

AUGMENTED REALITY FOR CULTURAL UNDERSTANDING AND CHARACTER EDUCATION: A STUDY ON LAMPUNG TAPIS

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Abstract

Lampung Tapis Cloth is one of the cultural heritages of the archipelago which is full of philosophical values, aesthetics, and character of the people of Lampung. Currently, the interest of the young generation in local culture has decreased due to the limited interactive learning media that are able to package cultural values in an interesting way. This problem is the background of research aimed at developing Augmented Reality (AR) of Lampung Tapis Cloth as a technology-based educational facility oriented towards cultural preservation and character education. The research method used is the Multimedia Development Life Cycle (MDLC), with stages including concept, design, material collecting, assembly, testing, and distribution. The problem-solving stage is carried out through the design of a system that combines 3D visual elements of filter cloth with information on cultural values and noble characters such as hard work, precision, and pride in regional identity. The results of the black box test showed that all the key features worked well (95–100%), and users responded positively to the interface and ease of use. The novelty of this research lies in the integration of AR technology with the local culture-based character education approach, making the application not only a medium for preserving cultural heritage, but also as a tool for forming moral values and national identity among the younger generation.

Keywords: Augmented Reality, Lampung Filter Cloth, Cultural Preservation, Character Education, Multimedia Development Life Cycle

I. INTRODUCTION

Indonesia is known as the largest archipelagic country in the world with a very diverse cultural richness. Each region has a distinctive cultural heritage that is the identity and pride of its people, including Lampung Province which is famous for its Tapis cloth (Prasatyo Nugroho, Cahyana, and Asep Miftahul Falah 2021) (Fitri, Agha, and Suyuti 2024) (History et al. 2025). Lampung Tapis Cloth is a high-value cultural heritage that is not only visually beautiful, but also full of philosophical and symbolic meaning that reflects the values of the life of the people of Lampung. The motifs and patterns on Tapis cloth symbolize wisdom, purity, and honor, so they become an important part of the tradition and identity of the community. In the context of national culture, Tapis cloth not only functions as a textile artwork, but also as a medium for learning the noble values of the nation that are inherited across generations. The interest of the younger generation in local cultural heritage such as

Tapis cloth began to decline due to the rapid flow of globalization and the lack of interesting and interactive educational media. Cultural preservation efforts that are still conventional have not been fully able to foster a sense of pride and concern for regional culture. Therefore, a new approach is needed that is able to bridge tradition and technology, one of which is through the use of *Augmented Reality* (AR) as a digital learning medium. The application of AR can not only introduce Tapis fabric visually and interactively, but also instill character values such as love for culture, respect, responsibility, and pride in the nation's identity. Thus, this technology becomes an educational means that is in line with the goal of character education, which is to form a young generation who are cultured, creative, and have strong character in facing the times (Sumarni et al. 2024).

Augmented Reality (AR) is a technology that integrates *virtual* elements into the real-time environment with the help of digital devices such as *smartphones* and *AR glasses* (Utomo, Degeng, and Praherdiono 2022). This technology provides the ability for users to interact directly with digital objects in real life. Currently, the application of AR has expanded to various areas of life and is expected to continue to grow rapidly due to its attractive nature and making it easier for users to carry out various activities. Through AR, users can view and interact with digital information displayed on top of their real environment. The digital content can be text, images, videos, or 3D objects that look as if they are present in the real world. Devices that support AR technology include *smartphones*, *tablets*, and smart glasses such as *Microsoft HoloLens* and *Google Glass*. These devices utilize cameras and sensors to detect position and movement, then process and display digital information tailored to the user's real-world view (Ranti 2024).

Based on previous research studies, it can be identified that the application of *Augmented Reality* (AR) technology in the context of culture still faces a number of fundamental problems. Most previous research has succeeded in utilizing AR as a medium for cultural introduction such as traditional clothing, woven fabrics, and batik, but the focus is still limited to the aspect of presenting visual information without integrating strong interactivity elements and character education values. The development methods used, both *Waterfall* and *Extreme Programming* (XP), tend to produce informative applications, but they have not touched on the reflective and meaningful learning dimension. In addition, the majority of research emphasizes more on the technical aspects of cultural object recognition than on its use as an educational means that can foster a sense of cultural love, social responsibility, and pride in national identity.

