AUGMENTED REALITY FOR ZOO EDUCATION

FINAL MASTER PROJECT

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BEEKSE BERGEN

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Abstract

Zoo education is often skipped over by visitors, who mostly visit zoos for the entertainment of viewing animals. This can be improved by developing interactive education, which is better at keeping audiences engaged.

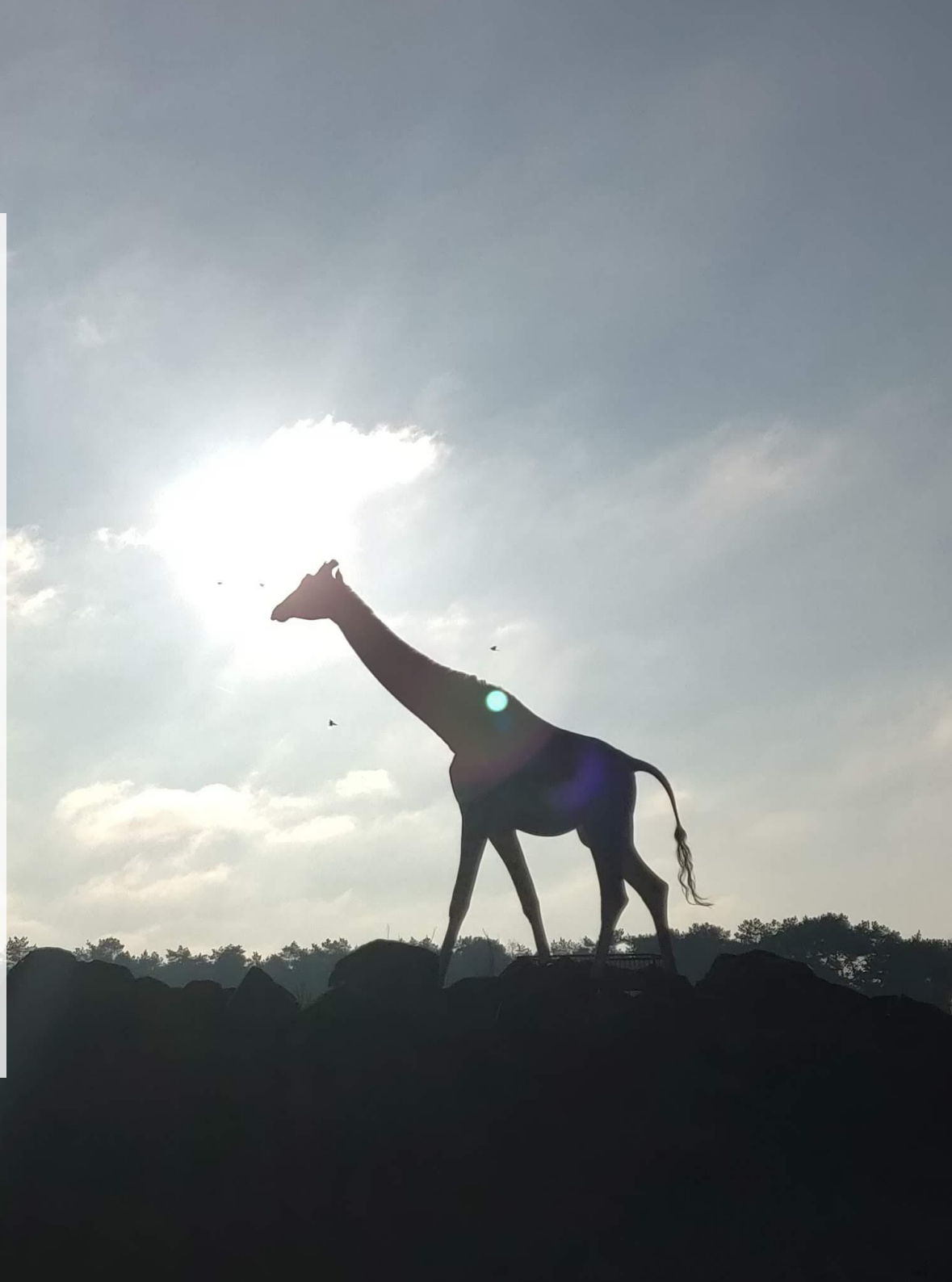
This project explores how mobile phones and augmented reality can be used to create new kinds of interactive zoo education.

In total, five concepts were designed and prototyped, covering a range of topics, interaction styles and experience types. These prototypes were tested with visitors at a real zoo.

Responses were overwhelmingly positive, with participants finding them to provide an added value to zoo education by being both fun and educational.

Using these designs, zoo education could be made more attractive for a much larger audience than it is today, helping zoos ignite their audiences' love for animals and nature.

These designs might even prove useful in other contexts in the future, such as museums.



INTRODUCTION

EDUCATION IN ZOOS

Historically, the main function of zoos was to serve as entertainment for the general public [8]. Nowadays, while entertainment is still an important aspect of zoos, their main goals are the conservation of endangered animals, researching animals, and educating the general public about animals [47]. Education is deemed so important in fact, that the Dutch Association Zoos of conducts regular inspections on its quality among members [48]. To maintain a continuous improvement to the quality of the provided education, it's important to constantly explore new methods for doing so.

And yet, the most common methods are still presentations and information signs, the same it has been for decades [32]. While information signs are definitely a necessity in zoos, they also tend to be heavily underutilized by visitors [7,12,33]. Even though visitors recognize the zoo as a place for education, and the importance of its educational role, most people's main reason for visiting a zoo is still enjoyment [5]. As a result, they are only willing to engage with educational activities as long as they fit with their primary goals of enjoyment and seeing animals [10,14].

INTRINSIC MOTIVATION & ZOO EDUCATION

A trip to the zoo isn't inherently educational. One person's zoo trip can differ greatly from someone else's. How educational a visit to the zoo is, depends completely on how much a visitor chooses to engage with the educational content provided. It is a self-directed learning process [14]. In order for visitors to engage with the education, they need to be intrinsically motivated to do so [35].

On top of making an activity interesting and engaging, Self-Determination Theory and Cognitive Evaluation Theory teach us that to make an activity more intrinsically motivating it needs to provide a feeling of autonomy, competence and relatedness [11].

While regular zoo signage can be intrinsically motivating to some, it clearly isn't for all. Therefore it's necessary to offer the educational content in a variety of ways.

INTERACTIVE EDUCATION

The issue of education signs being underutilized has been known for decades, and in response, interactive education methods have also been around for a long time to supplement signage. These interactive exhibits can take many shapes and forms, from employee run stands, to interactive signs, or playground items incorporating educational aspects. In recent years, digital elements such as video and audio have also become more prevalent [29,39].

These interactive experiences show to engage visitors more, and also lead to better information retention [24]. They lead to longer stay time at exhibits [29]. In museums, interactive exhibits have also been shown to be much more attractive to visitors [6,34].

There are a number of challenges to overcome when it comes to providing education this way. The kinds of interactive elements must not become too repetitive, or visitors will expect all to be the same and they will lose their appeal [5]. There's also the risk of non-natural technologies negatively influencing the naturalistic look and feel of the zoos [9]. These challenges can be overcome through clever design choices, like integrating them into the environment, or creating an environment that suits them [2,36].

The biggest downside to these interactive experiences is their cost compared to regular signage. Not only does it cost more to design and construct elaborate interactive exhibits, but they also have a higher cost of upkeep, especially when they feature a lot of moving parts or technological aspects. Even more so if they require employees to be present.

What's also holding current interactive educational exhibits back, is that they're primarily being designed for younger audiences, ages 5-12. As a result, older visitors have a tendency to dismiss these educational exhibits as childish, even though other age groups would also hugely benefit from them [37].

DESIGN BRIEF

The goal of this project was to design new kinds of interactive, educational experiences, by using mobile phones, and Augmented Reality (AR) in particular.

M2.1 PROJECT

This project follows up on the findings of my M2.1 project. In that project, I explored potential ways both AR as well as VR (Virtual Reality) could be applied to a zoo setting.

This was done by studying existing interactive educational stands at a zoo, and by creating both AR and VR prototypes for zoo visitors to try out.

The most successful prototype to come out of the M2.1 project was a phone-based AR experience. A sign with a QR code was placed in the zoo. Scanning the QR code would open a website that let people see the world through the eyes of a deer, who have colorblindness. This affects the camouflage of tigers.

The sign used in the M2.1 Project. It reads: "How effective is the camouflage of a tiger? With such a striking color, it's not hard for us to spot a tiger. Yet for some animals this isn't that easy. See for yourself by scanning the QR Code!"

What a tiger looks like with color-blindness.

Visitors appreciated the way the experience visualized what it was trying to teach. They had little issue with using their phones, as they recognized the added value this brought over just a picture on a sign.

While this prototype showed a lot of potential, it also left some things to be desired. For instance, people couldn't tell what the experience was going to be prior to scanning the QR code, making them hesitant to scan it. The sign also didn't stand out much, going unnoticed by many visitors.

When asked whether people preferred to get the information on their phone or on a sign, though many people greatly appreciated what the phone brought, many wondered why it had to be one or the other. Requiring the phone leaves out part of the zoo audience while the information could easily be added on the sign.

These issues will be addressed in the new design, and it will be explored how this concept can be used to make a variety of new interactive experiences as well.

THE CLIENT

The client for this project is Safaripark Beekse Bergen, a zoo located in the south of the Netherlands.

Beekse Bergen, together with all other zoos under the Libéma company, are dedicated to creating fun and engaging ways to involve guests with the education they provide. They want to offer a variety of educational activities to inspire people [23] .

On top of this, Beekse Bergen already has a well-established app. The main purpose of this app it to provide practical information, such as opening or feeding times, but it also has some interactive experiences. These experiences include “spotting animals” which encourages people to take a picture of every animal in the zoo, and an audio tour for the car safari. There’s also an “animal codex”, which includes information about every animal in the park.

The app, which a mobile experience could easily be integrated into, and Beekse Bergen’s interest in interactive education make them a perfect client for this project.

The education team was able to provide useful insights into educating visitors, and the zoo provided the possibility to test prototypes with real users at the park.

RELATED WORKS

The concept of using phones as a means to provide zoo education isn't new. Even AR applications have been attempted in zoos before. Museums also make use of these technologies.

REPLACING SIGNS WITH PHONES

One way zoos have tried to deal with the underutilization of signage has been removing the signs altogether, instead offering the educational content through an app [27,43,49]. The results of these attempts were less than desirable, many visitors demanding education signs to be put back.

The problem with offering information through an app in this way, is that it doesn't make the educational activity any more motivating or engaging than it would be reading the information off of a sign. If anything, it only makes things worse, as it now takes an extra step to obtain the information. It has been shown in museums that people prefer direct mechanisms of obtaining information over having to scan a QR-code to do so [50].

This poses a potential challenge when using QR codes. Can this extra barrier they create be overcome by making sure the experience they provide is worth the extra effort?

AR AT THE ZOO

Augmented reality is defined as a real time view of the real world, enhanced/augmented by adding virtual elements to it [17]. This enhancement can be added in a number of ways. The best way to distinguish them is by looking at the type of tracking they utilize [40]. The most common types are image tracking, world tracking and face tracking.

There's little literature exploring AR in a zoo context [38]. A few commercial applications can be found, such as Zoo-AR from 2012 [3], which seems to have been discontinued since then.

Of the available literature, two used AR as a means of accessing additional information, such as videos [20,38]. Participants in these studies responded positively to the experience, but the papers don't do a great job at explaining what that experience was like exactly, apart from involving accessing video content.

These applications don't seem to be taking full advantage of the possibilities AR provide in terms of interaction. There seems to be only one paper focused on creating an interactive experience using the affordance offered by mobile phones; AR by making a GPS-based treasure hunt for kids [30].

This game had the interesting downside. While being incredibly fun for participants, it actually detracted from the zoo experience, as participating kids were too distracted with the game to take in and experience the zoo [30].

A screenshot from Zoo-AR's promotional video, showing an AR rhino bursting through an education sign.

Zoo-AR is mostly focuses on showing animals in AR. Although this can certainly be fun, it does not add much to the experience of a zoo, where you can already see these animals (though perhaps not from up close).

As for using AR to access videos, this does not add much to watching these videos on a screen at the zoo. These projects seem to be focused on showing things in AR, rather than using the affordances AR provides to convey information in a new way, which is what I hope to accomplish.

IMPACT ON THE SOCIAL EXPERIENCE

Something that these papers also fail to properly explore is the implications phone-based AR will have on the social experience at zoos. After all, zoos are a social setting, with people often visiting with groups [31]. Only one of the papers briefly mentions that the effects of these technologies on the social aspect should be investigated further [30].

While the use of phones in social settings can isolate a group member, AR systems actually has the potential to support social interactivity [19]. Collaboration in group dynamics can be enhanced, for instance by having one player take clues from the digital world, and one player taking clues from the virtual world [21].

FINAL DESIGN

In total, four new AR-experiences were developed, on top of the one developed in the M2.1 project, which was adjusted to fit the new format of these experiences, taking into account what was learnt in that project.

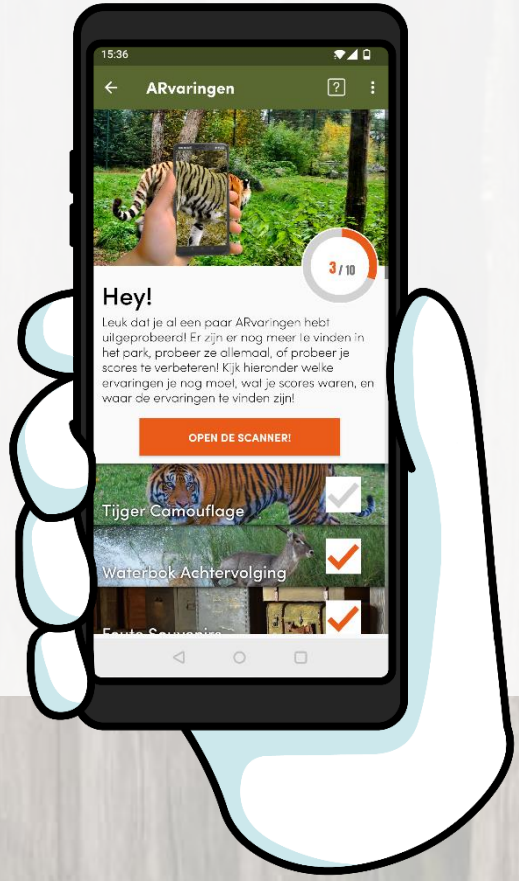
These five experiences form a series of interactive experiences, portraying a variety of AR types, game styles, and educational topics. This variety keeps the experiences fresh and engaging with every new experience the user tries.

