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Developing BioFold-AR Learning Media Using Assemblr Edu to Enhance Students' Motivation in Islamic Education

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Abstract. *Islamic Religious Education (IRE), particularly in Islamic history topics, continues to face challenges in enhancing student engagement and motivation to learn due to the content's abstract and narrative nature. Although Augmented Reality (AR) has the potential to provide more interactive learning experiences, its application remains largely limited to general use and has not been adequately integrated into IRE learning contexts. This study aims to develop and evaluate an AR-based learning medium, namely BioFold-AR, using the Assemblr Edu platform, to improve students' learning motivation. This research employed a Research and Development (R&D) approach using the ADDIE model, combined with a quasi-experimental design. The study was conducted at SMP Negeri 1 Besuki Tulungagung, focusing on Islamic Cultural History material. Data were collected through expert validation, user response questionnaires, and a learning motivation instrument based on Keller's ARCS model. The results indicate that the developed media meet the criteria of validity and practicality and are effective in significantly improving students' learning motivation based on statistical analysis. The findings demonstrate that AR integration can enhance student engagement in IRE learning. This study offers a novel contribution by integrating low-tech AR (Assemblr Edu) with the ARCS motivational framework, thereby bridging the gap between technological accessibility and the internalization of religious values in the development of more adaptive IRE learning media. In addition, this media enables IRE teachers without programming backgrounds to independently design and develop learning media.*
Keywords. *Augmented Reality (AR); Assemblr Edu Platform; Islamic Religious Education (PAI); Students' Learning Motivation; ADDIE Model*

Abstrak. Pembelajaran Pendidikan Agama Islam (PAI), khususnya pada materi sejarah Islam, masih menghadapi tantangan dalam meningkatkan keterlibatan dan motivasi belajar siswa akibat penyajian materi yang cenderung abstrak dan naratif. Meskipun Augmented Reality (AR) berpotensi menghadirkan pengalaman belajar yang lebih interaktif, pemanfaatannya masih terbatas pada penggunaan AR secara umum dan belum mengkaji integrasinya dalam pembelajaran PAI. Penelitian ini bertujuan untuk mengembangkan dan mengevaluasi media pembelajaran berbasis AR, yaitu BioFold-AR menggunakan platform Assemblr Edu, dalam meningkatkan motivasi belajar siswa. Penelitian ini menggunakan pendekatan Research and Development (R&D) dengan model ADDIE yang dipadukan dengan desain quasi-experimental. Penelitian dilakukan di SMP Negeri 1 Besuki Tulungagung pada materi Sejarah Kebudayaan Islam. Data dikumpulkan melalui validasi ahli, angket respons pengguna, dan instrumen motivasi belajar berbasis model ARCS. Hasil penelitian menunjukkan bahwa media yang dikembangkan memenuhi kriteria valid dan praktis, serta efektif meningkatkan motivasi belajar siswa secara signifikan berdasarkan analisis statistik. Temuan ini menunjukkan bahwa integrasi AR dapat meningkatkan keterlibatan belajar siswa dalam pembelajaran PAI. Penelitian ini memberikan kontribusi kebaruan dengan mengintegrasikan AR berbasis low-tech

(Assemblr Edu) dengan kerangka motivasi ARCS, sehingga menjembatani kesenjangan antara aksesibilitas teknologi dan internalisasi nilai-nilai keagamaan dalam pengembangan media pembelajaran PAI yang lebih adaptif. Selain itu, media ini memungkinkan guru PAI tanpa latar belakang pemrograman untuk merancang dan mengembangkan media secara mandiri.
Kata Kunci. *Augmented Reality (AR); Platform Assemblr Edu; Pendidikan Agama Islam (PAI); Motivasi Belajar Siswa; Model ADDIE*

A. INTRODUCTION

In the context of modern learning, the use of appropriate and varied learning media can significantly increase the effectiveness of the teaching and learning process (Valverde-Berrocoso et al., 2022). Learning media not only functions as a visual or auditory aid, but also serves as a facilitator in building a deeper understanding of concepts (Mayarita et al., 2023). In addition, it can also foster independent learning and critical thinking, accommodate unique learning styles (Yalçin & Samur, 2024), as well as foster interest in the subject and maintain student motivation (Min et al., 2022; Seßler et al., 2024; Yaseen et al., 2025). One factor that influences motivation is the use of learning media that is engaging and relevant to the character of today's digital generation (Dong, 2025; Tampubolon & Tampubolon, 2025). However, in the context of Islamic Religious Education, the challenges of using media have different characteristics compared to general subjects.