The research gap that emerged from previous studies lies in the absence of AR applications that incorporate educational, interactive, and character-building approaches in an integrated manner in the context of learning local cultures. Previous studies have only presented cultural objects in three dimensions without providing space for users to understand the philosophy, moral values, and symbolic meaning behind the objects. On the other hand, the tests carried out are still limited to functionality tests and have not touched on the aspect of user *experience* which plays an important role in learning effectiveness. This shows the need for innovation in the development of AR-based media that not only functions as a visual aid, but also as a means of education of values and characters based on regional culture.

As a solution to this gap, this study developed the *Augmented Reality* application of Lampung Tapis Cloth as a medium for cultural preservation and digital-based character education. The app is designed to interactively display the filter fabric motif in a three-dimensional form, complete with a philosophical explanation and character values contained in each motif. Through this approach, it is hoped that users will not only get to know the visualization of filter cloth, but also understand the meaning and moral value behind this cultural heritage. The purpose of this research is to produce AR-based learning media that is able to increase cultural understanding, instill character values such as love for culture,

responsibility, and national pride, and support the preservation of Lampung culture through the use of adaptive and attractive technology for the younger generation.

II. METHOD

2.1. Data Collection

(Nashrullah et al. 2023)(Fajar and Aviani 2022) The stages of data collection through literature studies in this study are carried out systematically to ensure a strong theoretical foundation and relevance to the focus of the research. The first stage is the identification of library sources, which is determining the type of reference needed such as scientific journals, conference proceedings, academic books, and previous research reports that discuss the topics of *Augmented Reality*, cultural learning, and character education.

The second stage is literature selection and evaluation, where researchers examine the content of each source to ensure its suitability with the variables and research objectives. This process includes an analysis of methodological approaches, research results, and relevant scientific contributions. Literature that does not meet the criteria of relevance, originality, and up-to-date will be eliminated so that the results of the study remain focused and in-depth. At this stage, the researcher also notes important concepts, empirical findings, and research *gaps* that arise from previous studies.

The last stage is the synthesis of the literature, which is integrating the various information that has been obtained into a complete theoretical framework and supporting the formulation of research problems. The results of this synthesis are the basis for the preparation of conceptual foundations, the development of system models, and the selection of appropriate research methods. Thus, the study of literature serves not only as a collection of references, but also as a scientific process that ensures that the research has a clear direction, is rooted in strong theories, and is relevant to the latest developments in the field of *Augmented Reality* technology for cultural preservation and character education.

2.2. System Development

This study uses the *Multimedia Development Life Cycle (MDLC) method*. MDLC is a systematic and structured approach to designing and developing multimedia systems, which is described as a continuous process like a spinning wheel. This process consists of several stages that are passed sequentially to produce software according to the needs of users (Nofiar, Nasari, and Pribadi 2023). The *Multimedia Development Life Cycle* method includes six main stages, namely: *Concept, Design, Material Collecting, Assembly, Testing, and Distribution*. The following is an explanation of each stage in the method.

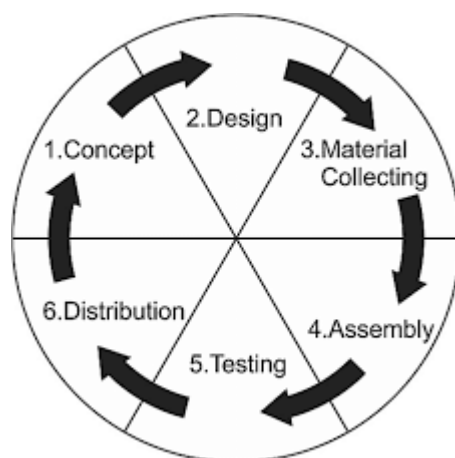


Figure 1. MDLC Method

The MDLC (Multimedia Development Life Cycle) method is a systematic approach in the development of multimedia applications, including Augmented Reality (AR)-based applications. This method has six main stages that are interrelated and sequential, starting from concept formulation to final product distribution. The goal is to ensure that each development process runs in a directional, efficient manner, and produces an application that suits the needs of users and research objectives.

The first stage, Concept, focuses on determining the basic idea and purpose of the application to be developed. At this stage, needs analysis, determination of target users, and planning of the main functions of the application are carried out. The next stage, Design, is the process of designing an application structure that includes navigation flows, *user interfaces*, and designs of interaction between multimedia components. This design is a reference in the implementation process so that the final result is consistent with the initial design.

