table in the database [15]. If the username and password match, the database will provide data from the Lecturer table.

Then PHP sends a request to the database to get data for courses that are taught by the user. The data that has been obtained by PHP is converted into JSON form [16] to be given to Android applications. Android calls that data via the onPostExecute function and passes it into a ListAdapter object. After the data is processed by the ListAdapter, the data will be passed to the ListView object. Through a ListView object, users can view data in an Android application in the form of a list.

*3)  Database design*

The representation model of the database design uses an Entity Relationship Diagram (ERD) [17] which represents entities and attributes and their relationships. Data storage in this application is centralized in the database on one server. The database design is modeled in the form of an Entity Relationship Diagram. ERD consists of entities, attributes, and relationships between entities. Entities are objects and are composed of attributes that can represent them. Entities can have relationships with other entities, namely in the form of one-to-one, one-to-many, or many-to-many relationships as shown in Fig. 1.
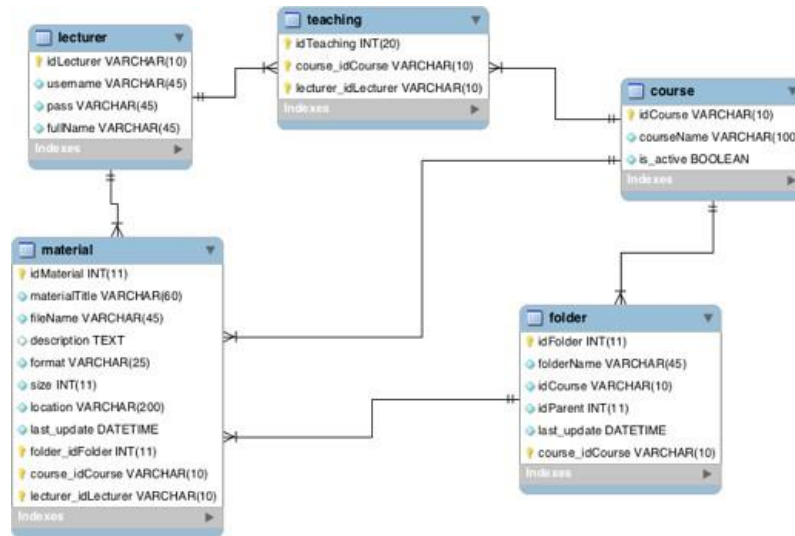
Fig. 1 Physical Diagram.

Determination of the design of entities, attributes and relationships obtained from the results of the analysis that refers to the analysis of system requirements. The entities needed by this system are lecturers as system users, courses taught by lecturers, grouping of lecturers by courses taught and materials to be presented by lecturers. So that five entities are formed in the database, namely the Lecturer, Course, Teaching, Material and Folder entities as illustrated by Fig. 1.

The Lecturer entity contains attributes that store user data and has an idLecturer which acts as the primary key. The Course entity contains attributes that store course data and has the idCourse attribute as the primary key. The Teaching entity contains attributes that store information on the relationship between the lecturer and the courses being taught, so that this entity is related to the Lecturer and Course entities.

The Teaching entity has a primary key, namely idTeaching. idTeaching is a unique id that is only owned by one lecturer and one course. The idTeaching entity is required by the View Course use case. As referred to in the See Courses use case scenario, the system will retrieve course data that is taught by the actor based on the actor id obtained when the user logs in. The system will collect idTeaching which has an idLecturer that matches that of the user. So that the type of relationship between the Teaching entity and the Lecturer is one to many, because one user can have many idTeaching while a unique idTeaching only has one user. The relationship between the Teaching entity and the Course entity also has a one to many types of relationship.