From the perspective of Islamic Religious Education, the use of learning media is becoming increasingly important because learning is not only oriented towards cognitive aspects, but also includes affective and psychomotor dimensions related to the internalization of Islamic values. This is in line with the view of Syed Muhammad Naquib al-Attas who emphasized that the goal of Islamic education is the formation of a complete person through the integration of knowledge, faith, and good deeds, so that the learning process needs to provide meaningful experiences, not just the transfer of knowledge (In'Ami et al., 2025; Kosim et al., 2020) **.** Therefore, learning media in IRE needs to be able to provide learning experiences that touch the emotional and spiritual aspects of students.

However, the implementation of learning media in IRE practice still faces various obstacles. Several studies show that IRE teachers still tend to use conventional media such as textbooks, whiteboards, and student worksheets (Alimni et al., 2022; Faqihuddin & Muflih, 2024; Wan Yusoff et al., 2022). This condition was also found in observed at SMP Negeri 1 Besuki Tulungagung, where IRE learning is still dominated by the use of PowerPoint and simple videos. In the Islamic Cultural History material, students showed low levels of participation, tended to be passive, and lacked motivation. This indicates that the use of less varied media has not been able to accommodate the characteristics of students living in the digital era. In this context, learning motivation in IRE is not only related to academic interest but also related to students' awareness of values and affective involvement in the Islamic material being studied (Febriandika et al., 2024; Thoyib et al., 2024)**.**

The development of digital technology opens up significant opportunities for delivering more interactive and meaningful learning. Therefore, in this digital era, teachers are expected to be able to integrate technology into learning. Digital innovation is needed for education to foster 21st-century competencies (O. Ghosh & Kumar, 2025; UK Ghosh & Jermsittiparsert, 2024). One potential technology is Augmented Reality (AR), which can integrate virtual objects into the real world, helping students understand concepts more concretely and visually (Guntur et al., 2020; Putra & Kaltsum, 2026). In the context of IRE,

this technology can be utilized to present visualizations of Islamic historical objects or important events more vividly, so that students not only understand cognitively but also feel an emotional connection to the material being studied. This approach aligns with the principle of experiential learning in Islamic education, which emphasizes the importance of direct experience in building understanding and appreciation of Islamic values (Muhamad et al., 2024; Suhartini et al., 2025). Compared to other technologies that require special devices, AR is more likely to be implemented in schools because it can be accessed through devices commonly used by students.

However, the use of AR in IRE learning remains relatively limited. Most AR media development relies on software such as Unity 3D, Vuforia, or Blender, which require programming skills, making them difficult for most IRE teachers to implement (Asari & Hufron, 2023; Puggioni et al., 2020). This poses a major obstacle to technology integration in IRE classrooms. Therefore, a simpler and easier-to-use platform is needed to enable teachers to develop learning media independently. Assemblr Edu is a user-friendly AR platform that enables the creation of three-dimensional content without requiring programming skills. Pedagogically, this ease of use is important in the context of IRE because it allows teachers to act as learning designers capable of integrating Islamic values into media that is contextual and relevant to students' lives.

Several studies have shown that the use of Assemblr Edu can improve student engagement and understanding in general subjects (Laowo & Hermon, 2025; Paramita et al., 2025). However, studies specifically examining the use of this platform in IRE learning are still very limited. Furthermore, most previous studies have focused more on improving learning outcomes, while the aspect of learning motivation in the context of religious education has not been explored in depth. Therefore, there has been no study that systematically integrates the use of a simple platform-based AR in IRE learning that focuses on student learning motivation (Joseph et al., 2025; Kamińska et al., 2023). In fact, motivation plays a crucial role in IRE learning because it is related to affective engagement and the internalization of Islamic values. This situation indicates a gap between the proven effectiveness of AR technology and the need for contextual implementation in IRE learning. Therefore, developing AR media that is not only easy to use (low-tech) but also pedagogically relevant is crucial.