The third stage, Material Collecting, is the process of collecting materials such as images, videos, audio, 3D models, and other supporting data that will be used in the application. After the materials are collected, the assembly stage is carried out by combining all multimedia elements according to the design design to form a functional application. The next stage is Testing, where *blackbox testing* is carried out to ensure that all features and functions of the application run properly according to the user's needs without checking the internal code. Finally, the Distribution stage is carried out by storing and distributing the application to the intended storage medium or platform, such as Android or web devices, so that it can be widely used. By going through these six stages of MDLC, the AR application development process becomes more structured, efficient, and produces quality final products.

III. RESULTS AND DISCUSSION

3.1. Research Results

The design of a UML (Unified Modelling Language)-based system in this study is used to structurally model the relationship between components in the development of the Augmented Reality (AR) application of Lampung Filter Cloth. This design is visualized through a Use Case Diagram that shows the interaction between the User and the Camera actor with key features such as *Login*, *Filter Fabric Selection*, *Virtual Try*, *Guide*, as well as *Scan Marker* and *Display 3D Objects*. In addition, the Class Diagram depicts the relationship between the main classes of *User*, *Tapis motif*, *Application*, and *ARD tecton* which play a role in the process of authentication, motif detection, and 3D object visualization. This UML-based approach ensures that the system is designed in a systematic, easy-to-understand, and effective manner in integrating cultural values and character education into the digital learning experience interactive based on AR technology.

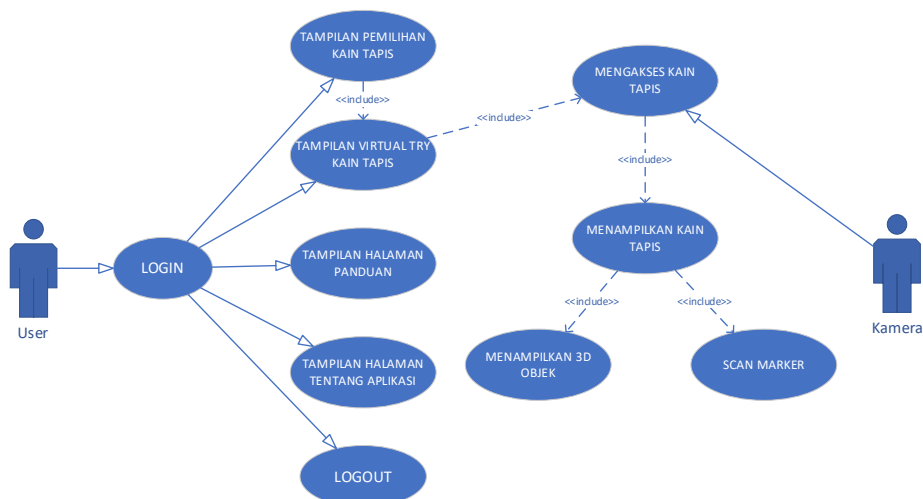


Figure 2. Use case Diagram

The use case illustrates the interaction between the two main actors, namely the User and the Camera, in the use of the Augmented Reality application of the Lampung Filter Cloth. The User actor plays the role of the main user who accesses various application features ranging from the login process, choosing the type of filter fabric they want to explore, to trying the Virtual Try feature which allows users to see the appearance of the fabric interactively in three-dimensional form through AR technology. In addition, users can also access the guide page to understand how to use the app, view general information about the app, and log out when it's done. Meanwhile, the Camera actor serves as a key supporting component in the implementation of AR, which is in charge of scanning markers, accessing filter fabric data, and displaying 3D objects in real-time. Thus, cameras play an important role as a link between the real and virtual worlds, allowing users to gain an immersive and educational visual experience of Lampung's filter fabrics.

Activity Diagram is one of the diagrams in UML (*Unified Modeling Language*) that functions to visualize the flow of processes or sequences of activities that occur in a system.