These experiences were used to gauge how visitors perceived other interaction styles and topics presented in this manner, and gather feedback on how the designs could be improved going forward.

While the prototypes themselves are just a bunch of seperate experiences, the idea is that ultimately they will be united through their inclusion in the Beekse Bergen app. Here, visitors will be able to view and locate each of the experiences, track their progress and read back on what they learnt in the experience.

The idea is still that QR codes can be used to access the experiences. This will bind users to the locations of the signs, keeping the experiences within their desired context. It also prevents users from having to look up the experience in a long list. A QR-code scanner will be built into the app, so that people no longer have to rely on third-party scanners which don't always come pre-installed, and can be unreliable.

Another advantage to using QR-codes to open the experiences is that the QR-codes will still function with regular QR-code scanners. The codes can be made such that when a user has the Beekse Bergen app installed, it opens the app, and when they don't, it opens the store page [1]. This could lead to additional downloads of the App if users can be convinced to try out the experiences.



THE NEW SIGNS

All the issues of the M2.1 project sign were addressed with the new signs, using findings from that project.

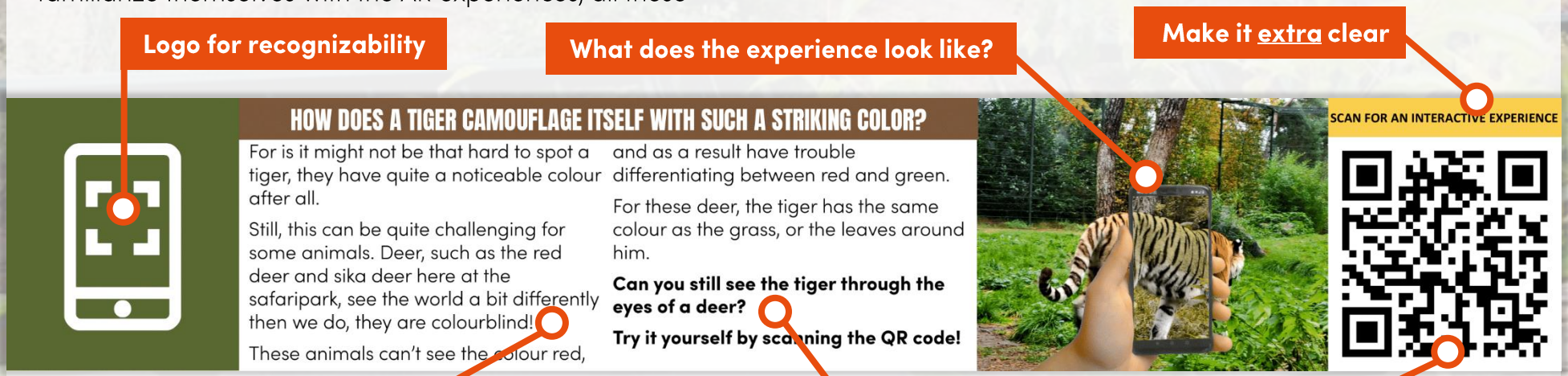
Making the main body of text black on white makes the sign stand out a lot more compared to the all-green sign of the M2.1 project. It also features a bit more information, such that even a visitor who does not scan the QR-code has the opportunity to learn something from the sign.

Since the barrier for scanning the QR-code can be quite high, several elements have been added that are there to help convince the user to scan the code. Once people familiarize themselves with the AR experiences, all these measures might be a little excessive, but to get them to that point they have to try at least one of them.

First of all there is "the hook". This is the conclusion of the story, which tells the user what they'll see if they scan the code. Next up there's the image, which shows what they'll be able to see if they scan the QR code. This helps them decide whether it is something they'd want to spend time on.

Lastly, just to drive it home, a yellow block has been added above the QR code that tells people it is an interactive experience they'll get to see, just to be sure they'll know it'll more than just additional information.

All the developed signs in can be found in appendix A.



PURPOSES OF THE SIGNS

Ultimately, the signs serve the following purposes:

- Draw the attention of visitors to the AR experiences.
- Give access to the experiences via QR-code.
- Provide information on the subject, even to those who don't want to use their phone.
- Guide users to a location suitable for the experience:
    - Not blocking other users.
    - Having sufficient shade to prevent sun glare.
    - Having a fitting context for the experience topic.
- Provide an interaction field for the experience (in cases where image-tracking AR is used).

HOW WILL THE SIGNS BE DISPLAYED?

The thin information signs are intended to fit underneath the current education signs of any animal that they might be appropriate to (in this case, the tigers). These signs belong to experiences that don't use image-tracking. The experiences that do, require larger signs which include the image-tracking target.

These signs will be the same size as the animal signs, and are placed independently. While these signs have a different layout, they include all the same features of the thin horizontal signs.

For added recognizability, it might be desirable to add a taller pole with the logo on top, similar to those on top of the directional signs and feeding show information signs that the zoo has. This would make finding every experience easier for guests looking to do so. The thinner signs could be made vertical, and mounted on these poles.

THE EXPERIENCES – DESIGN GUIDELINES

Just like how the signs have a set template, the experiences themselves were also given a degree of consistency through a number of design guidelines.

STARTING SCREEN

Every experience starts with a starting screen. Not every guest reads the entire sign before they scan the QR-code. This often led to them being confused about the educational message. The starting screen gives users any valuable information they might have missed if they didn't read the whole sign.

GOAL

Since the Beekse Bergen app was going to be tracking people's progress with the experiences, it was attempted to give every experience an end goal. Achieving this goal would count the experience as "completed" in the progress tracker.

While not applicable to all, this did guide the design of some of the experiences to be less open-ended.

DURATION

Every experience was intended to be of a short duration, preferably between one and two minutes. This would be to assure that they are able to complete it before they get bored, or before members of their group want to move on.

Making experiences between one and two minutes makes them fit in the average time guests spend at exhibits, which is two to three minutes [29].

TARGET AUDIENCE

The target audience for these experiences can be described as "zoo visitors with a mobile phone". But who are these people really?

In the Netherlands, most children receive their first phone around age 12, when they go to high school [51]. Considering that teenagers are often seen as the "most neglected age group in overall zoo planning" [37], they might seem like a very suiting target audience.

However, teenagers are also the smallest target group of zoos, making up only around 5% of the zoo audience [37]. Adults aged 21-34 on the other hand, make up about 32% of zoo audiences [4]. If the experiences can be made appealing to them, it's a lot more likely the experiences will end up being used.

AESTHETIC

To make the experiences appealing to this target audience, the aesthetic was kept somewhat mature, using either real life photos, or realistic drawings like those found on the zoo's signage wherever photos weren't an option. The aesthetic of also follows that of the Beekse Bergen app and signs, to make them fit in with the zoo's brand.

USE OF SOUND

While the Beekse Bergen app uses audio, namely with the audio tour that can be enabled in the car safari, it was decided that this would not work as well in the context of the walking route.

While in the car safari, family groups are in an enclosed space, where they are the only ones hearing the sound. On the walking route on the other hand, having to turn on your phone's sound, probably to a fairly high level to be audible, wouldn't be something a lot of people would do. It also has a higher chance to disrupt other people in the park.

This could be avoided by wearing earphones, but it is unlikely anyone would want to do this, especially when going out as a group.

This is why the experiences should not rely on auditory cues. They should be playable without any sound.

EXPERIENCE 1: TIGER CAMOUFLAGE:

In tiger camouflage, the visitors views the tigers through the eyes of a deer.

EDUCATIONAL GOAL:

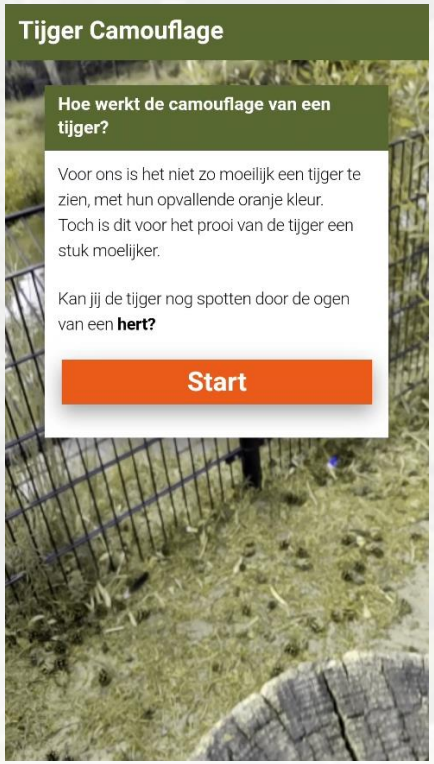
Teach visitors how effective the tiger's camouflage actually is, due to the color-blindness of their prey [16].

DESCRIPTION:

By looking at the tiger through the eyes of a deer, they get to see how colorblindness makes the tiger's camouflage a lot more effective.

Coming out of the M2.1 project, this experience has been updated to include a lot of the improvements added since then, such as the start screen.

The experience has also been made consistent with the rest of the experiences, making the camera full screen. The info text, which was underneath the video screen in the M2.1 iteration, is now put in a menu at the bottom of the screen, which can be opened and collapsed.



EXPERIENCE 2: PROTECTING FARMERS:

In protecting farmers, visitors help the farmer on the signs with their problems, caused by wild animals.

EDUCATIONAL GOAL:

Teach visitors about the various ways non-profit organizations tackle Human-Wildlife Conflict [44,52,53].

DESCRIPTION:

The sign features a couple of potential solutions to specific human-wildlife conflict problems.

When looking at the sign in AR, the farmer will get a speech bubble, giving the player a problem. The player then has to select the correct solution.

Whenever a solution is selected, the player will get to read why it was a fitting solution or not. Each problem will have a key detail that makes it fit to only one solution.

This encourages players to read the solutions in depth to find the right one. When they get it wrong, they learn about why that solution isn't right for this problem.

It teaches players the importance of listening to the problems these farmers have so that the right solution can be found, which is what these organizations do in real life as well.

BENEFITS

Making an interactive "quiz" on a phone this way, compared to traditional interactive interfaces with buttons, has a number of advantages:

- It is less costly to make/maintain a sign like this.
- Multiple people can interact with the signs on their phone at once.
- It's easy to add new problems to the game in the future.

EXPERIENCE 3: WATERBUCK ESCAPE:

In waterbuck escape, you play as a waterbuck, trying to escape from a lion. You have to closely follow your fellow waterbuck, or be caught by the lion.

EDUCATIONAL GOAL:

Teach visitors the purpose of the circle on the back of the ellipse waterbuck. It helps waterbuck stay together as a group when fleeing from a predator [45].

DESCRIPTION:

In the game, the player needs to follow their fellow-waterbuck by looking at their circle. Looking at the waterbuck in front of them, progresses the player forward. Whenever the player isn't looking at the waterbuck, they are stationary, and the lion will catch up to them. The game consistently reminds the player to focus on the circle whenever they fail, reaffirming the educational message.

The game uses gyro-tracking, meaning it uses the phone's gyro-sensor to rotate the digital camera the same way as the phone, making it seem as if the digital elements are around them.

The waterbuck will randomly move around the player, changing its direction and speed. As the game progresses, the waterbuck will get further away from the player, making it harder to see and track. The game ends when the player reaches the finish before being caught by the lion.

After completing the game, the player gets to see how long it took them to complete the game. The better the player was able to track the waterbuck, the lower their time will be. This end screen encourages players to try to get a lower time, giving the game some replay value. It also creates some friendly competition among group members.

EXPERIENCE 4: BAD SOUVENIRS:

In bad souvenirs, visitors' phones act as an x-ray device, which they can use to look inside of suitcases on a conveyor belt.

EDUCATIONAL GOAL:

To teach visitors what bad souvenirs are out there, and how these kinds of souvenirs threaten animals [15,22,25,42,54,55]. Encouraging visitors not to buy these souvenirs when travelling themselves.

DESCRIPTION:

Looking at the sign in AR, the conveyor belt starts moving, and suitcases will move from the top of the screen, down to the bottom.

The box in the middle of the screen has an X-ray effect. Showing the bad souvenirs that are inside some of the suitcases. This allows people to discover these "bad souvenirs" in a fun, engaging way.

Tapping a souvenir opens a little info menu about that souvenir. Each one of these stories hammers down on that fact that if people stop buying these souvenirs, they will also stop being sold. This is done to encourage people not to buy these souvenirs. Once a souvenir is found, it will stop showing up until all souvenirs are found.

EXPERIENCE 5: RHINO MANAGEMENT:

In rhino management, visitors are being put in the shoes of species coordinator of the southern white rhino.

EDUCATIONAL GOAL:

Teach visitors something about the role zoos play in the conservation of species.

As a side-goal, it teaches visitors why sometimes they might see an all-male bachelor group at a zoo.

