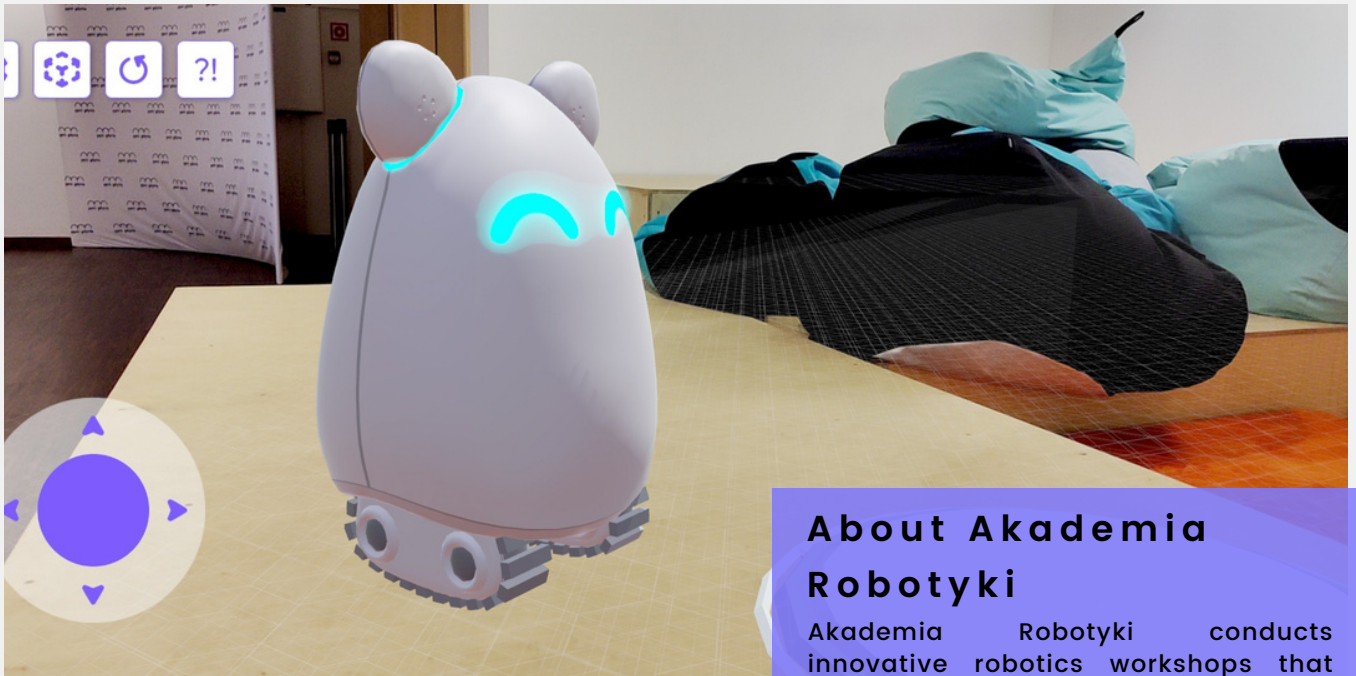


Game, Set, Learn: Unpacking the 'ARnie' Educational Game



Robotics coding, programming, augmented reality, and 3D modeling all in one application? Indeed, a comprehensive tool designed to educate children in the spirit of STEAM (Science, Technology, Engineering, Arts, and Mathematics) has been developed through a collaborative effort between Akademia Robotyki and Braindance Studio.

About Akademia Robotyki

Akademia Robotyki conducts innovative robotics workshops that immerse children in the world of modern technologies and programming. Their approach combines a strong educational value with fun, using the 'Learn by play' philosophy to make learning engaging and memorable. Each session is a new adventure, building constructions that relate to the world around us, from nature to industry and technology.