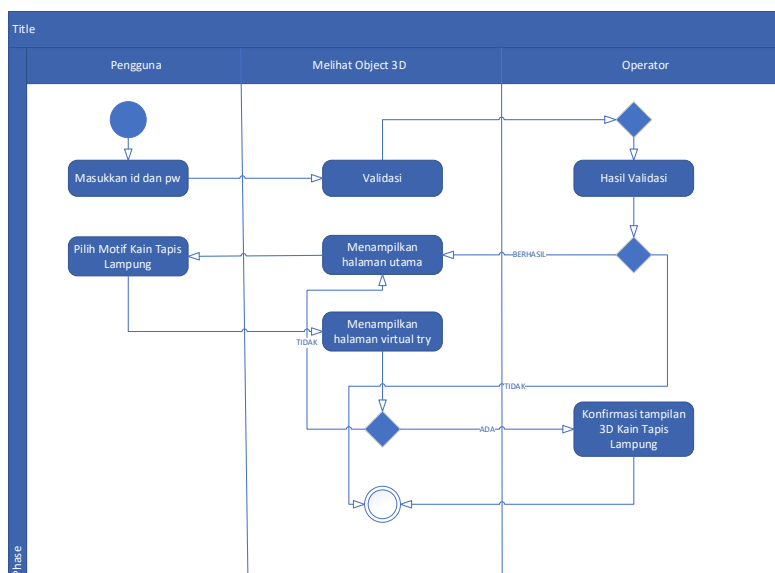


Figure 3. Activity Diagram

The flow starts from the user logging into the app. After that, the AR Application will process and validate the login data. If the validation is successful, the application displays the main page and users can proceed by selecting the Lampung filter cloth feature. Next, the app will display a *Virtual Try page*, which allows users to virtually try on filter fabrics through *Augmented Reality-based 3D modelling*. This process can also involve the role of operators, especially in the context of manual validation or checking user data. The operator will review the validation results and provide a decision. If the validation is declared successful, the system will display the overall appearance of Lampung filter cloth through *the AR feature*.

A *class diagram*, or class diagram, is a type of diagram in UML (*Unified Modelling Language*) that is used to describe the static structure of a system. This diagram shows the classes that exist in the system, along with the attributes, methods, and relationships between classes.

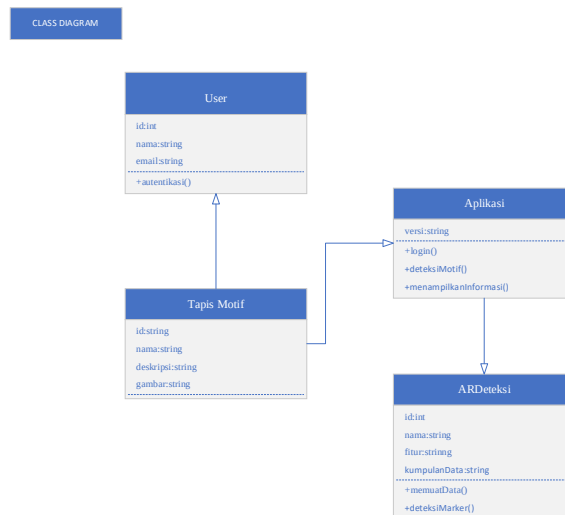


Figure 4. Class Diagram

The diagram class describes the main structure and relationships between components in the Lampung Tapis Cloth Augmented Reality application system. Class User functions to represent application users with identity attributes such as *id*, *name*, and *email*, and has an *authenticate method* for the login or authentication process. The TapisMotif class stores key data regarding the tapis fabric motif, including *id*, *name*, *description*, and *image*, which can be accessed by users through the application. The Application Class serves as the core of the system that manages the entire process, with *version attributes* as well as methods such as *login*, *Motive detection*, and *Information view* to execute the application's core functionality. Meanwhile, the ARDeteksi Class is an AR marker detection module that has *id*, *name*, *feature*, and *Data set attributes*, as well as a *Data loading* and *Marker detection method* to support the scanning and visualization process of filtered fabric objects. The relationships between classes show close functional integration, where the application leverages ARDdetection to run Augmented Reality features, as well as connects users with filter motif data in an interactive and informative manner.