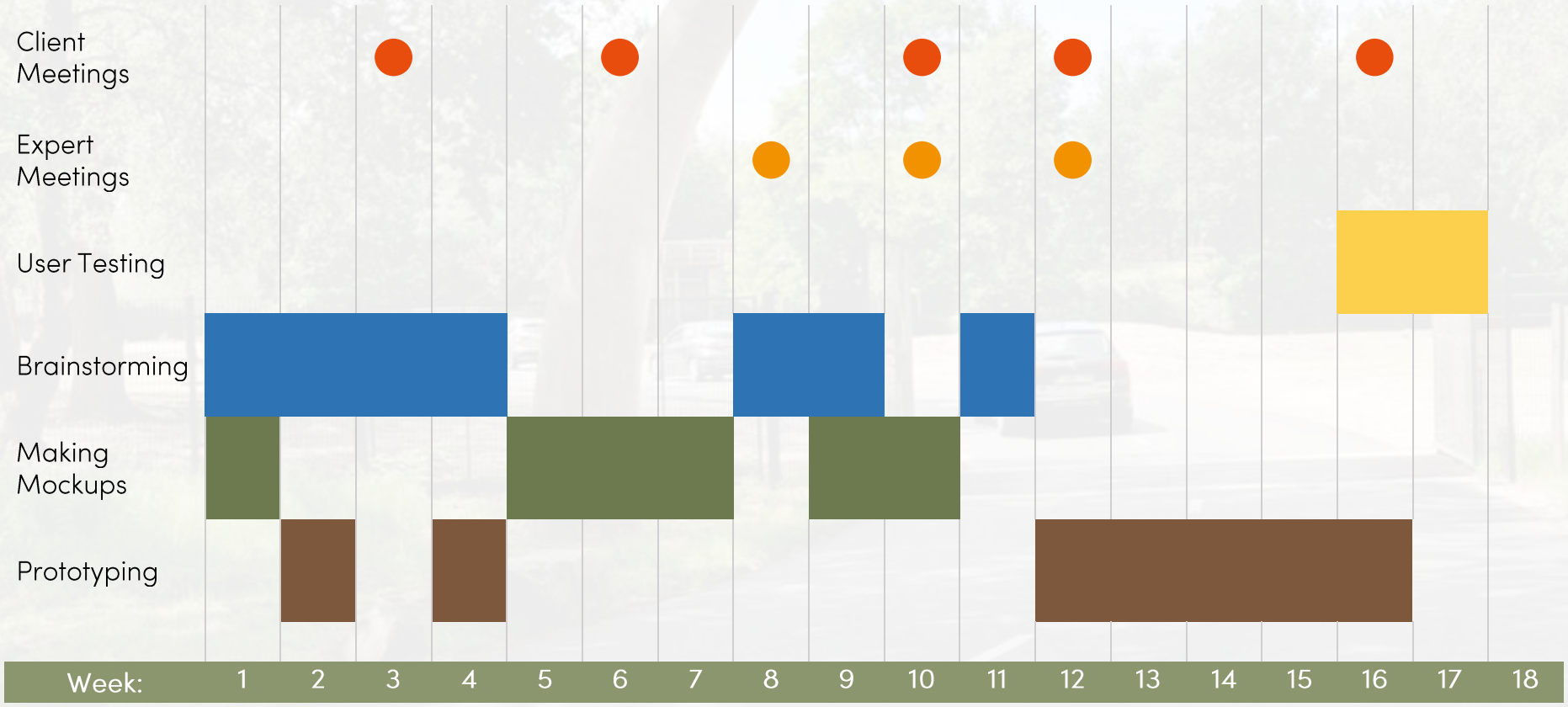
DESCRIPTION:

In this game, this task has been translated into a puzzle. Every enclosure has a few problems, like inbreeding, or males fighting over females. Players solve these problems by moving rhinos between enclosures.

By doing so, players will gain an understanding of the kind of things zoos do to keep their animal healthy.

There's one problem players will encounter however, having more than one male together with any number of females causes the males to fight over the females. This is why to solve the puzzle, players need to make one enclosure that is filled with just males, teaching them why they might see an all-male group at the zoo as well.

DESIGN PROCESS



MOVING ON FROM M2.1

Over the course of the M2.1 project, I got a clear picture of the zoo visitors at Beekse Bergen, as a result of two separate user studies. Through these observations I was able to define the design guidelines mentioned before, which would be the foundation for each of the new experiences.

The tiger camouflage prototype of the M2.1 project was highly effective, but rather simple. It used a video filter, which technically counts as AR in the broadest of terms, but isn't really what would come to mind when thinking about AR. There's also not a lot of uses for video filters in this context, aside from mimicking a certain animal's vision.

So, it was necessary to look at other interactions offered by phones and AR. For the phone this would include the touchscreen, but also sensors like the gyroscope.

As far as AR is concerned, it depends on the type of AR technology used. Image-tracking AR is a great fit, as it can be used to make an education sign "come to live" as it were, or at least make it interactive. Through AR, the sign becomes a screen with which you can do whatever you want.

Face-tracking AR was also looked into, as projecting objects onto the user's face could make for some fun interactions. Its exact educational benefit was yet to be figured out.

FINDING NEW EDUCATIONAL GOALS

On top of needing new interaction styles, in order to make new educational experiences I would need some new educational topics that these experiences could teach about.

According to the education manager at Beekse Bergen, zoo education typically falls into one of three categories:

Wonderment

These are your typical animal facts, meant to impress visitors and generate interest in the animal.
By generating this interest, zoos hope visitors will be more willing to support these animals in the wild.

Conservation

Education about conservation spans a wide range of topics. Conservation can be both about in-situ and ex-situ conservation.
In-situ conservation topics are generally the issues that causes an animal to be endangered, as well as the solutions being offered for tackle these issues.
Ex-situ conservation mostly talks about external breeding programs, such as those in zoos.

Action-Perspective

Action-perspective is a bit of an extension of conservation topics, focusing specifically on the things that visitors themselves can do to make a positive change.

To find educational topics for the experiences, I went through all of the education currently at the zoo, to get an idea of the topics already covered, but also to find some inspiration.

For instance, the "bad souvenirs" topic originated from something I read at the zoo. There is a sign about ivory, which calls ivory a bad souvenir. This made me wonder if there were any other bad souvenirs worth teaching about, and after doing some research I found quite a few:

- Elephant/Giraffe hair bracelets [42]
- Exotic Feathers [54,55]
- Traditional Medicine [22,46,55,56]
- Exotic pets, especially reptiles [15,25]

The waterbuck topic I also learnt about at the zoo, though not from signage. I learnt about the circle helping waterbuck stay together when fleeing from a predator by listening to an educator during one of the bus tours.

The topic of Human-Wildlife Conflict in "protecting farmers" came from doing research on the work done by organizations the zoo supports through the Wildlife Foundation, a non-profit organization inside the zoo that raises money and donates it to a number of conservation organizations [57].

I went through all organizations they support, investigating which problems, and solutions they deal with. I was particularly inspired by the Elephants and Bees project. This project aims to use beehives to protect farms and villages against wild elephants [52]. This was such a unique solution to a problem, I had incorporated it into an experience, so human-wildlife conflict was chosen as a topic.

Lastly, the topic of "rhino management" came mainly from the desire to explain why bachelor groups exist. Bachelor groups are commonly used with all sorts of species where only one male can be present in a family group. The zoo already has signs about breeding programs, and this would be a nice addition to that story.

This combination of topics neatly covered each of the different categories of zoo education:

Wonderment	→	The ellipse waterbuck's circle's purpose
Conservation:		
- In-situ	→	Human-Wildlife Conflict
- Ex-situ	→	The tasks of a species coordinator
Action Perspective	→	What souvenirs not to buy

A number of other topics were considered as well, such as the similarities between primate and human faces, how people can furnish their gardens to be more ecological friendly, and the different purposes of horns among various animals.

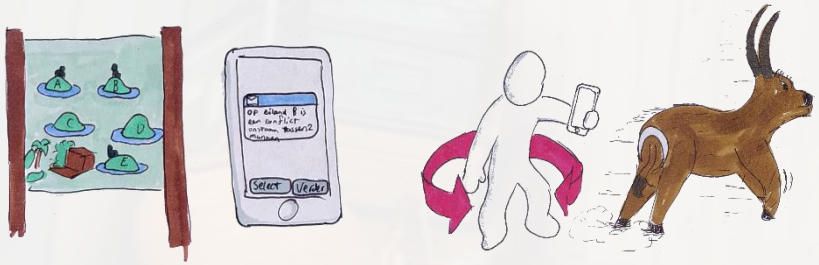
The purposes of horns topic would've been translated into a quiz like experience, where the visitor receives questions about which attributes of horns seem useful to them (being able to cool off, impress mates, defense, etc.). At the end it would be revealed what animal's horns are most suitable for you based on which attributes you found important. It would've used face-tracking AR to project those horns onto the visitor's head as a fun way to end the interaction.

The idea was discussed with one of the educators at the park, who gave a brief presentation about the topic. The purposes of horns are mostly the same for any species, so it's hard to assign one kind of horn as "most suitable". While some horns might be better at some things than others, most of that is pure speculation, which the zoo would rather not present as fact.

Thanks to the insights of this expert, it was determined that the initial idea wouldn't work. The idea was put to rest until a later time, for if the project is ever continued. The same goes for the other topics, they might still be used in the future.

DESIGNING THE EXPERIENCES

With these educational topics picked out, it was time to design the experiences around them. This was done using sketches, prototypes, and mockups.

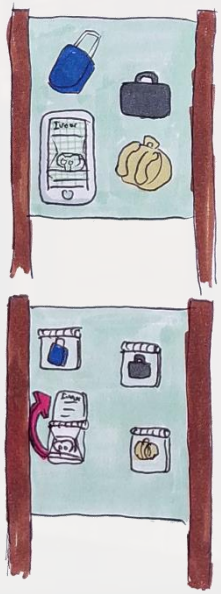


Sketches were used to get the initial ideas out of my head onto paper, to make them a bit more tangible and able to be discussed. One of the main topics of these discussions being "do these experiences have added value".

CREATING ADDED VALUE

You can technically make any topic into an AR experience, for example by putting an "AR ranger" into the physical world. This ranger can talk about any topic. But what is the added value of that over a sign with text, or a video?

This was my main criticism with implementations of AR and cell phones in zoos so far, so I wanted to add both interactions, as well as game elements, not possible with regular signs. These bits of interaction, that have people do something beyond just reading information (but now in AR!), were particularly important for me to create.



This is what led to the Bad Souvenirs game to have a moving conveyor belt.

Initially, the idea was just to have a sign with a bunch of suitcases on it. Looking at the sign in AR would reveal the bad souvenirs inside the suitcases.

While this idea certain had some level of added interaction through the use of AR, a similar effect could be created by using flip over panels, as in the example on the left.

Making the conveyor belt move gave the experience just that bit of extra interaction it needed to stand out. It created other advantages as well, like the ability to add new souvenirs to the experiences without needing to make a new sign with extra suitcases to accommodate the added souvenirs.

The rest of the experiences also evolved a lot before ending up where they are now. Many changes, big and small, were made to keep experience short and clear.

CREATING GOALS

The initial concept of waterbuck escape and rhino management did not have a clear end goal. While this isn't inherently bad, it can cause experiences to take longer than they should. This was improved by creating clearer goals.

Waterbuck escape had you chasing the waterbuck, with it getting further and further away whenever you failed to look at it, until you'd eventually lose sight of it completely. This was solved by adding the progress bar. Reaching the end of the progress bar completed the game. Failing to reach the end in time would get you caught by the lion, which is a much more logical and satisfactory scenario.

Rhino management was originally thought of as an event-based game, where events would occur in each of the enclosures that the player would have to respond to, but these events could go on indefinitely. The event based system also didn't give the players a lot of agency, which wouldn't be very engaging. Turning the game into the puzzle game it is now gives players a lot more freedom, lets them make mistakes to learn from. And of course, this change gave the experience the end goal of solving the puzzle.

CONVEYING THE MESSAGE

With the games primary goal being education, it was important that the educational message was clear. The educational messages of these experiences are mainly conveyed through text, both on the signs as well as on the phone. The idea was doing the interactive activity would make the information clearer, or at the very least more memorable.

The way the message is conveyed differs between the experiences. Protecting farmers actively engages people with the information on the sign, practically forcing them to read and learn.

Bad souvenirs takes inspiration from the plastic soup signs at Beekse Bergen, which also try to convey an action perspective to visitors, asking them not to litter their trash. This is done by constantly restating this fact "don't litter". Bad souvenirs does this as well by constantly emphasizing the fact that if people stop buying bad souvenirs, they will stop being sold eventually as well. Waterbuck escape also does this to an extent, constantly telling the player to pay attention to the circle.

Tiger camouflage conveys its message by letting people experience it. Rhino management teaches people about the need for bachelor groups by letting them figure out why they are needed for themselves.

It had to be assured no aspect of the experience muddled the message the experience was trying to convey. Which posed some challenge during the design of two experiences.

It was considered to add even more game elements to bad souvenirs, for instance, letting players check whether or not a souvenir is illegal, or if the owner is allowed to carry them. However, not only does this risk making the game overly complicated, it can also muddle the educational message. Th experience isn't just about illegal souvenirs, but any souvenir that is harmful to animals and nature. How would you handle these souvenirs that are technically not illegal? For this reason, the experience was kept the same it is now.

With protecting farmers, initially the idea was to give the experience more of a narrative, and to give the farmer a bit more dialogue. For instance, you would tell the farmer to build a fence, and he would later return needing more help. However, this might give the impression that building fences isn't effective, undermining the work organizations do.

I also wanted the farmer to respond to the offered solution, but some of the responses wouldn't feel genuine coming from the farmer, such as guard dogs not being a good solution against African wild dogs because of the risk of guard dogs transferring diseases, which is something the charity organizations are much more concerned with than the farmers are.

KEEPING THINGS SHORT

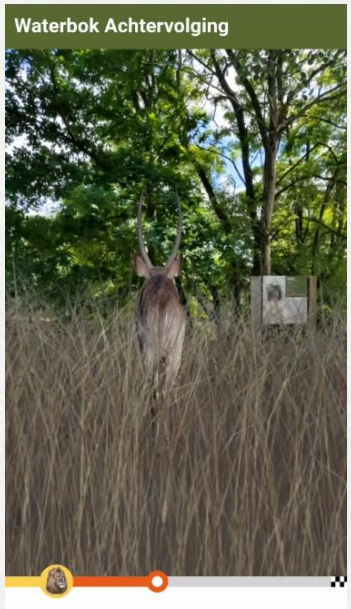
As mentioned in the design guidelines, I intended to keep the experiences between one and two minutes. This sometimes meant compromising aspects of the experiences if they took up too much time.