The urgency of this research lies in the urgent need to transform IRE learning to make it more relevant to the digital generation. The integration of AR in IRE is not merely a technological innovation but also a pedagogical strategy to support a more meaningful learning experience. In the context of Indonesian education moving towards digital transformation, this study seeks to contribute to the development of technology-based learning media that is contextual and easy to implement by IRE teachers. By using the Assemblr Edu platform, teachers can create interactive 3D media without requiring advanced technical skills. This aligns with the principle of teacher empowerment, which empowers teachers to become creators, not just users of learning media (Liang et al., 2025). The development of this media is expected to increase learning motivation, enliven the classroom atmosphere, and support the achievement of IRE competencies that emphasize the values of faith, knowledge, and good deeds.

Based on the description, this study aims to develop Augmented Reality-based learning media using Assemblr Edu and test its validity, practicality, and effectiveness in increasing student learning motivation in IRE subjects at SMP Negeri 1 Besuki Tulungagung. The main contribution of this article is to present a practical Assemblr Edu-based AR media development design that can be replicated by IRE teachers in the learning context. Theoretically, this study provides a limited contribution to enriching the study of technology integration in Islamic education, particularly regarding the use of AR to support

student learning motivation. Practically, the results of this study are expected to be an alternative solution for Islamic Religious Education teachers in developing more interactive learning media that are appropriate to the characteristics of students. Thus, this research positions technology as a learning support tool that is oriented towards strengthening student involvement and motivation to learn in the context of religious education.

B. RESEARCH METHOD

This research uses a Research and Development (R&D) approach with the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model (Branch, 2009, pp. 165–168; Molenda, 2015). The ADDIE model was chosen because it provides a systematic framework for developing learning products while testing their feasibility and effectiveness in real learning contexts. In this study, the ADDIE model was used as the main framework for media development, while effectiveness testing was conducted through a quasi-experimental design with a non-equivalent control group design . The study was conducted at SMP Negeri 1 Besuki, Tulungagung, with research subjects being Grade VIII students. Two classes were used as samples, namely class VIII A as the control group and class VIII B as the experimental group.

The development procedure briefly follow the ADDIE stages in brief. The analysis stage is conducted through observation and interviews to identify IRE learning needs and student motivational challenges. The design stage involves designing AR media based on Assemblr Edu, including material development, usage flow, and integration of three-dimensional objects. The development stage involves media creation and validation by media experts and IRE subject matter experts. The implementation stage involves testing the media in experimental classrooms. The evaluation stage assesses the feasibility and effectiveness of the media based on validation results, practicality, and increased student motivation.

The research instruments consisted of an expert validation sheet to assess the feasibility of media and materials, teacher and student response questionnaires to measure media practicality, and a student learning motivation questionnaire based on the ARCS (Attention, Relevance, Confidence, Satisfaction) model (Keller, 2010). The learning motivation instrument was developed into four main dimensions, each reflecting aspects of attention, relevance, confidence, and student satisfaction in learning. Examples of indicators include student interest in the media, the relevance of the material to life, confidence in understanding the material, and satisfaction after participating in the learning. The instrument was tested for validity and reliability before use. The validity test was carried out using the Product Moment correlation, while reliability was tested using Cronbach's Alpha.

Data were analyzed descriptively and inferentially. Media validity was analyzed using percentages to determine the feasibility category, while practicality was analyzed based on the percentage of teacher and student responses with reference to the Likert scale assessment criteria (Creswell, 2014, pp. 212–213; Ferrando et al., 2025). Media effectiveness was analyzed using a quasi-experimental design by comparing the results of student learning motivation in the experimental group and the control group. The analysis was carried out using a paired sample t-test to see the differences in pretest and posttest in each group, as well as an independent sample t-test to compare the posttest results between the two groups. In addition, the increase in learning motivation was analyzed using N-Gain to determine the level of improvement after using the media.