Interface design is the design of a user interface that includes visual elements such as buttons, menus, icons, colors, layouts, and navigation, so that users can interact with the system efficiently and intuitively. The interface design will be done as follows:

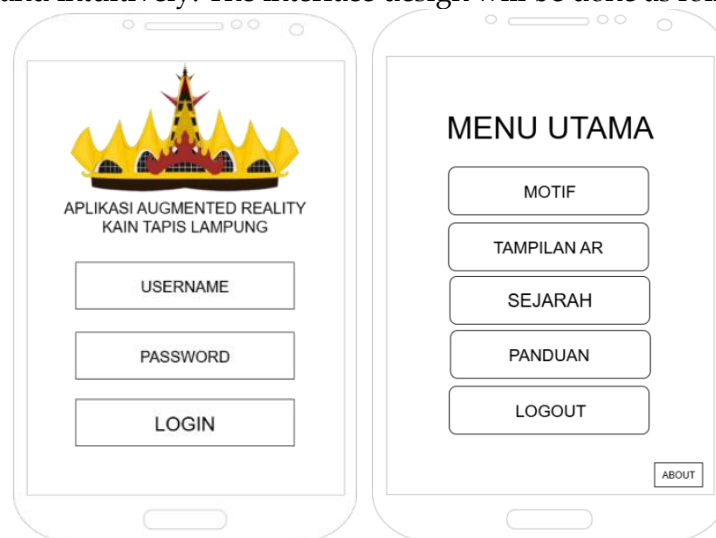


Figure 5. Login Page Design

Application implementation means the process of turning an application design or prototype into a system that is running and used by users, including testing, installation, and

evaluation of usage results. This page serves as the app's initial view, where users are asked to enter an email and password as an authentication step to ensure security as well as personalization of user data.



Figure 6. Login Page View

Testing of the prototype of the Augmented Reality application of the Lampung Filter Cloth was carried out using *the Blackbox Testing method*, involving 20 respondents. This test aims to assess whether the main features in the application can function according to the design, without looking at the internal structure of the program. The features tested include the login process, navigation between menus, Marker scanning to display 3D objects, filter fabric motif display, as well as guide and logout pages. The test results showed that the login feature ran smoothly for all respondents (100%), both when valid data was entered and when the data did not match, where the system provided the right error notification. Menu navigation was considered easy to understand by 19 out of 20 respondents (95%), although there was one respondent who felt that the initial interface could still be simplified. In the motif display feature, all respondents stated that the motif information of the filter cloth appeared clearly and appropriately. Likewise, the user guide page and information features function as they should and do not cause significant obstacles. In terms of security, respondents generally feel quite comfortable with the email login and password features. However, some suggest additional systems such as two-step verification (OTP) to increase users' confidence in personal data protection. However, some problems have arisen with *the Augmented Reality (AR) feature*. A total of 16 respondents (80%) managed to display the filter cloth 3D object well after scanning the Marker, while 4 respondents (20%) had difficulty in the Marker detection process, especially in poor lighting conditions or when the camera was moving fast. In addition, 5 respondents (25%) reported that the display of AR objects was less precise when the device's screen was changed from an upright to horizontal position.

3.2. Discussion

The results of the implementation of the *Augmented Reality (AR) application* prototype of the Lampung Tapis Cloth show that the use of AR technology is effective in increasing users' interest in local culture. These findings are strengthened by the research of Kartini, Bunda, and Afni (2022) who developed *an AR application* for the introduction of North Sumatra culture. In his research, the simple interface and navigation are considered to be very helpful for users in accessing information (Agus Kartini, Permata Bunda, and Afni 2024). Users of the filter application also responded positively to the available menus, ranging from login, motif displays, to *accessible AR features*. Research by Musyaffa and Isdaryanti (2022) who

developed the educational media "SI BUDI" to introduce Indonesian cultural diversity to elementary school students. In the study, media validation by experts reached a level of "very valid" with a score above 93%, and student responses showed high interest in the material (Musyaffa and Isdaryanti 2024). This is in line with the application prototype that the researcher conducted. The app's prototype has included a number of important components, such as fabric motif information, a guide page, an AR display menu, and a logout feature. Based on *blackbox* testing, 95% to 100% of features run well. Oktapiani, Irdiyansyah, and Indriani (2025) who used the *Assemblr Edu platform* to introduce Indonesia's rich culture to elementary school students, showed that students are not only interested in using the application, but also feel happy and involved in the learning process (Oktapiani, Irdiyansyah, and Indriani 2025). This is similar to the findings in the prototype of the filter cloth AR application, where respondents felt more enthusiastic about getting to know Lampung culture because of the presentation of the content that is visual, dynamic, and interactive. Putri and Rahadiyan (2022) regarding the introduction of archipelago traditional houses with Marker-based AR technology adding interactive quiz features to strengthen user engagement (Putri et al. 2022). The AR application of Tapis Lampung Cloth also uses a marker-based approach, and can take lessons in terms of technical optimization and increased interactivity. Ramzy and Fachrie (2024) developed an AR application for students to get to know traditional houses, the results of which showed that users felt more aware of the local culture and were encouraged to explore further (Ramzy and Fachrie 2024). This is a solid basis that the use of AR technology is not only limited to children, but also effective among adults.