Adding more complicated game mechanics, like the aforementioned idea of having players perform checks on the bad souvenirs, might make the game a lot more difficult to understand. If a player has to take time learning how the experience works, this takes up valuable time. So this was another reason to keep game mechanics simple, and immediately understandable.

A major change that was made to keep things short, was with the waterbuck escape. Initially, this game has another round, in which the player followed the waterbuck a second time, only now without the circle on its back.

The idea was that doing this would let the player notice how much more difficult it is without the circle, even being able to tell through the difference in scores with or without circle.

However, this difference turned out to be negligible and this entire second half only made the experience unnecessarily long. Therefore it was removed from the final version.



STANDARDIZING THE EXPERIENCES

One way the experiences would eventually be united would be through the Beekse Bergen app, but I wanted to make sure that each experience followed a similar format so that visitors could get familiar with this format.

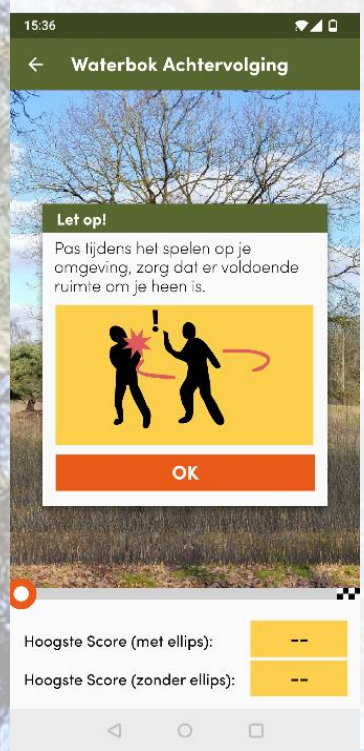
While designing and developing the experiences, if I implemented something in one experience, I would evaluate whether it would make sense adding it to other experiences as well.

This is what lead to every experience getting a starting screen for instance.

MAKING MOCKUPS

Once the designs started to come together, mockups were created of the designs to get a clear picture of what the final designs would be like. The idea was to get a full picture of the experiences, from start to finish.

This included the text that should be in each of the menus, where buttons would be, what the different icons would look like.



For instance, the warning message on the left was thought of, and designed during the mockup stage. This warning felt necessary due to the nature of the motion controls used in the game.

Thanks to these mockups, it was possible to discuss the details of each experience with the client without needing a fully functional prototype.

Another aspect of the design that was explored with the mockups was how objects would be selected in the game, such as the suitcases in bad souvenirs or answers in protecting farmers.

Since AR allows for you to move around an object physically, pointing at a specific part of it, I thought it felt natural to do these selections by pointing at them and pressing a select button.

This decision was especially influenced by bad souvenirs, where the game had a box that functioned as the Xray device (the Xray effect created by turning the image black and white and reverting it), which could double as a “selection box”, selecting whatever object was inside the box.

To keep a sense of consistency, I decided to use these selection boxes for the other experiences as well.

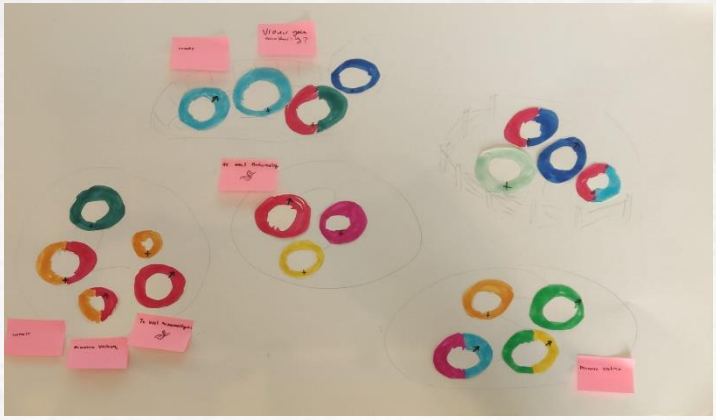
A full overview of all the developed mockups, annotated in Dutch for the client, can be found in appendix B.

Paper Mockup

The puzzle featured in rhino managed was also mocked up, but this time using paper. This was do see how solving the puzzle would be like. Was the puzzle solvable, fun to complete, what scenarios arose?

Using this paper mockup, it was decided how many of different genes (colors) there should be, and what problems the game should focus on. The initial concept focused on a lot more problems, such as animals not fitting into a certain group socially, or a gene being overrepresented in the gene pool.

These were left out because they were either not clearly communicated through the mechanics of the game (how is a player supposed to know an animal doesn't fit in a group beforehand?) or simply made the game more complicated than it needed to be.



INTEGRATION INTO THE BEEKSE BERGEN APP

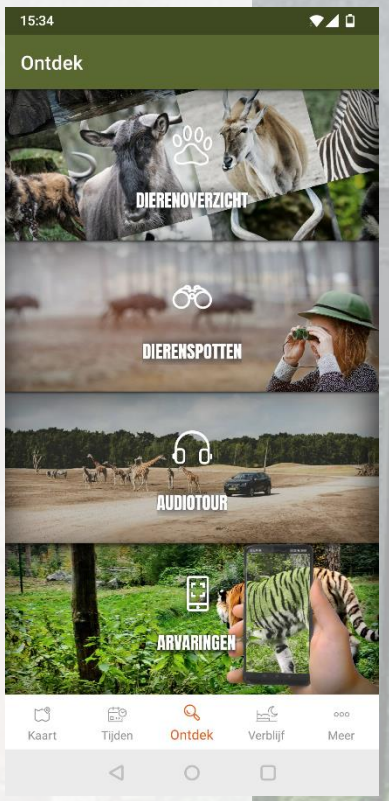
One major way in which these experiences would be united into one overarching experience, was through their integration into the Beekse Bergen app.

This was also explored using mockups, taking screenshots from the existing app, and seeing how the AR-experiences could be integrated.

As was the case with the mockups for the experiences, the integration into the app was also worked out in great depth.

The main features that were explored were:

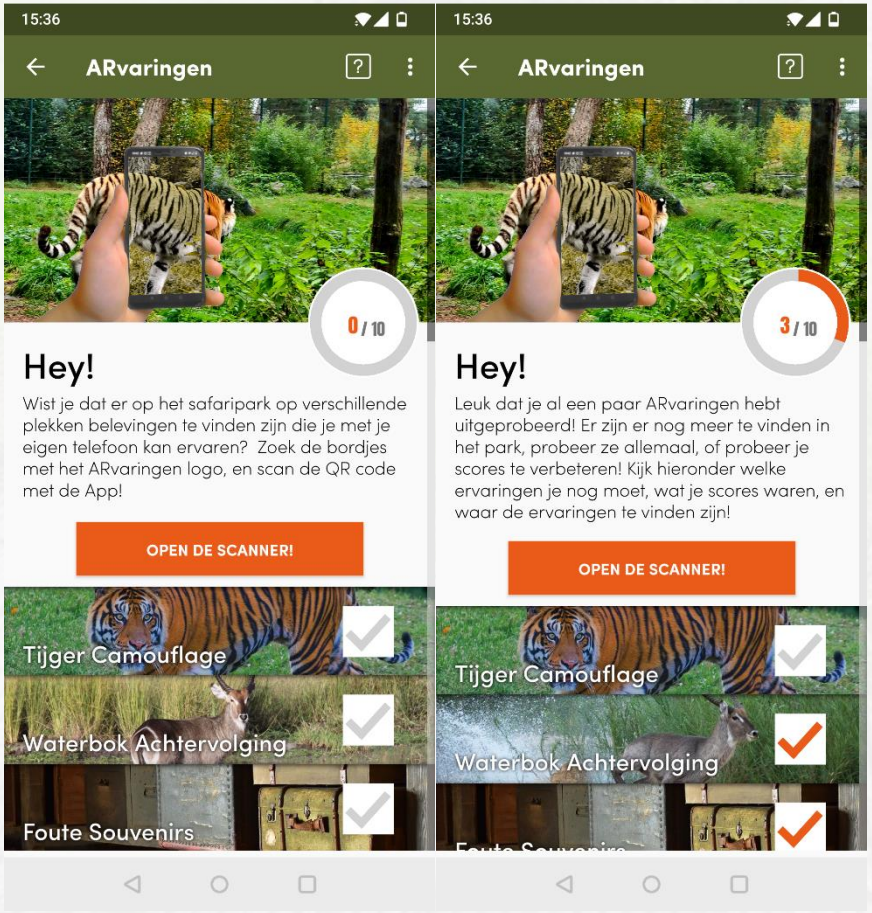
- Tracking user progress
- Encouraging users to try more experiences
- Reading information about the experiences



Tracking user progress

By tracking users' progress, the app gives users a clearly defined goal to work towards. Giving smaller goals, clearly defining each action users can undertake to get closer to reaching that goal will help motivate them to keep going [13]. This is why the main page of AR experiences is designed

to show the overall progress at the top, and each of the sub-goals (the different experiences) at the bottom. Each experience has its own criteria for being "completed". For tiger camouflage, it's simply trying out the experience, for bad souvenirs it's collecting all the souvenirs, for rhino management it's solving the puzzle.



(further) Encouraging users to try more

To further encourage users to try out more experiences, the main body of text at the top of this page also changes as you start to complete some experiences. At first, it introduces the concept of the experiences, telling people to find the signs in the park to try it out.

After completing a few experiences, this piece of text will thank them for trying out some experiences, encourage them to try them all, and inform them they can read back about what they learnt on this page.

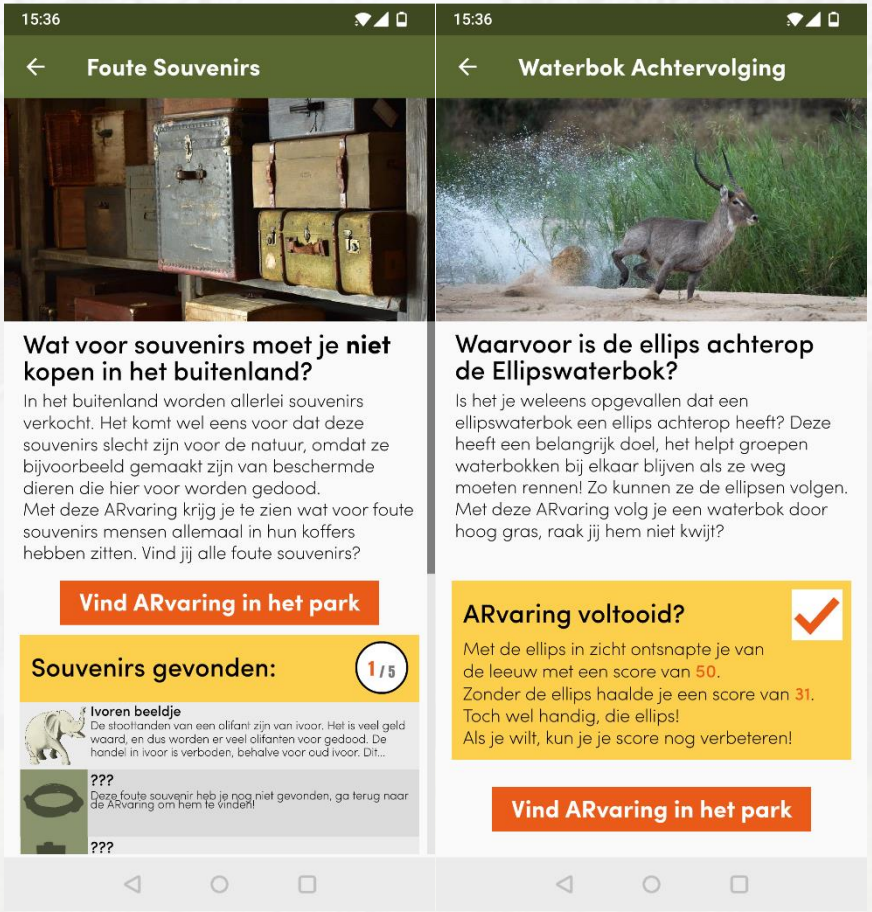
When all experiences are completed, it will encourage users to try experiences again, beat high-scores, let other people in their group try them, or reset their progress so they can start again if they want.

Reading information about the experiences

At the bottom of the main page is a list of all the experiences. Tapping on an experience here will open a page about that specific experience.

It tells you what the experience is about, you can open map to find out where you can try the experience, and it shows you your progress with this experience specifically.

For instance, the bad souvenirs page will show each of the souvenirs you have collected so far, and the waterbuck page will show your current high score.



Discussing possibilities with the App Team

To see whether the ideas were feasible, all mockups were shown to, and discussed with, a team of experts responsible for the Beekse Bergen app. It was also discussed if there were any ways for the prototypes to be made in the app, or at least be made in a way they'd be easier to add later on.

The team was very excited about the idea in general. They mentioned having a desire to add more interaction and education to the app for a while, as most of the app's features are very practical. A lot of features that will be added in the future will only be relevant for guests of the safari resort as well, so it would be nice to add something new for park guests to enjoy as well.

The only problem at this moment, is that the app is being transferred to another company, Jstack. Jstack is going to build the app from the ground up, in another language. This transfer is likely to take priority over any new additions for the foreseeable future.

To get further insight into what this meant for the prototypes, the plan was also discussed with an expert from Jstack. They said that making the prototypes using websites, as I was already considering at the time, would make it possible to display the websites in the app if so desired, so these are definitely the way to go.

MAKING THE PROTOTYPES

Each of the experiences was turned into a fully functional prototype website, making it possible for people to try them with their own phones.