TABLE I
LECTURER TABLE STRUCTURE

| Field Name | Data Type | Description | Sample Data | Field Name |
|---|---|---|---|---|
| idLecturer (PK) | Varchar | Code from the lecturer obtained from PTIIK web service | ebeac9 | idLecturer (PK) |
| username | Varchar | Username | dioctaria | username |
| pass | Varchar | User password | r4h4s1as3k4l1 | pass |
| fullName | Varchar | User's full name | Dita Oktaria | fullName |
| idLecturer (PK) | Varchar | Code from the lecturer obtained from PTIIK web service | ebeac9 | idLecturer (PK) |

The Material entity contains attributes that store material data and has one attribute from the Lecturer entity, namely idLecturer which shows the user code that uploaded the material. The idLecturer attribute functions as

the key to the relationship between the Lecturer and Material entities that have a one-to-many relationship, because one lecturer can upload many materials while one idMaterial must only be uploaded by one lecturer. The Materials table has an idCourse attribute which stores the course code of the material. With this attribute, the system can get materials owned by a course, so that several users can use the same material resources as long as these users are teaching the same course.

The Folder entity contains attributes that store folder data. This entity has a one-to-many relationship with the Material entity because one content can only be in one folder, whereas a folder can have many materials. These folders can be represented as a family tree starting with root which has child folders. In one folder can contain other folders or files. The folder entity also has a relationship with the Course entity in the form of a one-to-many relationship, because a folder is only owned by one Course, while a Course can have many folders in it. When the user uploads a material and does not select a folder, the system will put the file in the root folder of the course.

Entities in the ERD represent tables in the database, while attributes represent fields from each table. The following is the structure of each table and a description of each field in the database. The Lecturer entity represents the Lecturer table in the database. The Lecturer table stores data when the user makes changes to account data. The data stored is in the form of a user code, the user's full name, and the username and password used to login. The structure of the Lecturer table is shown in Table I.
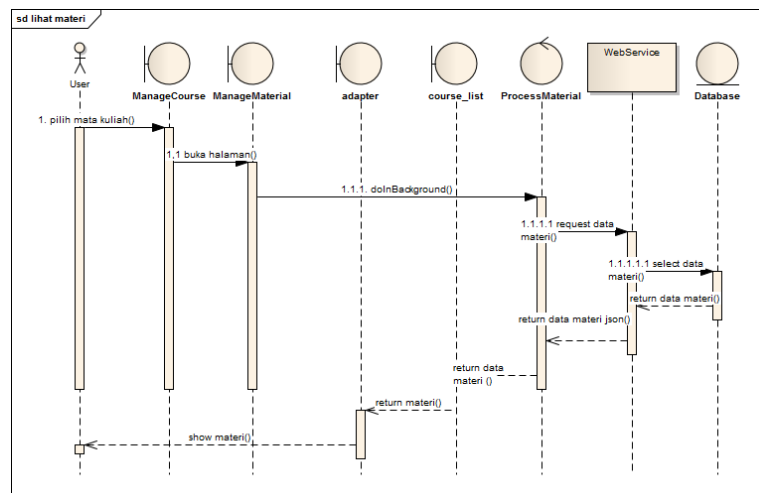


Fig. 2 Sequence Diagram Viewing Material.

*4)   Sequence Diagram Design*

Sequence Diagrams [18] describe the interactions between objects in a system based on time stages accompanied by messages sent and received between objects. Sequence diagrams are also used to model the logic of methods or services in the system.
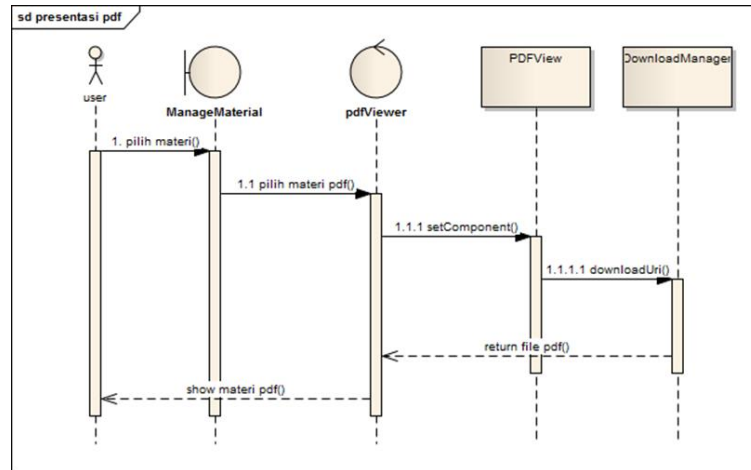


Fig. 3 Sequence Diagram Presentation PDF.