THE CHALLENGE

Traditional coding learning tools, while popular, start from a very basic level and depend heavily on teacher guidance. They primarily function as code editors, lacking an interactive and engaging storyline. This approach, though educational, could often become monotonous and uninspiring, with no quests or interactive challenges to maintain the students' interest and engagement. Recognizing this gap, Akademia Robotyki and Braindance Studio sought to incorporate gamification into the learning process, transforming coding education into a thrilling adventure.

The decision to design "ARnie" as a game stemmed from the need to actively involve children in the learning process. In a typical educational setting, the onus of engagement falls on the teacher. However, by gamifying the learning experience, we intended to shift this responsibility onto the game itself, ensuring that the students are not just passive learners but active participants.

Moreover, the integration of Augmented Reality (AR) was a strategic choice aimed at addressing another critical aspect of learning - the development of spatial awareness and psychomotor skills. Traditional flat-screen games have limitations in replicating real-world interactions. Through AR technology, children are encouraged to move around, bend, and scan their physical environment, making the learning experience more holistic and engaging. This not only aids in the development of coding skills but also enhances their physical coordination and spatial reasoning abilities.

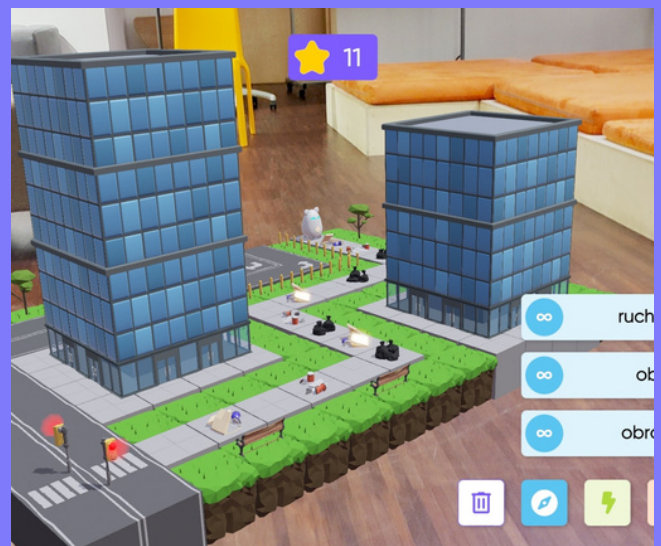
ARnie, the friendly robot in the game, serves as a companion and guide for the children, making the learning journey less intimidating and more enjoyable. The game's design allows it to be played anywhere - at home, in school, or any other setting, adding a layer of convenience and flexibility to the learning process.

THE SOLUTION

Braindance Studio, in collaboration with Akademia Robotyki, created ARnie, an educational game that seamlessly combines robotics coding, programming, augmented reality, and 3D modeling. This innovative application is aimed at providing a holistic STEAM (Science, Technology, Engineering, Arts, and Mathematics) education for children aged 4 to 12 years.

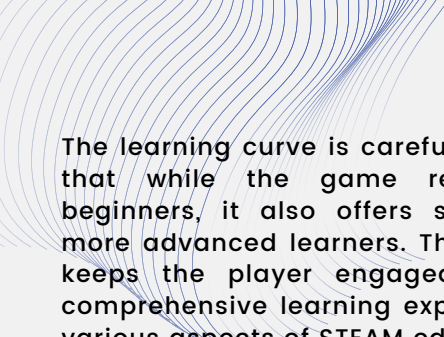
From a technical standpoint, the game is developed using ARFoundation, a Unity framework that supports both AR Core (Android) and AR KIT (Apple), eliminating the need for platform-specific designs and allowing for a unified development process. Unity MARS, another integral tool, played a crucial role in the development of ARnie. This framework enables the simulation of AR experiences on a computer, creating a virtual scene where movements can be freely tested without the need for continuous building and testing on physical devices. This not only expedited the development process but also ensured a more refined and bug-free user experience.

ARnie is delivered as a mobile application, with a development journey spanning over two years, ensuring a product rich in features and content. The game takes the player on an exciting adventure, starting with a chest containing a map, leading to various parts of ARnie, the friendly robot. Once the parts are found, the player engages in a building activity, assembling ARnie piece by piece.