Thanks to the mockups that were already developed, all that was left to do was to replicate those designs using HTML and CSS, and then use JavaScript to create all the mechanics and user interactions. I was able to reuse a lot of the assets I had already made for the mockups, such as icons and drawings.

THE TECHNOLOGY BEHIND THE EXPERIENCES

Tiger camouflage kept a lot of the same code it had in the M2.1 project, with a few upgrades. The colorblindness effect, which was originally achieved by manually transforming every pixel of the video feed, was now done using a CSS filter effect [26]. This greatly improved the performance. Sadly, these CSS filters aren't compatible with iOS devices, so those had to keep using the old method.

These differences between iOS and android were an issue for waterbuck escape as well. This was the first experience I programmed using 3D objects. To get 3D objects into my websites I used the JavaScript library three.js [58].

I also used the three.js "deviceorientationcontrols", which orients the virtual camera in 3D space to match the phone. This controls library is no longer officially supported due to its compatibility issues with some devices [59]. The main issue being that iOS blocks access to the phone's orientation sensor until access is granted after a user input. So the website can't request this access upon loading the website, you have to make a button which triggers whatever script asks for this permission. So in order to solve this issue on iPhones, I had to add an additional menu that features a button like this.

The rest of the experiences, which all used image-tracking AR, were made using MindAR, an opensource JavaScript library that supports both image- and face-tracking [41]. MindAR combines a three.js 3D scene with a video feed to project the 3D objects onto a given target.

PROGRAMMING THE GAME MECHANICS

The game mechanics of these experiences are quite simple. Every game has a couple of different game states: start, play, menu, and end, which are used to decide how the game should behave, and which elements should be shown. For instance, in any of the image-tracking experiences the game only requires you to look at point your phone at the sign during the "play" state, so that people can read the menus in a position that is comfortable to them. The conveyor belt of bad souvenirs also only moves during the "play" state, to not give the idea people need to hurry up reading information menus.

Waterbuck escape's main mechanic is the moving and tracking of the waterbuck.

To create the movement, the waterbuck is anchored at the center of the area, in the same position as the player camera. By rotating this anchor, it creates the effect of the waterbuck moving around the player. Every couple of seconds the waterbuck will pick a new direction and speed.

For the tracking, the game detects if the waterbuck is in the center of the screen, and if so, increases the player progress. The lion has its own progress, which if it exceeds the player's, causes the player to lose. If the player's progress exceeds the threshold to win, they win.

The rest of the mechanics are mostly based on touch events, which check if the "correct" item was touched.

In bad souvenirs, tapping a suitcase opens it. If it contained a souvenir, that souvenir's info menu is opened. If it was empty, a menu is opened communicating that.

In protecting farmers, circles are projected onto the answers on the sign to indicate they can be selected. Pressing a circle checks if it was the correct answer to the current problem being displayed. Every combination of question and answer leads to a different piece of text, explaining why the player's answer is incorrect or not. Instead of making a menu for each possible combination, there's a default menu whose contents are set by code upon selecting an answer.

In rhino management, every enclosure is being tracked in an enclosure object. This object tracks which rhinos are in the enclosure and uses this to see which the enclosure has. Whenever a rhino is removed from, or added to an enclosure, that enclosure recalculates its problems.

Rhino management was the last prototype to be developed. It was made in only a few days before being tested with users, so not a lot of iterations were made during prototyping.

CHANGES DURING PROTOTYPING

While developing the prototypes, most experiences stayed relatively close to their mockup counterparts, apart from a few minor design changes.

Over the course of programming a lot of changes were made tweaking aspects of the design that weren't a part of the mockup, pertaining to the feel, and interactivity of the games. Things like the speed of the waterbuck, or the conveyor belt.

The biggest change from the mockups that was made while prototyping, was the choice select objects using a point and click interface, letting users use the touchscreen to tap whatever object they wanted to select instead.

While designing the mockups, both options were considered, and the select was button chosen to be more user friendly. While trying out the prototypes for the first time however, it became apparent that it was much more natural to just tap objects.

At first the behavior was changed to allow both, but this also caused confusion. In protecting farmers, whatever answer you are about to select became highlighted as you pointed towards it. This highlighted answer confused players using the touchscreen to tap on the answers, so the select button was removed entirely, as were these feedforward elements.

USER TESTING

The developed prototypes were taken into the zoo to be tried with real users. The main goals of these user tests were to find out whether users found the experiences enjoyable, educational, clear to use, and whether they felt motivated to use them.

METHOD

To gather insights on the various experiences, this study uses quantitative measures in the form of a questionnaire.

THE QUESTIONNAIRE

The questionnaire consisted of 23 items, a statement the participant could indicate their agreement with on a 7 point Likert scale (-3 = totally disagree, 3 = totally agree).

The items in the questionnaire can be divided into three distinct categories; items to measure the feeling of intrinsic motivation, items to measure the clarity of the controls of the experience and items about the experience in general.

Measuring Intrinsic Motivation

To measure the feeling of intrinsic motivation participants felt towards the experiences, this study used the intrinsic motivation inventory [60].

The intrinsic motivation inventory was used to measure the feelings of interest/enjoyment, competence and choice perceived by participants during the user test by using their respective subscales. These feelings contribute to a feeling of intrinsic motivation, and can be used to determine if a participant felt intrinsically motivated during the experiences.

Using the full list of items in the subscales would make the questionnaire very long. Out of concern this would cause zoo visitors to be unwilling to participate, a shortened version of the intrinsic motivation inventory developed was used [18]. This limited the subscales to three items each.

These items were translated into Dutch with the help of an existing Dutch version of the intrinsic motivation inventory [28].

Measuring Ease of Control

To determine whether the controls of the experiences were clear, this study used the “ease of control” subscale of the player experience inventory [61].

While the player experience inventory also has subscales similar to those in the intrinsic motivation inventory, such as mastery (competence) and autonomy (choice), the language the player experience inventory uses is more focused towards games, while the intrinsic motivation inventory can be more generally applied.

Since not all of the experiences measured in this study are games (the tiger camouflage experience for instance), the intrinsic motivation inventory was chosen over the player experience inventory.

General Questions

The general items were added to evaluate aspects of the experiences not covered by either inventory, and to gather participant's impressions on aspects of the full concept not included in the final prototypes, such as the use of the Beekse Bergen app. These items are as follows:

- I would like to try experiences like this more often
- I would use these types of experiences more if they were featured in the Beekse Bergen App
- I worry about the data-usage of this experience
- I learnt something new during this experience
- I thought this experience was fitting for the zoo
- I thought this experience was too childish
- I would like to see an overview of each of the mobile experience in the park (for instance, in the App)
- I would like to view my own progress in this overview
- I would like to read back on what the experience was about in this overview

The last question got mistakenly left out due to a printing error, so no results were gathered on it. The full questionnaire can be found in appendix C.

PARTICIPANTS & PROCEDURE

The study took place over 5 days. Each day a different experience was put up somewhere in the zoo for people to try. The days chosen were either holidays (Ascension Day, and the day after) or weekend days, to assure a large turnout of visitors.

In total, 129 people participated in the user study. Protecting farmers and waterbuck escape both had 37 participants, bad souvenirs had 28, tiger camouflage had 23 and rhino management only had 4.

It's worth mentioning that rhino management had a couple of design flaws, as well as a few technical issues that came up during testing. As a result, participants needed a lot of help and additional explanation to understand the game. Once this became apparent, testing was ceased to not waste participants time on a nonfunctional prototype, hence the low number of participants for this experience.

All participants were adult zoo visitors visiting Beekse Bergen. Participants were approached at the zoo during their visit, and asked if they wanted to try a new kind of educational experience using mobile phones, and answers some questions about them, taking between 5 and 10 minutes on average.

Alternatively, in case a visitor used one of the prototypes without being asked, they were asked if they wanted to answer some questions about what they just did.

In some cases, a group of people would try out the prototype together. When this was the case, only the person who actually played the game on their phone was given the questionnaire, though they usually did fill it in together with the people who participated in the experience as well.

When multiple members of a group each played the game on their own phone, they were each given a questionnaire. The questionnaires were handed out after completed the experience, or whenever a participant no longer wished to continue playing, though this rarely occurred.

ANALYSIS

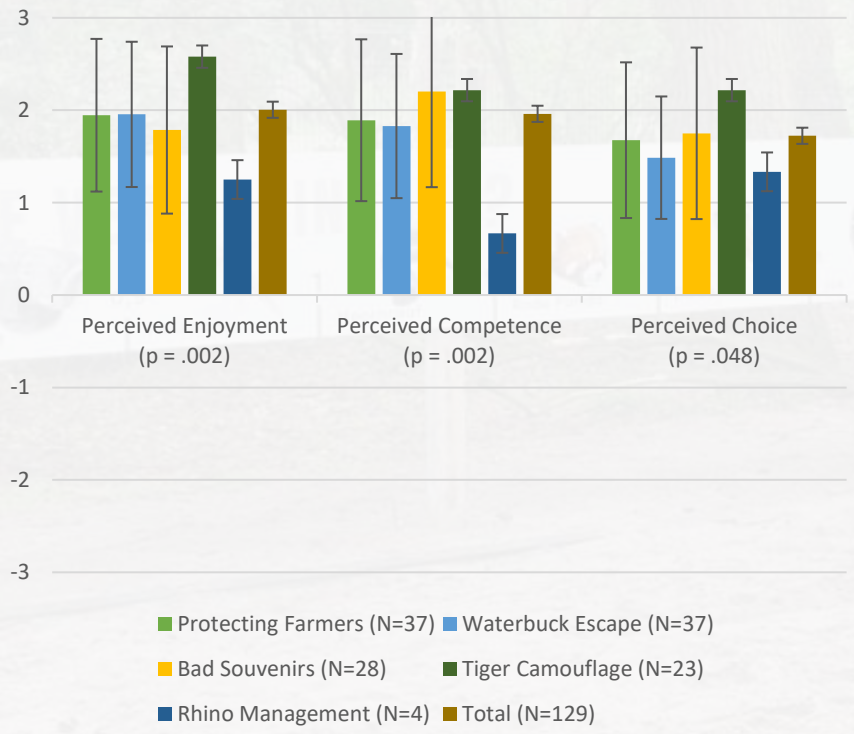
The collected data was copied into a digital format and analyzed using SPSS statistics. The items relating to the enjoyment, competence, autonomy, and ease of control subscales were averaged out to get a single score for these subscales. These scores, as well as the scores for the more general items, where compared using a one-way ANOVA, showing the differences between each of the experiences.

The scores were also tested for correlation using spearman's coefficient to find any relations between the variables.

RESULTS

ENJOYMENT & MOTIVATION

The one way ANOVA yielded significant differences for each of the items related to enjoyment or motivation. Tiger camouflage scored the highest overall, while rhino management scored the lowest. None of the experiences received a negative score on any of these scales.



Perceived Enjoyment (p = 0.002)						
	Protecting Farmers (N=37)	Waterbuck Escape (N=37)	Bad Souvenirs (N=28)	Tiger Camouflage (N=23)	Rhino Management (N=4)	Total (N=129)
Mean	1.946	1.955	1.786	2.580	1.250	2.005
Std. Deviation	0.826	0.875	0.842	0.379	1.198	0.840

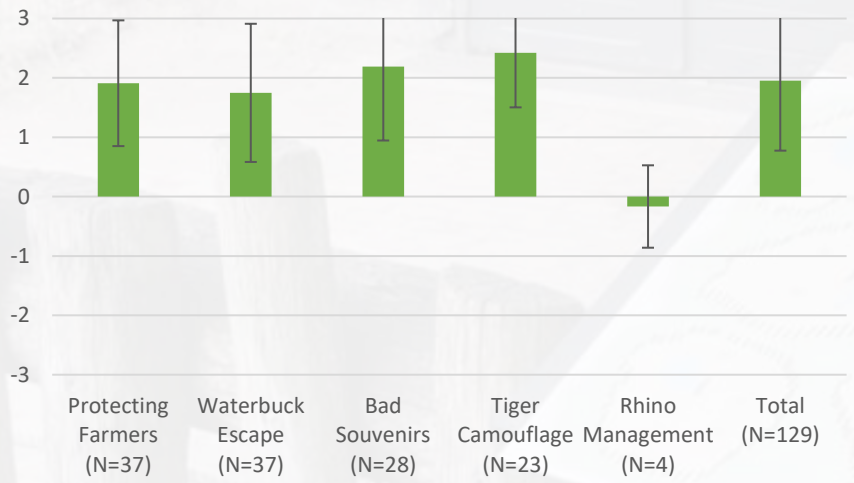
Perceived Competence (p = 0.002)						
	Protecting Farmers (N=37)	Waterbuck Escape (N=37)	Bad Souvenirs (N=28)	Tiger Camouflage (N=23)	Rhino Management (N=4)	Total (N=129)
Mean	1.892	1.829	2.202	2.217	0.667	1.961
Std. Deviation	0.786	0.780	0.663	0.640	1.587	0.806

Perceived Choice (p = 0.048)						
	Protecting Farmers (N=37)	Waterbuck Escape (N=37)	Bad Souvenirs (N=28)	Tiger Camouflage (N=23)	Rhino Management (N=4)	Total (N=129)
Mean	1.676	1.486	1.750	2.217	1.333	1.724
Std. Deviation	0.904	1.035	0.928	0.769	0.609	0.943

CLARITY OF CONTROLS

There was also a significant difference ($p < .001$) between the experiences when it came to the ease of control subscale. Once again, tiger camouflaged scored the highest and rhino management scored the lowest with the only negative score of this subscale.