C. RESULTS AND DISCUSSION

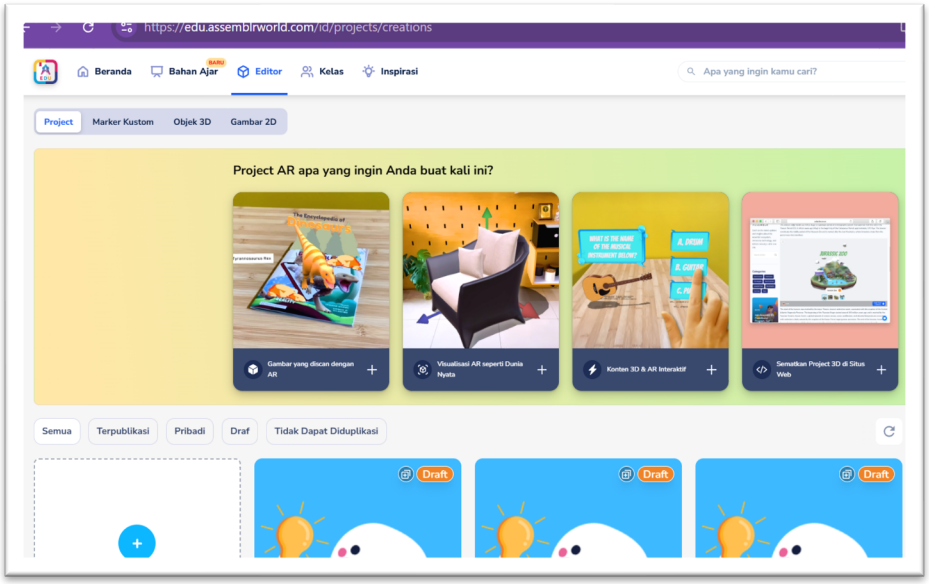
RESULTS

At the analysis stage, the study identified the learning needs and obstacles faced by teachers and students. The findings indicate that IRE learning at SMP Negeri 1 Besuki Tulungagung is still dominated by the use of conventional media such as textbooks, PowerPoint, and simple learning videos. Based on the observation results, the learning process tends to be teacher-centered and relies on lecture methods, so that student engagement in learning is still relatively low. In addition, in the Islamic Cultural History material, students appeared less active in participating in learning and showed a low level of learning motivation. This is indicated by the results of the initial measurement of student learning motivation which obtained an average score of 60,47. This condition indicates that the use of less varied learning media has not been able to accommodate the characteristics of students who require a more interactive and contextual learning experience. This finding indicates a need for the development of learning media that can increase student learning motivation, especially through the use of technology that can present more interesting and interactive visualizations in IRE learning.

Based on these findings, the research proceeded to the product design and development stage. The product developed in this research is a learning medium called Bio-Fold AR based on Assemblr Edu. BioFold-AR consists of foldable printed materials designed using Canva and equipped with a QR code to access the Augmented Reality content. By scanning the code using a smartphone, students can view three-dimensional visualizations of objects related to the learning material. In this case, the learning theme is *Emulating Productivity in Work and the Spirit of Literacy during the Golden Age of Islam during the Abbasid Caliphate* (750–1258 CE) .

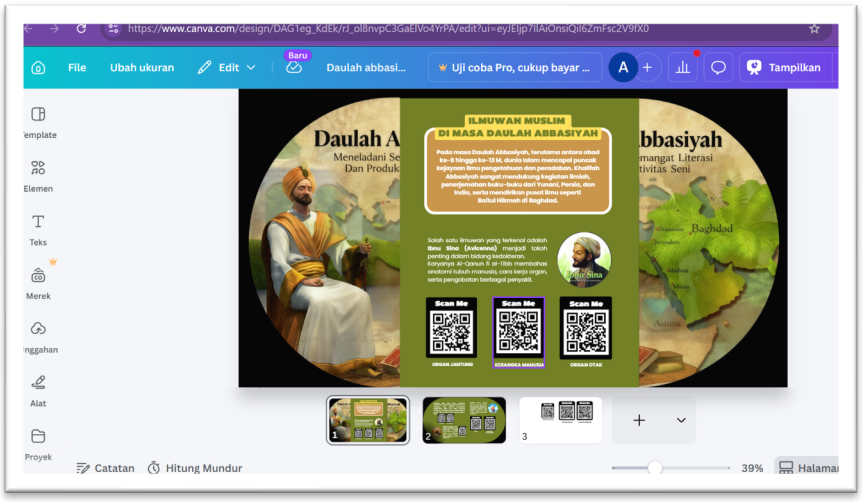
The design process began with the collection of three-dimensional (3D) assets relevant to the theme of Islamic history. Because Assemblr Edu has limited availability of IRE objects, the researchers created new objects using the Artificial Intelligence feature provided by Assemblr Edu. They also downloaded additional objects from the 3D model provider platform, Sketchfab and Rigmodels**.** The objects are Muslim scientists such as Al-Khawarizmi**,** Ibn Sina**,** and Al-Farabi in three-dimensional form, thus helping students to understand the material more contextually. In general, the media developed has been adapted to student characteristics and IRE learning needs, particularly in increasing student engagement and motivation to learn through the use of Augmented Reality technology.