Sequence Diagrams describe the interaction between objects based on time stages accompanied by messages sent and received between objects. Fig. 2 shows a sequence diagram for viewing material needs. Fig. 3 shows a sequence diagram for PDF presentation needs, and Fig. 4 shows a sequence diagram for video presentation needs.
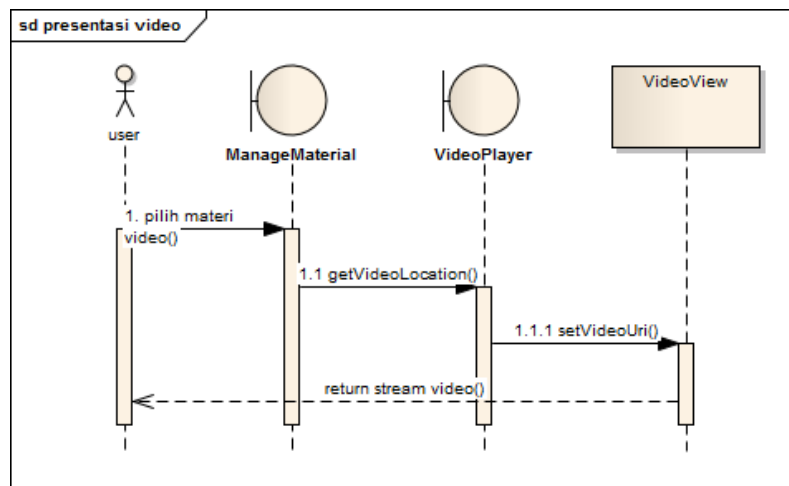


Fig. 4 Sequence Diagram of Video Presentation.

*5) Interface Design*

Interface design is done by creating a layout consisting of components that make up the layout such as textboxes, buttons, and labels. In the design image for the video presentation page interface (Fig. 5), number 1 shows the play button, number 2 shows the progress bar of the video travel time.



Fig. 5 Video Presentation Pages.

The Login page is displayed when the user starts the application or after the user logs out. The login page display is shown in Fig. 6. Login page displays the application logo, application tagline, fields to enter a name and password.
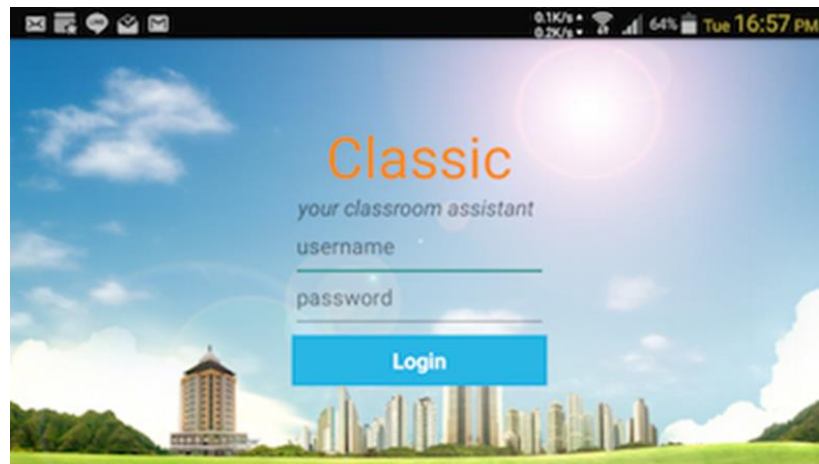


Fig. 6 Login Pages.

*B. Evaluation Methods*

The tests carried out in this research are functionality testing and non-functionality testing. Functionality testing uses the black-box testing method with validation techniques carried out to determine the suitability of the system made with the functional requirements specifications that underlie it. Meanwhile, non-functional testing is divided into usability testing, response time testing and portability testing. Usability testing is used to determine the level of system quality and the ease with which users can use the system to meet their needs. Response time testing is carried out to determine the response time from the server to the application. The last test is the portability test which serves to ensure the software can be installed and running on Android Set-top-box devices.