The adventure continues as ARnie guides the player to a secret base, the access to which requires deciphering a password. Along the way, players discover new animals and objects, each addition enriching their adventure journal. The game incorporates not only color sensors, which add an educational layer on color recognition and association, but also a range of interactive tools and gadgets to engage the players: sound sensors, distance sensors, a vacuum cleaner, a combine harvester, a camera, a grabber, a drill, a speaker, a marker, and a jetpack.

Diversity in the gaming environment is ensured through four distinct biomes, each providing unique challenges and learning opportunities. The coding and programming aspects of the game are thoughtfully designed, starting with simple tasks and progressively becoming more challenging to cater to the player's developing skills. Arcade levels introduce an element of dexterity, where players collect stars and engage in tasks such as building bridges to complete the level.



The learning curve is carefully calibrated to ensure that while the game remains accessible to beginners, it also offers sufficient challenge for more advanced learners. This progression not only keeps the player engaged but also ensures a comprehensive learning experience, touching upon various aspects of STEAM education.

DESIGNING AN INTUITIVE AND CHILD-FRIENDLY USER INTERFACE

Creating a game that is both educational and engaging for children necessitates a keen focus on user interface (UI) design, particularly when the primary device in use is a tablet. ARnie is rich in mechanics and programming challenges, requiring a UI that not only accommodates the technical aspects of the game but also aligns with the physical and cognitive abilities of young users.

To achieve this, the UI was designed to be kid-friendly, with large, easily tappable icons and straightforward navigation pathways. The instructions provided within the game are clear, concise, and age-appropriate, ensuring that the children can understand and follow them without adult intervention. The design also takes into consideration the intuitive touch gestures that are second nature to the digital native generation, making the game accessible and easy to engage with.

Moreover, the UI design incorporates vibrant colors and engaging graphics, capturing the children's attention and maintaining their interest throughout the gameplay. This careful attention to detail in the UI design ensures that ARnie is not just a learning tool but also an enjoyable gaming experience for children.

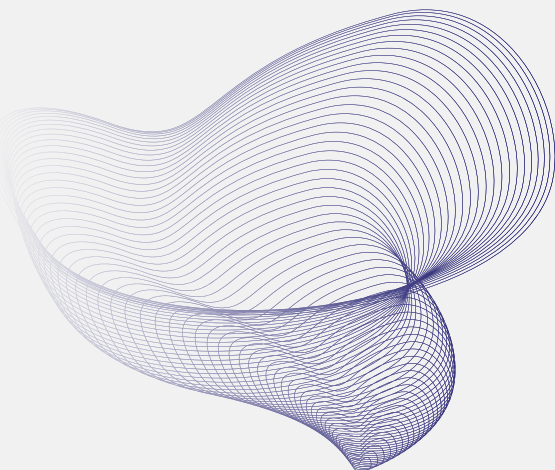


CRAFTING A UNIQUE BLOCK-BASED PROGRAMMING LANGUAGE

In ARnie, we introduced children to the basics of coding through a custom-designed, block-based programming language. This innovative approach aimed to simplify the coding process, making it more accessible and engaging for young learners. Initially, our interpreter, implemented in C#, operated in a turn-based manner, similar to a game of chess, where each block represented a discrete move or action.

However, we soon realized that this method, while simple, did not provide the smooth, real-time feedback necessary for an immersive learning experience. To address this, we transitioned to a real-time solver, ensuring that with every tick or movement of ARnie, the game continuously updated, resulting in smooth, delay-free actions. This shift not only enhanced the gameplay but also allowed for a more interactive and responsive learning environment.