Ease of Control ($p < 0.001$)						
	Protecting Farmers (N=37)	Waterbuck Escape (N=37)	Bad Souvenirs (N=28)	Tiger Camouflage (N=23)	Rhino Management (N=4)	Total (N=129)
Mean	1.910	1.748	2.190	2.420	-0.167	1.951
Std. Deviation	1.059	1.164	1.245	0.917	0.694	1.176



GENERAL ITEMS

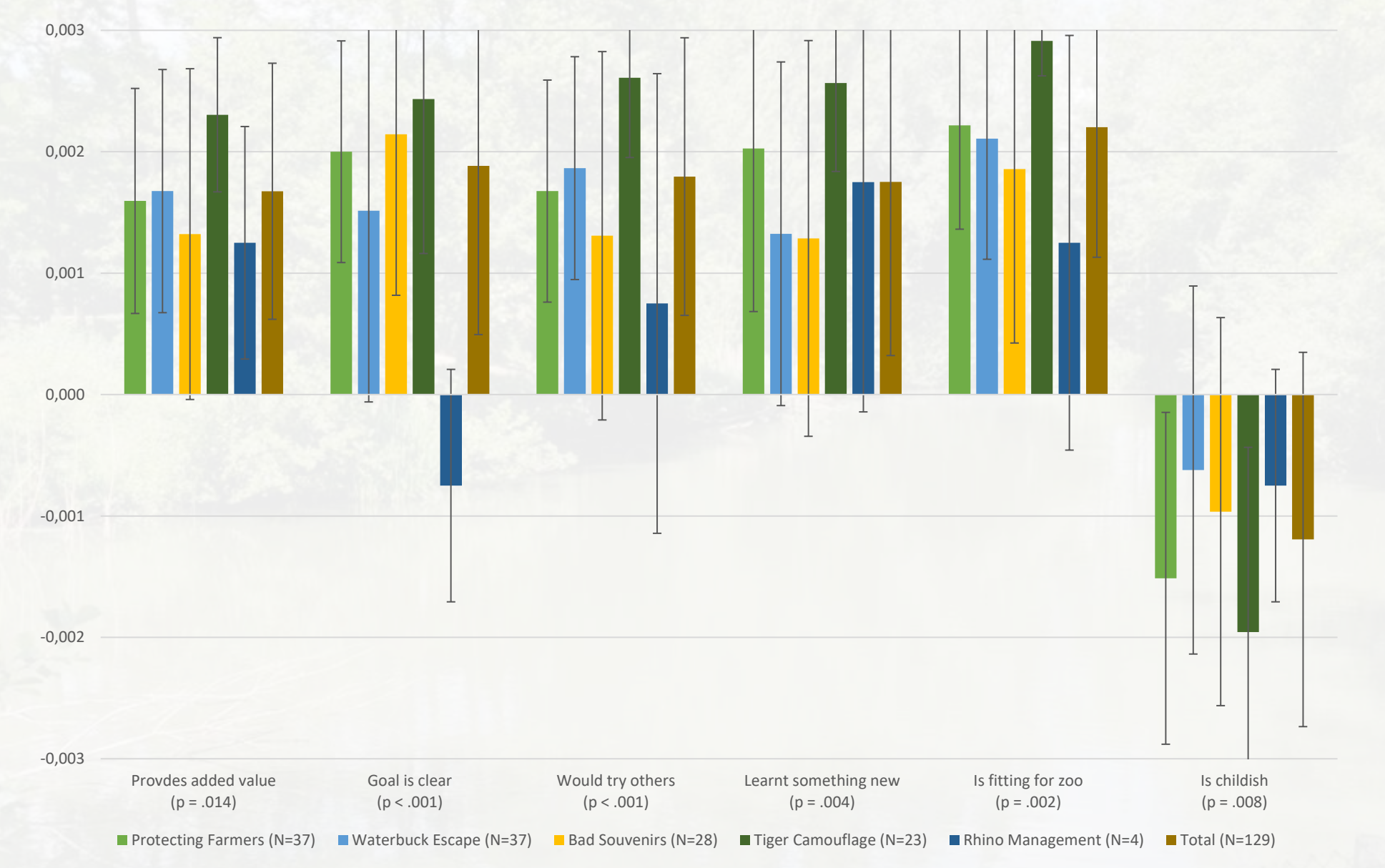
When it came to the rest of questionnaire items, there were no significant differences between experiences on whether:

- people preferred to use the app over websites ($p = .695$, $M = 1.49$, $SD = 1.69$)
- people were concerned about their data usage ($p = .209$, $M = -1.42$, $SD = 1.80$)
- people would like to try these experiences outside the zoo ($p = .454$, $M = 0.26$, $SD = 1.49$)
- people would like an overview of all experiences ($p = .962$, $M = 1.52$, $SD = 1.47$)
- people would like to see their progress in this overview ($p = .630$, $M = 0.65$, $SD = 1.62$)

The remaining items, seen on the next page, did yield significant differences between each of the experiences.

Again, tiger camouflage performed the higest overall (note that "is childish" should be interpreted in reverse, a low score is something good) while rhino management scored the lowest in most.

With the exception of the goal being clear in rhino management and the experiences being childish, all results are again positive.


0,003
0,002
0,001
0,000
-0,001
-0,002
-0,003
Provdes added value (p = .014)
Goal is clear (p < .001)
Would try others (p < .001)
Learnt something new (p = .004)
Is fitting for zoo (p = .002)
Is childish (p = .008)
Protecting Farmers (N=37)
Waterbuck Escape (N=37)
Bad Souvenirs (N=28)
Tiger Camouflage (N=23)
Rhino Management (N=4)
Total (N=129)

CORRELATIONS

A spearman correlation coefficient was computed to assess the relationships between each of the items.

On the next page, a table featuring the full correlation matrix can be seen. In this table, items that are not significantly correlated ($p > 0.05$) are marked with grey ■, positively correlated items are marked green ■, and negatively correlated items are marked red ■. The stronger the correlation, the stronger the color of red or green used.

In total, 82 statistically significant correlations arose, 73 of which were positive correlations, and 9 of which were negative correlations.

Among these correlations, the following stood out in particular:

Negative correlations

Of all the negatively correlated items, all but one of them were negatively correlated with the experiences being childish.

This correlation was the strongest with:

- Learnt something new ($r(127) = -0.49$, $p < .001$)
- Would use outside of zoo ($r(127) = -0.40$, $p < .001$)
- Would try others ($r(127) = -0.37$, $p < .001$)

Added value

"Provides added value" had strong positive correlations with the following items:

- Perceived enjoyment ($r(127) = 0.62$, $p < .001$)
- Would try others ($r(127) = 0.57$, $p < .001$)
- Learnt something new ($r(127) = 0.49$, $p < .001$)
- Is fitting for zoo ($r(127) = 0.58$, $p < .001$)

Education

"Learnt something new" was also positively correlated with:

- Perceived enjoyment ($r(127) = 0.51$, $p < .001$)
- Would try others ($r(127) = 0.45$, $p < .001$)
- Is fitting for zoo ($r(127) = 0.61$, $p < .001$)

App use

Preferring to do these experiences in the Beekse Bergen app is positively correlated with wanting an overview of the experiences (in the app) ($r(127) = -0.53$, $p < .001$).

Wanting this overview was positively correlated with wanting to see your progress in that overview ($r(127) = -0.54$, $p < .001$)

Fitting for zoo

The experiences being fitting for the zoo was positively correlated with:

- Learnt something new ($r(127) = 0.61$, $p < .001$)
- Provides added value ($r(127) = 0.58$, $p < .001$)
- Enjoyment ($r(127) = 0.56$, $p < .001$)

CORRELATIONS BETWEEN ITEMS		Perceived Enjoyment	Perceived Competence	Perceived Choice	Ease of Controls	Provides added value	Goal is clear	Would try others	Would prefer app	Concerned about data usage	Learnt something new	Is fitting for zoo	Would use outside zoo	Is childish	Would like overview	Would like overview of progress
Perceived Enjoyment	r(127) =		0.50	0.42	0.29	0.62	0.32	0.56	0.20	0.00	0.51	0.56	0.35	-0.33	0.24	0.11
	p =		.000	.000	.001	.000	.000	.000	.020	.987	.000	.000	.000	.000	.006	.212
Perceived Competence	r(127) =	0.50		0.46	0.54	0.39	0.47	0.48	0.11	0.01	0.21	0.37	0.28	-0.26	0.30	0.17
	p =	.000		.000	.000	.000	.000	.000	.229	.917	.017	.000	.001	.003	.001	.049
Perceived Choice	r(127) =	0.42	0.46		0.48	0.24	0.49	0.34	0.13	-0.02	0.25	0.23	0.31	-0.26	0.16	0.20
	p =	.000	.000		.000	.005	.000	.000	.135	.854	.005	.009	.000	.003	.068	.022
Ease of Controls	r(127) =	0.29	0.54	0.48		0.25	0.83	0.35	0.18	-0.15	0.18	0.34	0.25	-0.12	0.16	0.15
	p =	.001	.000	.000		.004	.000	.000	.046	.090	.047	.000	.004	.188	.076	.097
Provides added value	r(127) =	0.62	0.39	0.24	0.25		0.33	0.57	0.27	-0.02	0.49	0.58	0.33	-0.32	0.23	0.14
	p =	.000	.000	.005	.004		.000	.000	.002	.870	.000	.000	.000	.000	.009	.127
Goal is clear	r(127) =	0.32	0.47	0.49	0.83	0.33		0.30	0.24	-0.14	0.19	0.37	0.23	-0.16	0.15	0.12
	p =	.000	.000	.000	.000	.000		.001	.006	.124	.031	.000	.008	.070	.098	.196
Would try others	r(127) =	0.56	0.48	0.34	0.35	0.57	0.30		0.23	-0.08	0.45	0.55	0.37	-0.37	0.22	0.21
	p =	.000	.000	.000	.000	.000	.001		.009	.387	.000	.000	.000	.000	.012	.021
Would prefer app	r(127) =	0.20	0.11	0.13	0.18	0.27	0.24	0.23		-0.07	0.15	0.15	0.25	-0.12	0.53	0.38
	p =	.020	.229	.135	.046	.002	.006	.009		.423	.083	.098	.005	.171	.000	.000
Concerned about data usage	r(127) =	0.00	0.01	-0.02	-0.15	-0.02	-0.14	-0.08	-0.07		-0.21	-0.11	0.06	0.22	-0.17	0.04
	p =	.987	.917	.854	.090	.870	.124	.387	.423		.019	.219	.482	.011	.052	.694
Learnt something new	r(127) =	0.51	0.21	0.25	0.18	0.49	0.19	0.45	0.15	-0.21		0.61	0.28	-0.49	0.20	0.09
	p =	.000	.017	.005	.047	.000	.031	.000	.083	.019		.000	.001	.000	.021	.301
Is fitting for zoo	r(127) =	0.56	0.37	0.23	0.34	0.58	0.37	0.55	0.15	-0.11	0.61		0.24	-0.40	0.11	0.05
	p =	.000	.000	.009	.000	.000	.000	.000	.098	.219	.000		.006	.000	.234	.559
Would use outside zoo	r(127) =	0.35	0.28	0.31	0.25	0.33	0.23	0.37	0.25	0.06	0.28	0.24		-0.20	0.23	0.24
	p =	.000	.001	.000	.004	.000	.008	.000	.005	.482	.001	.006		.024	.010	.006
Is childish	r(127) =	-0.33	-0.26	-0.26	-0.12	-0.32	-0.16	-0.37	-0.12	0.22	-0.49	-0.40	-0.20		-0.07	0.06
	p =	.000	.003	.003	.188	.000	.070	.000	.171	.011	.000	.000	.024		.434	.475
Would like overview	r(127) =	0.24	0.30	0.16	0.16	0.23	0.15	0.22	0.53	-0.17	0.20	0.11	0.23	-0.07		0.54
	p =	.006	.001	.068	.076	.009	.098	.012	.000	.052	.021	.234	.010	.434		.000
Would like overview of progress	r(127) =	0.11	0.17	0.20	0.15	0.14	0.12	0.21	0.38	0.04	0.09	0.05	0.24	0.06	0.54	
	p =	.212	.049	.022	.097	.127	.196	.021	.000	.694	.301	.559	.006	.475	.000	

Discussion

Overall, the results of the user tests were overwhelmingly positive, and show that visitors are generally excited about these kinds of experiences. People found the experiences to be both enjoyable, as well as educational, and would like to try more of them.

All of the items on the questionnaire yielded positive averages apart from two, "I worry about the data usage of this experience", and "I thought this experience was too childish", which are both questions that you'd generally want low scores on.

The results do show some points for improvement, especially when it came to the ease of control for some of these experiences. When working with a wide target audience such as zoo visitors, you will be dealing with people who aren't as familiar, or comfortable with phone use, or game elements.

The correlation matrix shows that the ease of controls is strongly correlated with a variety of things, perceived competence, and choice most of all, but also enjoyment. So if controls aren't clear, it negatively impacts those areas. When the controls weren't clear, people also took a lot longer playing the game, making it take a lot more time then intended as well. It has to be made abundantly clear how the game works, to avoid these issues.

App use

The means indicated that people would prefer to use these experiences in an app. This was the same across all experiences. This was also the case with people wanting to see an overview of these experiences (in the app).

People's desire to see their own progress in this overview is positively correlated with wanting this overview, indicating that people who want the overview tend to also want to see their progress in it.

Added value

From the means it can be derived that in general, people found these experiences to an have added value. When people found an experience to be either enjoyable or to have taught them something, they were much more likely to find it to have an added value, as seen by the correlations. Interestingly, this also made them find the experience more fitting for zoos and make them more likely to try out others.

Enjoyment/motivation can be created by providing a sense of competence and choice. This is also supported by the correlations seen during this study. This can clearly be done in many different ways, as all the designs in this study scored positively in these areas.

The best ways these experiences achieved visitor learning, was by intertwining the reading of information, with the interactive aspect of the experience.

Tiger Camouflage
Tiger camouflage came out on top in almost all of the measures in the questionnaire. Clearly people still really liked this experience. It shines in its simplicity, the fun fact it provides, which is small and easy to remember, and the fact that it involves a real animal which you can now see through a whole new lens.

Where tiger camouflage did show some shortcomings was in communicating its goal. Though the results of the questionnaire do show a high score in this category, while performing the user tests, people often weren't sure what they were supposed to do exactly.

"Oh I just have to look at the tiger?"