After usability testing was carried out on 5 respondents, the results obtained were in the form of accumulated points in each aspect. There are 5 points, namely point 1 which indicates strongly disagree, point 2 which indicates disagree, point 3 which indicates neutral, point 4 which indicates agree, and point 5 which indicates strongly agree. The results of this test will be recalculated using a Likert scale in the analysis of usability test results [19], [20].

The results of usability testing were analyzed using a Likert scale [21]. After determining the answer score, the next step is to calculate the ideal score scale for all questions posed to the user. The ideal score scale is obtained by multiplying the number of respondents by each Likert score, so that the ideal score scale is found from the usability testing of the classroom online presentation system as shown in Table II.

TABLE II
USABILITY TESTING IDEAL SCORE SCALE TABLE

| Likert Score | Score Scale | Description |
|---|---|---|
| 1 | 5 | Strongly disagree |
| 2 | 10 | Do not agree |
| 3 | 15 | Disagree |
| 4 | 20 | Agree |
| 5 | 25 | Strongly agree |

After calculating the ideal score scale, the next step is to determine the interpretation of the score with an interval of 20 in the form of a percentage. shows the interpretation of within the interval of 20 in the form of a percentage with the choice of very unsatisfactory, unsatisfactory, ordinary, satisfactory, and very satisfactory.

TABLE III
LIKERT SCORE INTERPRETATION TABLE

| Likert Score | Score Scale | Interpretation of Scores with Intervals of 20 | Choice |
|---|---|---|---|
| 1 | 0 -- 5 | 0% -- 19.99% | Very unsatisfactory |
| 2 | 6 -- 10 | 20% -- 39.99% | Not satisfactory |
| 3 | 11 -- 15 | 40% -- 59.99% | Normal |
| 4 | 16 -- 20 | 60% -- 79.99% | Satisfying |
| 5 | 21 -- 25 | 80% -- 100% | Very satisfy |

Furthermore, the interpretation of the Likert score (Table III) is applied to obtain an index of the percentage of usability testing from the 30 questions [22], [23]. The index is obtained from the formula shown in Equation (1) and Equation (2). However, before calculating the index, the total score of feedback results First a questionnaire must be obtained.

$$Index(\%) = (\frac{TotalSkor}{Y}) \acute{} 100\% \qquad (1)$$

where $S$ denotes the sum of the feedback scores and $Y$ is calculated using the following equation:

$$Y = X \times N \tag{1}$$

Where $X$ is the highest Likert score and N is the number of the respondents. The formula for calculating the total score is shown in Equation (3).

$$S = \alpha_1 \times 1 + \alpha_2 \times 2 + \alpha_3 \times 3 + \alpha_4 \times 4 + \alpha_5 \times 5Y = X \times N \tag{1}$$

Where $\alpha_1, \alpha_2, \alpha_3, \alpha_4$, and $\alpha_5$ is total score of very unsatisfactory, not satisfactory, normal, satisfying, and very satisfy, respectively.

### III. RESULT

The process of analyzing the results of functional testing involves assessing the system's performance in relation to a comprehensive list of functional requirements. Through the validation test, which encompassed test cases covering activities such as logging in, accessing courses, viewing materials, and presenting content, it has been established that the classroom online presentation system's implementation and functionality fully meet the intended needs. Thus, the system has successfully demonstrated its ability to deliver on its objectives and fulfill the user requirements.
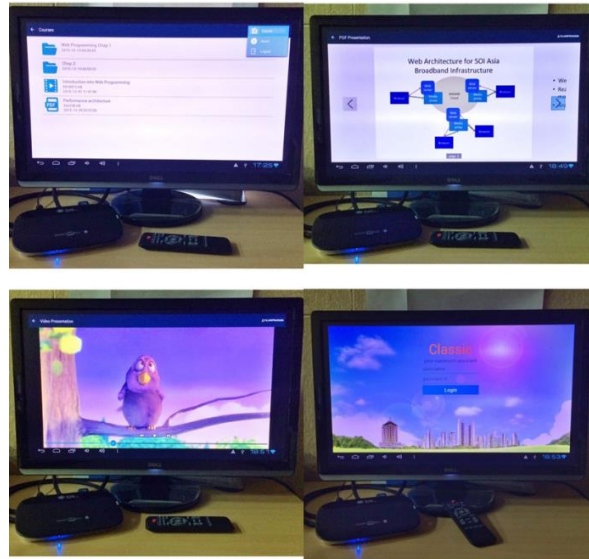