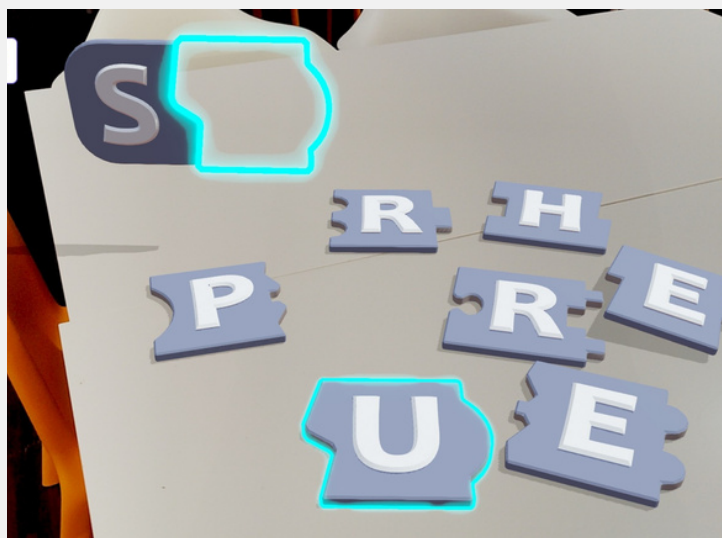
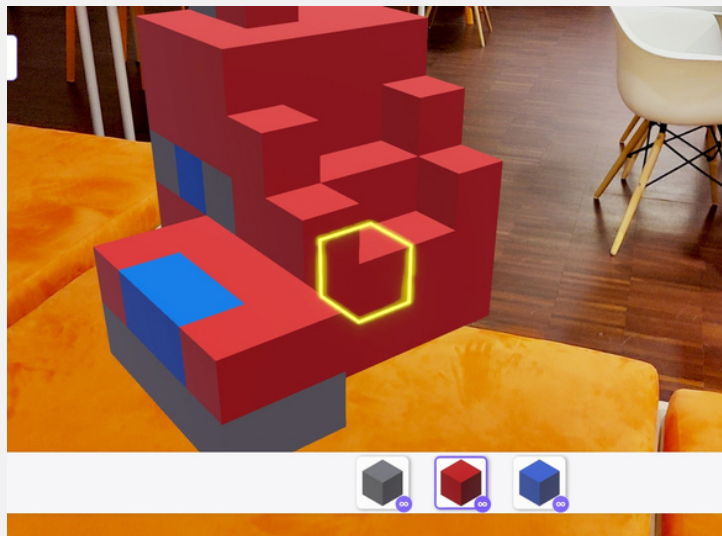
Despite these advancements, we encountered a significant technical challenge with recursion in the block-based commands. Unity, our chosen game engine, struggled to support recursion beyond ten levels of nesting, leading to issues within the editor. To circumvent this limitation, we developed a custom editor specifically designed to display the game board's data and enable block action editing. This tailored solution allowed us to maintain the integrity of our educational content while navigating the technical constraints of the platform.



CULTIVATING EFFICIENT CODING FROM THE GROUND UP

In ARnie, players are presented with various puzzles, and while they initially have access to only four programming blocks, the game's design allows for the usage of additional blocks if needed. We strategically integrated a reward system that motivates players to minimize their use of blocks, driving them towards finding the most concise and straightforward solutions to the challenges presented.

This innovative approach serves a dual purpose. Firstly, it introduces young learners to the fundamental concepts of coding, and secondly, it instills a mindset of optimization, encouraging them to constantly evaluate and refine their code for maximum efficiency. Through this, we aim to teach players that coding is not just about finding a solution, but finding the best possible solution with the resources available.