Figure C.1. Assemblr Edu Platform View



Source: https://www.canva.com/

Figure C.2. Arranging visual elements and supporting text using Canva



Source: Researcher documentation

Media validation results indicate that the level of suitability ranges from valid to very valid. Media experts scored 74.66% (valid), while material experts scored 80.4%–83.4% (very valid). Overall, the Augmented Reality-based learning media through Assemblr Edu was deemed suitable for use in learning with minor revisions.

Table C.1 Media Validation Results

No	Validator	Score (%)	Category
1	Media Expert	74.66%	Valid
2	Subject Matter Expert 1	80.4%	Very Valid
3	Subject Matter Expert 2	83.4%	Very Valid

This media was then tested in the classroom. The trial was conducted in the eighth grade of SMP N 1 Besuki as an experimental class. The developed learning media was aligned with the core competencies and learning outcomes outlined in the curriculum. This implementation aimed to determine the media's effectiveness in supporting the learning process, both in terms of goal achievement, ease of use, and the functionality of each available feature.

The practicality test results for the Assemblr Edu-based BioFold-AR learning media were obtained through teacher and student response questionnaires. Based on the assessment results, the teacher response scored 88.33% and the student response 82.8%, both of which fall into the very practical category. This shows that the media developed is easy to use and can be applied in learning.

The final stage of the ADDIE model is evaluation, which involves collecting data to improve the media. This evaluation process will also measure the effectiveness of Bio-Fold AR's use in IRE.

Table C.2 Results of the Independent T-Test

Independent Sample Test					
	t-test for Equality of Means				
	t	df	Sig. (2-tailed	Mean Difference	Std.Error Differenc e

Results Effectiveness	Equal variances assumed	-2,802	60	.005	-9,782	3,373
	Equal variances not assumed	-2,841	46,917	.006	-9,782	3,373

The results of the independent sample t-test showed that the significance value (Sig. 2-tailed) was 0.005 < 0.05. Thus, there was a significant difference between the average learning motivation of students in the experimental class and the control class.

The assessment of the effectiveness of Augmented Reality-based learning media through Assemblr Edu on the material of the Abbasid Daulah to increase students' learning motivation was also carried out using N-gain calculations.

Table C.3 N-Gain Score Test Results

Descriptive Statistics

	N	Minimum	Maximum	Mean	Standard Deviation
Ngain_Score	32	.17	1.00	.7720	.21160
Gain_Percent	32	16.67	100.00	77.1974	21.15982
Valid N (listwise)	32				

This N-gain calculation is used to determine the extent of motivation increase before and after learning to use AR. The following table shows the results of the N-gain calculation. Based on the analysis, the N-gain value was 0.77, which is considered high.

DISCUSSION

This study shows that the development of Assemblr Edu-based BioFold-AR media has successfully followed the ADDIE model stages, which began with the discovery that IRE learning at SMP Negeri 1 Besuki Tulungagung still tends to be conventional, with the dominance of lecture methods and the use of textbooks, resulting in low student learning motivation with an average score of 60.47. This condition is in line with view that emphasizes that learning media plays an important role in stimulating attention and increasing student learning interest (Sadiman, 2021, p. 7; Umamah et al., 2020). This finding indicates that low learning motivation is not only influenced by internal student factors, but also by the limited use of less interactive learning media. This finding is in line with research showing that the use of technology in learning, including AI and immersive media, has been proven to not only provide learning resources but also stimulate students' thinking processes, which ultimately contributes to increased engagement and motivation to learn (Rahman & Afandi, 2024) .