Fig. 7 Screenshot when the application is running.

The results of the validation test clearly indicate that the application built for the Android Set-top-box device (Fig. 7) has effectively fulfilled the requirements for logging in, accessing taught courses, viewing materials, and presenting content. As a result, it can be confidently concluded that the application functions seamlessly on the Android Set-top-box, demonstrating its successful integration with the device and its ability to deliver a smooth and satisfactory user experience.

### 1) Response Time Test Result

The response time test results were gathered from three test cases conducted with an internet connection. During testing, the application was connected to the internet using a LAN network with a bandwidth of 10 Mbps. The test aimed to assess the application's speed when accessing data, from the initial request for material data to the retrieval of the data from the database server. Table IV presents the access times recorded at each stage of data access. It is important to note that these tests were conducted under stable and ideal network conditions, enabling the application to demonstrate its optimal performance in efficiently retrieving and presenting material data based on the selected course.

TABLE IV
RESPONSE TIME BY USING A LAN NETWORK (MS)

| Test Number | View Material List | PDF Presentation | Video Presentation |
|---|---|---|---|
| 1 | 146 | 1620 | 38 |
| 2 | 118 | 685 | 61 |
| 3 | 143 | 669 | 46 |
| 4 | 146 | 871 | 35 |
| 5 | 159 | 419 | 28 |
| **Average** | 142.4 | 852.8 | 41.6 |

### 2) Usability Test

Based on the comprehensive usability test results, the classroom online presentation system has been found to achieve high user satisfaction, as evidenced by an impressive average Likert score of 23 and an average percentage of 93%. These results unequivocally demonstrate the system's effectiveness in meeting user needs and expectations, leading to the conclusion that the system successfully satisfies its users.

## IV. Conclusions

Based on the comprehensive analysis of the design, implementation, and testing, the following conclusions have been drawn: The classroom online presentation system has been successfully designed to cater to the needs identified from the results of the needs analysis, focusing on material viewing and presentation. The system incorporates centralized management of presentation files on a single server, facilitating seamless file sharing among users enrolled in the same course, thereby ensuring efficient access to uploaded materials. The implementation of online presentation for video and PDF formats via Android set-top-box has been effectively achieved through the integration of the Android PDFView library for displaying PDFs and the VideoView Class API in the Google Android framework for displaying videos. This versatile integration allows the application to support various formats, enhancing the overall user experience. The functional testing conducted using the black-box testing method indicates that all system function features are well-aligned with the specified requirements. The application performs efficiently, displaying materials in PDF, MP4, and WebM formats, ensuring a seamless and diverse presentation experience. The usability testing results demonstrate a high level of user satisfaction, with an average usability rating of 93%, signifying a very satisfactory user experience. The system excels in aspects such as usefulness, ease of use, ease of learning, and overall satisfaction. The response time test results reveal that the application can swiftly access data even under LAN network conditions, with an average response time of less than 1 second, confirming its excellent performance. Moving forward, several enhancements can be applied to further improve the developed system: Consider incorporating additional presentation media, such as PowerPoint and images, to broaden the range of content available for users, thereby enhancing the presentation options. Expanding support for more video formats, such as MOV, FLV, and MPEG2, will ensure greater compatibility and flexibility in presenting video content. Implement additional features, such as a search functionality within the PDF player, to facilitate efficient content navigation and user-friendly interactions. This will further elevate the user experience and ease of use.

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