The results of the implementation of the Augmented Reality (AR) application prototype of the Lampung Tapis Cloth show the latest in the approach to preserving local culture through interactive digital media. Unlike previous research that only displayed cultural objects statically, this app presents an immersive experience that allows users to *try* and explore filtered fabrics directly through marker-based AR features. These findings show that AR technology can function not only as a means of visual education, but also as a medium for the formation of deep and enjoyable cultural experiences. With a simple interface design and intuitive navigation, this application is able to attract users' attention while facilitating access to Lampung cultural information.

In the context of cultural learning, the results of this study confirm the findings of Musyaffa and Isdaryanti (2022) that the integration of interactive media can increase learning motivation and interest in cultural materials. However, the AR application of Kain Tapis Lampung presents an update on aspects of character values and cultural philosophy that are directly integrated into the visual and descriptive content of fabric motifs. Each motif is not only aesthetically defined, but is also associated with moral values such as politeness, hard work, and respect for ancestors. The integration of these character values reinforces a dimension of cultural education not found in previous research, making this application not only informative but also emotionally and morally educational.

The results of Blackbox Testing showed that 95%–100% of the key features ran well, indicating that the prototype had met the basic functionality aspects. However, the study also found technical challenges such as limitations in marker accuracy in low-light conditions and a decrease in the precision of 3D objects when the orientation of the screen changes. These findings serve as an important basis for further development, for example through the application of markerless AR or light sensor-based automatic calibration systems. Another innovation in this study is the evaluation of *usability* and *user experience* involving 20 respondents, showing attention to user comfort and security aspects, including suggestions for implementing two-step verification to maintain data privacy.

In terms of user experience, this application has proven to be effective in fostering curiosity and pride in the local culture. As many as 80% of respondents expressed enthusiasm for using the AR feature to get to know the motif of filter cloth and try to make it look in three

dimensions. This shows that AR technology has great potential to become a more interactive cultural learning medium than conventional methods such as exhibitions or textual learning. In addition, the dynamic visual approach makes it easier for the younger generation to appreciate the aesthetic value and cultural philosophy of Lampung, thus contributing directly to character education based on local wisdom.

Overall, this research presents updates in three main aspects: (1) the integration of character values in local culture-based AR content, (2) the application of AR as an interactive and reflective cultural learning medium, and (3) a thorough evaluation of technical aspects and user experience. With this approach, the prototype of the Lampung Tapis Cloth AR application is not only a technological innovation, but also a strategic instrument in the preservation of culture and character education of the younger generation. The results of this study reinforce the idea that the incorporation of modern technology with traditional cultural values is an effective step to maintain the sustainability of cultural heritage in the digital era.

IV. CONCLUSION

Based on the results of research and implementation of Augmented Reality (AR) Lampung Tapis Fabric, it can be concluded that the application of AR technology has proven to be effective as an interactive learning medium to introduce and preserve local culture while instilling character values. This application manages to combine educational, informative, and aesthetic elements through three-dimensional visualization that allows users to explore the motifs of filter cloth in a real and interesting way. The test results show that most of the app's features work well, and have received positive feedback from users regarding the ease of use, interface appearance, and pleasant learning experience. Apart from being a technological innovation, this application has a significant social and educational impact because it is able to foster a sense of pride in Lampung's cultural heritage and encourage the younger generation to appreciate local wisdom more. With the integration of character values such as politeness, hard work, and cultural preservation, this app not only introduces the beauty of filter cloth, but also becomes a means of culture-based moral education. This research emphasizes the importance of developing adaptive, reflective, and character-valued digital learning media in facing the challenges of the modern era.

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