In the design stage, BioFold-AR media was designed by integrating three-dimensional objects into Islamic history materials, especially Muslim scientists such as Al-Khawarizmi, Ibn Sina, and Al-Farabi, thus providing a more concrete and contextual learning experience. This is in accordance with Rochaendi's opinion that learning media must be relevant to student characteristics (Rochaendi, 2025, pp. 3–4), and supported by the opinion that states that Augmented Reality is able to place virtual objects into the real world via devices such as smartphones and tablets, so that they can be accessed anywhere and anytime (Enzai et al., 2020).

The results of the study also show that the use of this media is effective in increasing student learning motivation, which can be explained through the ARCS model (Keller, 2010), where the Attention aspect appears through interesting 3D visualization, Relevance through the connection of material to students' lives, Confidence through the ease of understanding the material, and Satisfaction through a fun learning experience. This finding aligns with previous studies that suggest that the use of visual-based media such as AR allows students to transform concepts into visual and contextual forms that are easier to understand (Ahyani et al., 2025). Therefore, the use of Assemblr Edu in Augmented Reality (AR)-based learning media has the potential to support increased student learning motivation in Islamic religious education materials.

This analysis shows that the increase in motivation did not occur universally, but was distributed across each ARCS component specifically. This finding supports previous research that stated Assemblr Edu is an effective and easy-to-use platform for learning (Safitri et al., 2023; Tuta et al., 2022), and is in line with the view that good learning media must be practical, relevant, and aligned with the curriculum (Rusman, 2024, pp. 45–47). Furthermore, Assemblr Edu's ease of use demonstrates that technological innovation in learning does not always require complex technical skills (Joseph et al., 2025; Nugrohadi & Anwar, 2022). In the context of Islamic Religious Education, this is important because teachers have limited technological mastery, so user-friendly media is easier to implement.

From an Islamic education perspective, the use of this media can be understood as an effort to provide a meaningful learning experience, in line with the thoughts of Syed Muhammad Naquib al-Attas who emphasizes the integration of knowledge and the formation of value awareness (Kosim et al., 2020) . This finding is in line with the view that from an Islamic education perspective, learning experiences are an important aspect because knowledge is not only obtained cognitively, but also through direct interaction with the environment which shapes students' understanding and attitudes (Kunthi & Suwendi, 2024) .

Thus, the use of BioFold-AR serves not only as a technical innovation but also as a pedagogical approach that supports the internalization of values in IRE learning. This result is also reinforced by the finding that the N-Gain value is in the high category, indicating a significant increase in student learning motivation, as well as changes in student behavior, who become more active and involved in learning. However, this study has limitations, including the limited number of samples in one school, the use of a quasi-experimental design without randomization, and the measurement of motivation that is still based on a questionnaire, so generalization of the results needs to be done carefully. Therefore, further research is recommended to test the use of AR media in a broader context and combine quantitative and qualitative approaches to obtain a more comprehensive picture of learning motivation in IRE learning.

D. CONCLUSION

Based on the results of research and development, it can be concluded that the developed media is valid, practical, and effective. These findings indicate that the use of Assemblr Edu-based BioFold-AR media is able to support a more interactive Islamic Religious Education learning process and increase student learning motivation. The application of this media has been proven to increase student learning motivation, especially in aspects of attention, relevance, confidence, and learning satisfaction. This indicates that the developed media aligns with the ARCS motivation model as a theoretical framework in increasing student learning engagement. Teachers also find it helpful in conveying material that is difficult to explain verbally, while students become more focused and active in participating in learning. Thus, the use of Assemblr Edu as an Augmented

Reality-based learning media can be an alternative innovation in Islamic Religious Education learning that is appropriate to the characteristics of students in the digital era.

However, this study has limitations, including being conducted in one school with a limited sample size and the use of a quasi-experimental design without randomization, so generalization of the findings needs to be done carefully. In addition, the measurement of learning motivation still uses questionnaire instruments so it does not fully describe long-term behavioral changes. Therefore, further research is recommended to develop AR media in other Islamic Religious Education materials and test its effectiveness in more diverse school contexts. In addition, further research can combine quantitative and qualitative approaches to gain a more comprehensive understanding of student learning motivation. Practically, Islamic Education teachers can utilize user-friendly platforms such as Assemblr Edu to develop learning media that are more contextual and easy to implement in the classroom.

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