I can see this become more of an issue when all experiences are deployed. Then, people might be used to having some kind of goal from the other experiences, and become extra confused at what to do with the tigers.

Protecting Farmers
Protecting farmers scored really well overall. All of the scores were really close to the total mean. Four main things stood out with this experience.

Firstly, this experienced triggered a lot of collaboration among group members, easily the most out of any of the experiences. Thanks to the answers to questions asked in the game being present on the physical sign, group members could participate without needing to see the phone screen, which allowed for some fun interaction.

Secondly, the quiz-like structure of this experience actively engaged people with the information on the sign. When people realized the information was there, they often started thoroughly read it, which was great to see. As hoped, people really enjoyed the information about the elephants and bees project, and this information was often shared among group members.

"Did you know elephants are afraid of bees?"

What works so well about the elephants and bees fact, is that it gets people interested with a fun animal fact, and then teaches something about conservation.

Thirdly, along with rhino management, which had very few participants, this was the only sign where not a single person scanned out of their own initiative. Interestingly, these were at the time of testing, the only signs that did not yet feature an image of what the experience looked like on phones. Essentially confirming that this image does a great deal in convincing people to scan the QR-code.

Lastly, it was interesting to see that both protecting farmers and waterbuck escape scored lower (albeit only slightly) on the competence scale. These experiences pose a slight

challenge, meant to give a feeling of competence for overcoming that challenge, yet experiences with no challenge at all come out higher.

Rhino management

Rhino management was a bit of a disaster during user testing, and the results reflect this. People had a lot of trouble understanding how the game worked. They didn't immediately understand they could open menus, tried drag and dropping rhinos instead of tapping them. Generally things were just very unclear.

This resulted in a very low score on "ease of control" (-0.167), as well as "goal is clear" (-0.750). Rhino management also scored low on many other items, which is likely in relation to the controls being unclear as a lot of these are correlated. This experience can definitely use an iteration or two more, to make it more intuitive, and perhaps a bit easier as well.

Waterbuck escape

While reading menus, people tend to be looking down. When waterbuck escape starts, you are supposed to be looking straight ahead, or you won't see the waterbuck running away. During testing, people were often still looking down from reading, and then be confused at what to do. This likely explains why waterbuck escape also scored below average on the "ease of control" subscale.

What was apparent here as well, was the wide range of skill levels in visitors. Some visitors finished the game on their first try, while others may need over five tries. The game's difficulty could be made adjustable, in a way that it becomes easier every time a player loses. This would give less skilled players a chance to complete it, without taking away the challenge it currently provides completely.

On the topic of player performance, people often wondered how well they actually performed when faced with their final score, when there was nothing to compare to. When multiple group members each played the game individually, they were heard talking about their scores, engaging in some friendly competition.

Bad souvenirs

Bad souvenirs performed really well on average. Its weaker point was that participants indicated not having learnt much new during the experience. During testing, a participant even mention that they already knew most of the information. Other participants were seen skimming the pieces of text, trying to move get back to the interactive element.

In hindsight, it is true that this experience requires people to engage with the information the least out of all the experiences. It is there to be read, but you don't need to understand it to progress.

SHORTCOMINGS OF THE STUDY

Lack of pilot study

Due to a lack of time, no pilot study was conducted. Not only did this cause a few errors to slip into the study, like a printing error with the questionnaire, along with a typing error, while performing the first study a bunch of interesting things were brought up I could no longer incorporate into the study.

I could have added questions about the duration of the experience, whether it had any replay value, their current attitude towards zoo education, or their opinion on cell phone usage. This could have led to some interesting insights.

Also, providing some room for participants to write down feedback, might have encouraged more to do so.

Some questions could have been phrased better, for instance the statement that was aiming to find whether people understood the goal of the game was worded as "I knew what I had to do", which can be interpreted many ways. A much better statement would have simply been "I understood the goal of the experience". In its current phrasing the statement sounds very similar to questions in the "ease of control" subscale, which is probably why the two are so strongly correlated ($r(127) = 0.83$, $p < .001$).

Accuracy of the results

The combined used of a shortened version of the IMI, and one translated into Dutch might also have an effect on the accuracy of the results. Many participants report to want to use more of these experiences in the future, but at the same time, only a handful of participants actually scanned the QR-codes out of their own initiative.

The results were self-reported, while I, the person who designed the experiences was present. This is likely to make people respond a bit more positively, to do me a favor. Having to fill in the questionnaire on paper helps mitigate this somewhat, but I think the way questions were framed (high scores were generally good in all but two items) might have caused acquiescence bias.

I think it's also quite likely my method of acquiring participants might have caused a selection bias and that these results are also not representative of every zoo visitor. There were plenty of people who turned down my request to try out the experience, sometimes showing disinterest in the concept, other times not wanting to participate in a study. It's safe to say participants were most likely to be people already more willing to engage with interactive education, so it's no complete surprise that they'd response positively to these concepts.

Future work

As it stands, I think this concept already has a good chance of becoming a fun inclusion of the already great lineup of education at safaripark Beekse Bergen.

The future of the developed concepts
While some changes to the intuitiveness of a few experiences, rhino management in particular, should still be implemented, the current prototypes should be able to be placed into the zoo as soon as the zoo wants.

Though many visitors indicated they are more likely to use these experiences as a part of the Beekse Bergen app, with the changes to the app that are on the horizon, it's not certain this will be feasible any time soon. The use of websites will be a suitable replacement in the meantime.

Once the experiences are added into the park, they can slowly start to be expanded. Not only by adding new experiences, but current experiences can also be expanded by adding new content or game modes, giving returning customers a reason to continue playing.

Bad souvenirs can receive additional souvenirs to be found, protecting farmers can receive more problems to solve, rhino management could receive new levels, with differently laid out puzzles, waterbuck escape can be given an "endless mode", where there is no finish line, and the game keeps getting more difficult until the lion catches you.

Something else that could be added is a leaderboard, where you can see how your score compares to other players. This would solve people not knowing what their score means, and create further incentive to play again.

If the games are only available at the zoo, adding new content might even incentivize people to come visit the zoo again.

What should probably be added first of all is an overview of the experiences, which can also be made outside of the app for the time being. Creating an overview of player's progress has a less high priority. The ability to save player progress on the other hand, is definitely important to add sooner than later, as losing progress might disincentivize people to keep playing.

Potential future research possibilities
The user study in performed during this project tested the experiences independently from each-other. It would be very interesting to have participants try each experience, and see what people think of the differences between them. Would this yield any different results? What would people say regarding the differences? I think there's a ton to be learnt from that in terms of unifying the experiences.

Once deployed into the zoo, the experiences themselves can also be used to gather a lot of statistical data as well. Analytical tools for evaluating websites can be implemented into the experiences' sites to track the amount of people using them, how long they spend on each experience, whether they were able to complete it, what their scores were, and much more. How does this compare to the current education?

Thanks to the experiences being location bound, tracking in which order users open experiences can even provide information into how these users move around the zoo.

Explore the need for AR

The main reasons it was chosen to use AR with these experiences were to keep users present in the real world while on their phone, and to keep experiences bound to a certain location. While I think these are still valid reasons to use AR, the user tests also showed some downsides to using AR, especially on websites. Do the pros outweigh the cons? That is worth exploring.

Many people weren't immediately comfortable allowing access to their device camera, some even have access blocked by default, which caused experiences not to work.

Image-tracking AR applications allow us to turn the education signs into a screen. However, one might argue; "why use the phone to make the sign a screen, when the phone has a screen?". Many of the image-tracking games can probably be made to be played without using AR. Would that make them better? Easier to understand?

Not using AR would make it easier to develop the game to be played outside the zoo as well. From the study results, we can determine that the demand for this isn't huge, but some people did show interest. I think people visiting either of Beekse Bergen's resorts might enjoy being able to play these games from their vacation home.

Going to other zoos

While these prototypes were designed for the Beekse Bergen, the concept could work in any other zoo. This would open up new possibilities for different topics, as Beekse Bergen is primarily focused on the continent of Africa. In other zoos, animals, and conservation issues from other parts of the world can be addressed with new designs.

Stepping out of the zoo context

Another interesting direction to take these concepts in the future, would be out of the zoo setting. Similar settings like museums could also be a great fit. Signs could be created about city landmarks, or nature reserves. Perhaps even theme parks, games like these might help make long queues more entertaining.

It will be interesting to see how these contexts change the requirements of the design.

Conclusion

In this project, I set out to create new, interactive, engaging kinds of educational activities for zoos using mobiles phones and augmented reality. The five developed concepts showed that this is not only possible, but actually shows great potential as a tool to not only provide education, but entertainment as well, matching the goals of both the zoo guest, as well as the zoo itself.

My hope is that I will be able to implement and expand the concept in the near future. Ultimately I want my contributions to zoo education to help transition the public perception of zoos as a means for entertainment and “seeing animals”, to one more focused on education as well.

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Appendices

APPENDIX A

All developed signs (scan QR codes for interactive experience)

APPENDIX B

The developed mockups

APPENDIX C

Questionnaire used in user tests

APPENDIX A – DEVELOPED SIGNS:

HOW DOES A TIGER CAMOUFLAGE ITSELF WITH SUCH A STRIKING COLOR?

For is it might not be that hard to spot a tiger, they have quite a noticeable colour after all.

Still, this can be quite challenging for some animals. Deer, such as the red deer and sika deer here at the safaripark, see the world a bit differently then we do, they are colourblind!

These animals can't see the colour red, and as a result have trouble differentiating between red and green.

For these deer, the tiger has the same colour as the grass, or the leaves around him.

Can you still see the tiger through the eyes of a deer?

Try it yourself by scanning the QR code!

SCAN FOR AN INTERACTIVE EXPERIENCE

WHAT PURPOSE DOES THE CIRCLE ON THE ELLIPS WATERBUCK SERVE?

When a group of waterbuck has to escape from a lion, or any other predator, it's important to stay together as a group.

This is what the circle helps with. When following each other, they only have to focus on the circle of the waterbuck in front of them. This circle stands out nicely between all the tall grass!

Can you escape from the claws of the lion as a waterbuck? Try it yourself by scanning the QR code!

SCAN FOR AN INTERACTIVE EXPERIENCE

BAD SOUVENIRS

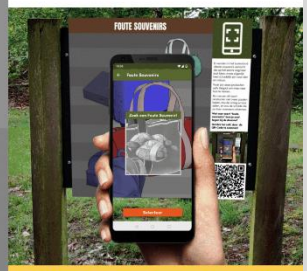
Er worden in het buitenland allerlei souvenirs verkocht die op het eerste oog heel leuk lijken, maar eigenlijk heel schadelijk zijn voor dier en natuur.

Vaak zijn deze producten zelfs illegaal om mee naar huis te nemen.

Als mensen dit soort producten niet meer zouden kopen, zou de vraag ernaar dalen, en zou de schade die ze doen eveneens afnemen.

Wat voor soort "foute souvenirs" kom je zoal tegen bij de douane?

Ontdek het zelf, door de QR-Code te scannen!



SCAN FOR AN INTERACTIVE EXPERIENCE

PROTECTING FARMERS

Living amongst wild animals in Afrika might seem like a dream, but in reality poses a real challenge, especially to farmers.

Wild animals damage their crops and attack their livestock. When farmers retaliate, they pose a threat to the animals as well as themselves.

This is why several organisations try their best to provide solutions to the conflicts between animals and humans, such as the ones seen in this sign.

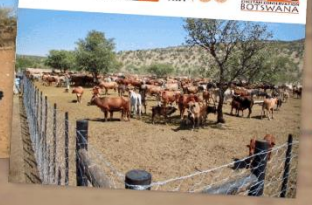
Can you find the right solutions to these farmers' problems? Try by scanning the QR-Code!

GUARD DOGS

Guard dogs can be deployed to protect livestock from predators. Especially smaller predators, like cheetah's, would rather stay away from guard dogs.
However, it is important that the guard dogs don't transmit diseases to local wildlife, such as African wild dogs.

FENCES & 'BOMAS'

Many farmers still let their livestock roam freely, making them easy targets for predators. This is why many organizations offer help building and repairing fences.
They also build special enclosures (bomas) for livestock to spend the night safely, when predators are most active.

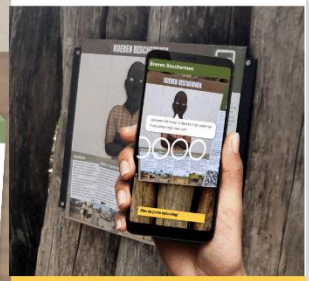


BEE-FENCES

Did you know that elephants are afraid of bees? When an elephant hears an angry bee, they'll flee and warn others to do the same.
The Elephants and Bees Project plants beehives around farms and communities to prevent them against free-roaming elephants.

FAKKEL LAMPEN

To protect livestock even better at night, specially designed lights can be mounted onto bomas. These inexpensive, blinking lights imitate humans holding torches, scaring off predators.



SCAN FOR AN INTERACTIVE EXPERIENCE

RHINO MANAGEMENT

Within Europe, roughly 330 zoos work together within the EAZA Ex-Situ Programme (EEP).

These zoos trade animals amongst each other to assure their offspring remains healthy.

Every species has its own coordinator, who decides which animals need to move where. That is quite the puzzle!

Safaripark Beekse Bergen manages the cheetah and white rhino programmes.