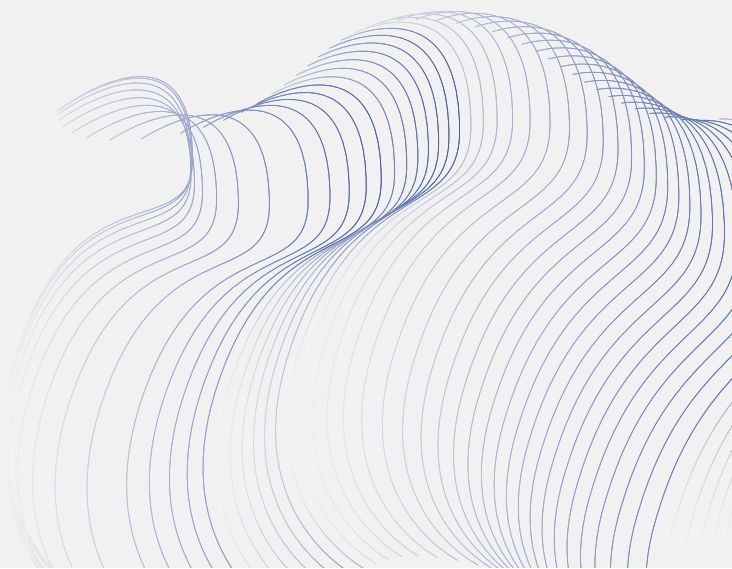
BALANCING PERFORMANCE AND AESTHETICS WITH CUSTOM SHADERS

For the creation of ARnie, a major challenge and achievement was the development of a custom shader in Unity. This task was necessitated by the unique demands of the game, which is designed to run on mobile devices and features a multitude of levels, each populated with numerous objects. To significantly enhance performance, the game was also optimized to use only 2 textures (texture atlas).

The necessity for a custom shader stemmed from the need to efficiently manage the rendering of these numerous objects, ensuring that the game would run smoothly across a variety of mobile devices. This was crucial in providing a seamless and enjoyable gaming experience, regardless of the device's capabilities.

Furthermore, the aesthetic of the game required special attention. ARnie is designed to be an educational tool for children, and as such, it was imperative that the visual style be more cartoonish and engaging than what is found in most games. Achieving this required a nuanced approach to shading, as the goal was to create a vibrant and appealing world that would captivate young players' imaginations and facilitate a conducive learning environment.

By developing a custom shader, we were able to strike the perfect balance between performance and aesthetics. The shader allowed for efficient rendering of the game's many objects, ensuring smooth gameplay, while also contributing to the game's charming and inviting visual style.



STEAM ELEMENTS IN ARNIE'S GAMEPLAY

ARnie's journey is not just about fun and games; it's a full-blown STEAM (Science, Technology, Engineering, Arts, Mathematics) adventure. The Science and Technology aspects are front and center as players gather parts for ARnie like batteries, body panels, motherboards, caterpillar tracks, and light matrices. Each piece is a puzzle that reveals more about real-life robotics and engineering principles.

The Arts component gets its spotlight through ARnie's building block module. Players express their creativity by constructing their own robotic models, tapping into basic engineering and design principles. And with plans to roll out a level editor developed by our team, players will soon have the chance to craft their custom levels. This feature not only opens a window to understanding game design but also encourages players to think like creators, shaping their virtual worlds.

THE CONCLUSION

ARnie is a prime example of how technology, when thoughtfully applied, can enhance the educational landscape, making learning more interactive, engaging, and accessible. The use of a custom programming language and block-based coding introduces young learners to the fundamentals of programming in a way that's both intuitive and fun, laying a strong foundation for future learning.

The game's innovative use of augmented reality (AR) not only breaks the traditional bounds of screen-based learning but also engages children in a multisensory experience, promoting spatial awareness and psychomotor skills. Moreover, the game's design, with its cartoonish aesthetics and custom shader, ensures that it is visually appealing and performs optimally across devices, further enhancing its accessibility and appeal to young audiences.



"Braindance Studio has played a crucial role in bringing ARnie to life, transforming complex programming concepts into an accessible and enjoyable game for children. Their dedication to balancing educational content with engaging gameplay has resulted in a tool that not only teaches but also inspires. We are grateful for their expertise and commitment to making learning programming a more interactive and fun experience. ARnie stands as a testament to what can be achieved when innovation and education come together."

**- Michal Murawko, Founder
Akademia Robotyki**