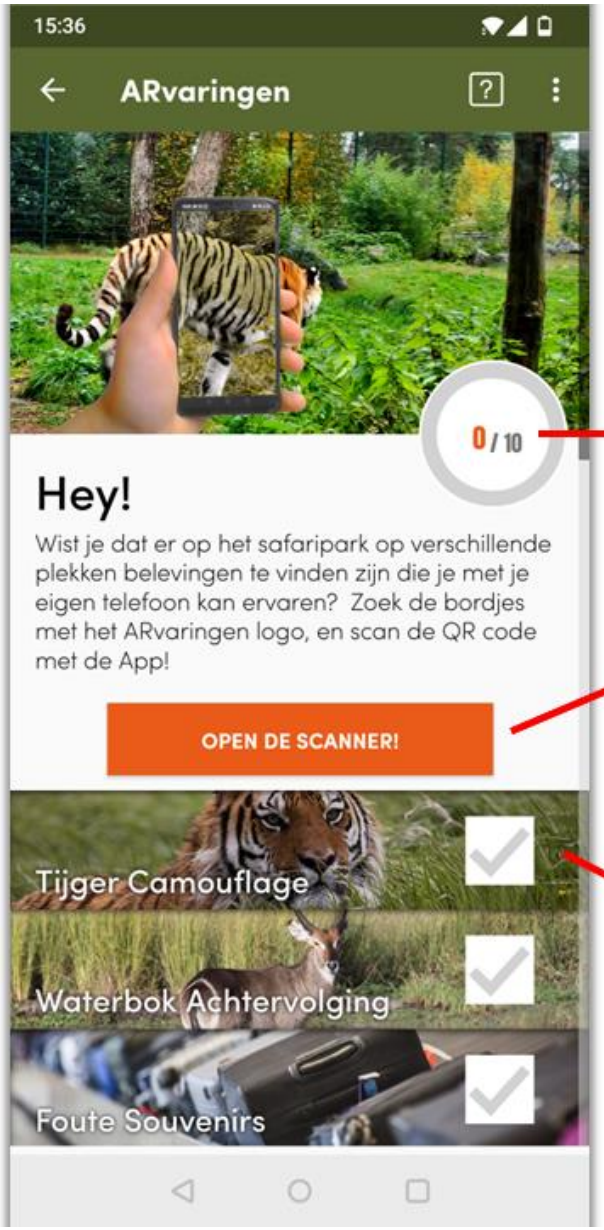
In the rhino enclosures on this sign, all sorts of things are wrong!

Can you solve all the problems? Try it out, by scanning the QR-Code!

SCAN FOR AN INTERACTIVE EXPERIENCE

APPENDIX B – ALL MOCKUPS:

"ARvaringen" worden toegevoegd aan het "ontdek" scherm in de app.



"ARvaringen" scherm heeft een soortgelijke indeling als het dierenspotten

Teller laat zien hoeveel "ARvaringen" er voltooid zijn

Open een QR code scanner om ervaringen mee te openen

+ Dit maakt het openen van iedere ervaring hetzelfde.
+ Het zorgt ervoor dat je bij het bord moet staan om de ARvaring te openen, en voorkomt daarmee dat mensen het op andere plekken doen (zoals midden op de wandelroute).
+ Mensen hoeven de juiste ervaring niet in een lange lijst op te zoeken.
+ Het kan ook werken met een normale QR code scanner, voor mensen die niet weten dat het in de app zit.
+ QR codes kunnen mensen die de app niet hebben naar de downloadpagina leiden.

Lijst met alle ervaringen

Hier kunnen mensen meer informatie zien over de ervaringen:

- Of ze de ARvaring voltooid hebben
- Waar de ARvaring te vinden is
- Waar het over gaat
- Wat hun score was (indien van toepassing)

De scanner is een gewone QR code scanner die de ARvaringen in de app opent.

Voorbeeld ARvaring

Tijger Camouflage

Tijger Camouflage

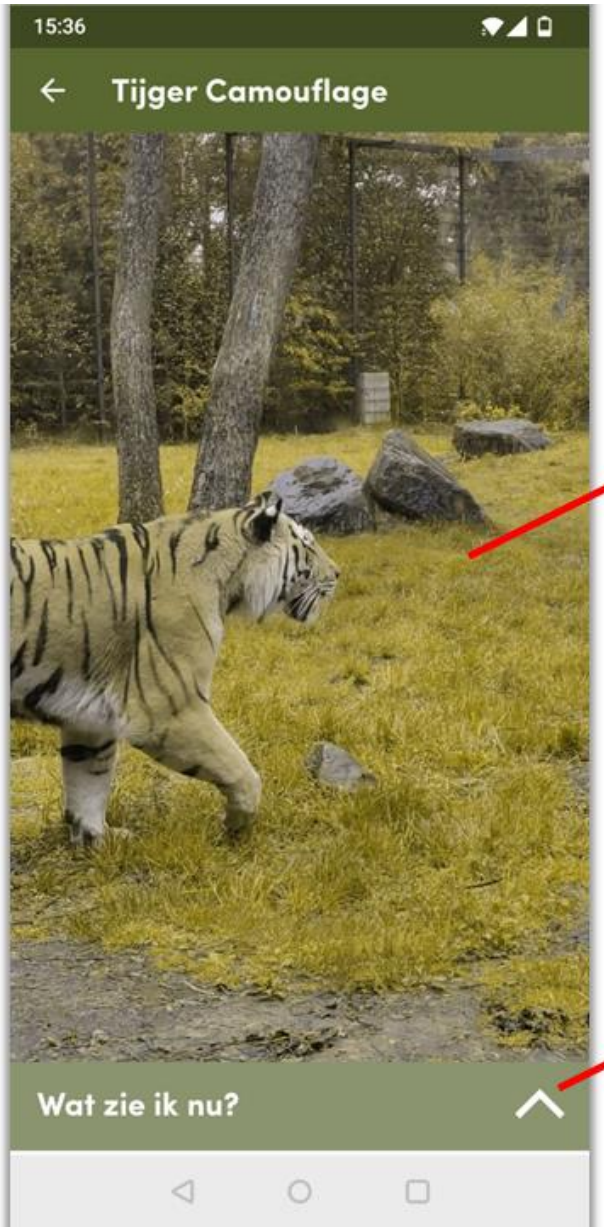
Startscherm

Korte uitleg waar de ARvaring over gaat.

Tijger Camouflage

Kleurenblind

Het beeld krijgt een kleurenblindheid filter, zodat je de tijgers ziet zals hun prooi ze zouden zien.



Tijger Camouflage

Zoom

Tijdens mijn vooronderzoek vorig jaar merkte ik dat mensen vaak probeerde in te zoomen op de tijgers, het kan dat ze dit voornamelijk deden omdat in dat prototype het beeld de pagina moest delen met de uitleg. Eveneens zou het een goede functie zijn.

Uitleg

Wanneer de gebruiker niet snapt waar ze nu precies naar kijken, kunnen ze hier een venster openen die ze dat vertelt.

Tijger Camouflage

Uitleg

Het uitleg venster kan ook weer gesloten worden om met het volledige scherm naar de tijger te kijken.

Borden en Herkenbaarheid

2 soorten borden

- zonder image-targets
- met image-targets

Dit is een voorbeeld van een bord voor een ervaring die geen image-tracking gebruikt.

Voor deze ervaringen wordt het bord enkel gebruikt om de ervaring te openen, de ervaring zelf gebruikt het bord niet. Hierdoor kan het bord klein gehouden worden (en eventueel aangebracht worden onder het normale educatiebord).

“ARvaringen” logo

Staat op ieder ARvaring bord, om ze herkenbaar te maken.

Tekst geeft een korte uitleg over het onderwerp.

Tijdens mijn onderzoek bij de tijgers vorig jaar, bleken meerdere mensen dit graag te willen, dan heeft het bordje ook een toegevoegde waarde voor mensen die hun telefoon niet willen gebruiken.
Afhankelijk van hoe lang de tekst is kan er ook een extra afbeelding bij gezet worden.

Afbeelding geeft weer wat de ARvaring inhoudt.

Om mensen een idee te geven wat ze er kunnen doen.

Dit wordt (mogelijk) de opmaak van een bord voor een ervaring die wel image-tracking gebruikt.

Bij deze ervaringen worden er in AR digitale elementen op het bord geprojecteerd waar de gebruiker iets mee moet doen. Het bord komt in die zin "tot leven".

Aan de rechterkant staat wat informatie over de ervaring, net als bij de andere borden.

Aan de linkerkant komt de AR-Marker te staan, dit is een afbeelding die die in de ervaring gebruikt wordt als "Image-Target" (herkenningspunt).

Deze borden zouden een iets andere vorm gegeven kunnen worden zodat ze nog beter te onderscheiden zijn van de andere educatieborden.

AMOERTIGER

BOEREN BESCHERMEN

BOEREN BESCHERMEN

Spreiding

TIJGERCAMOUFLAGE
BOEREN BESCHERMEN
NEUSHOORNBEHEER
HANDIGE HOORNS
WATERBOK ACHTERVOLGING
FOUTE SOUVENIRS

Voorbeeld ARvaring

Waterbok Achtervolging

Waterbok achtervolging

(kan nog een betere naam gebruiken)

Startscherm

Korte uitleg waar de ARvaring over gaat.

Voortgang

Zolang de waterbok blijft volgen kom je steeds dichterbij de finish.
Hoe verder je komt, hoe moelijker het wordt:

- De waterbok gaat sneller bewegen
- De waterbok wordt kleiner
- Er komt meer gras voor de waterbok

Waarschuwing

Voor het spel begint krijgt de speler eerst een waarschuwing dat ze goed op moeten letten, gezien ze bij de spel snel om hun eigen as moeten draaien.

Uiterlijk

Het huidige prototype/mockup gebruikt foto's van het internet voor de visuele aspecten. Dit kan nog verandert worden naar zelfgemaakte foto's, 3D modellen of getekende afbeeldingen.
De getekende afbeeldingen zouden gemaakt kunnen worden in dezelfde stijl als de informatieborden, wat de ARvaring een goede samenhang zou geven met de rest van de informatieborden.

Leeuw

Tijdens het spel verschijnt er een leeuw icoon die je "achtervolgt"

Score

Tijdens het spelen zie je je score oplopen.
Je score is gebaseerd op hoe goed je de waterbok blijft volgen
(een perfecte score zou dus zijn als je hem geen seconde uit het oog raakt)

Game-Over

Als je te lang de waterbok uit het oog verliest haalt de leeuw je in.
Als de leeuw je te pakken neemt kun je het opnieuw proberen.

Eindscherm

Als je het einde bereikt “ontsnap” je van de leeuw.
Je krijgt dan de mogelijkheid om het nogmaals te proberen, maar deze keer is de waterbok helemaal bruin.

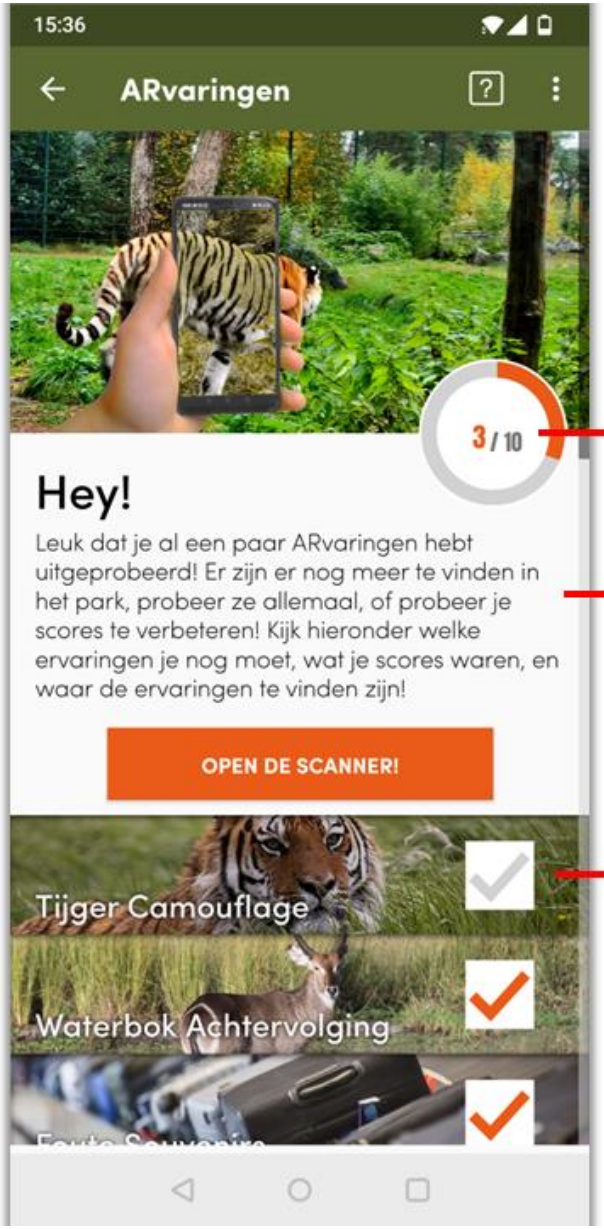
Eindscherm 2

Als je weer aan de leeuw ontsnapt, zonder hulp van de ellips, krijg je de mogelijkheid om een van de twee versies nogmaals te spelen om je score te verbeteren.

Score 2

De score zonder ellips wordt naast degene met ellips gezet, zodat je kan zien of het inderdaad moelijker was zonder.

ARvaring voltooid



Teller loopt op met het voltooien van ARvaringen
(net als bij dierenspotten)

Tekst past zich aan naarmate je een ARvaring hebt voltooid
Beloont dat je er gebruik van maakt, en nodigt uit meer te proberen, of scores te verbeteren.

Lijst met alle ervaringen
Je kan zien welke je al voltooid hebt.

Dit zie je als je een "ARvaring" selecteerd uit de lijst.

Dit scherm verschilt per ARvaring, in dit geval staat er niet veel omdat de ARvaring relatief simpel is. Op andere schermen staat meer informatie.

Tekst die uitlegt waar de ARvaring over gaat.

Kijk waar je de ARvaring in het park kan vinden

Is de ARvaring al voltooid?

Er zou op deze pagina een knop toegevoegd kunnen worden om de ARvaring te openen, zonder scanner, aangezien deze ervaring op meerdere plekken leuk kan zijn en mensen niet snel in de weg zou zitten.

Als mensen een specifieke ARvaring zoeken kunnen ze dat doen op de kaart.
Net als hoe dat nu kan moet de dieren.

ARvaring Icoon

Korte omschrijving

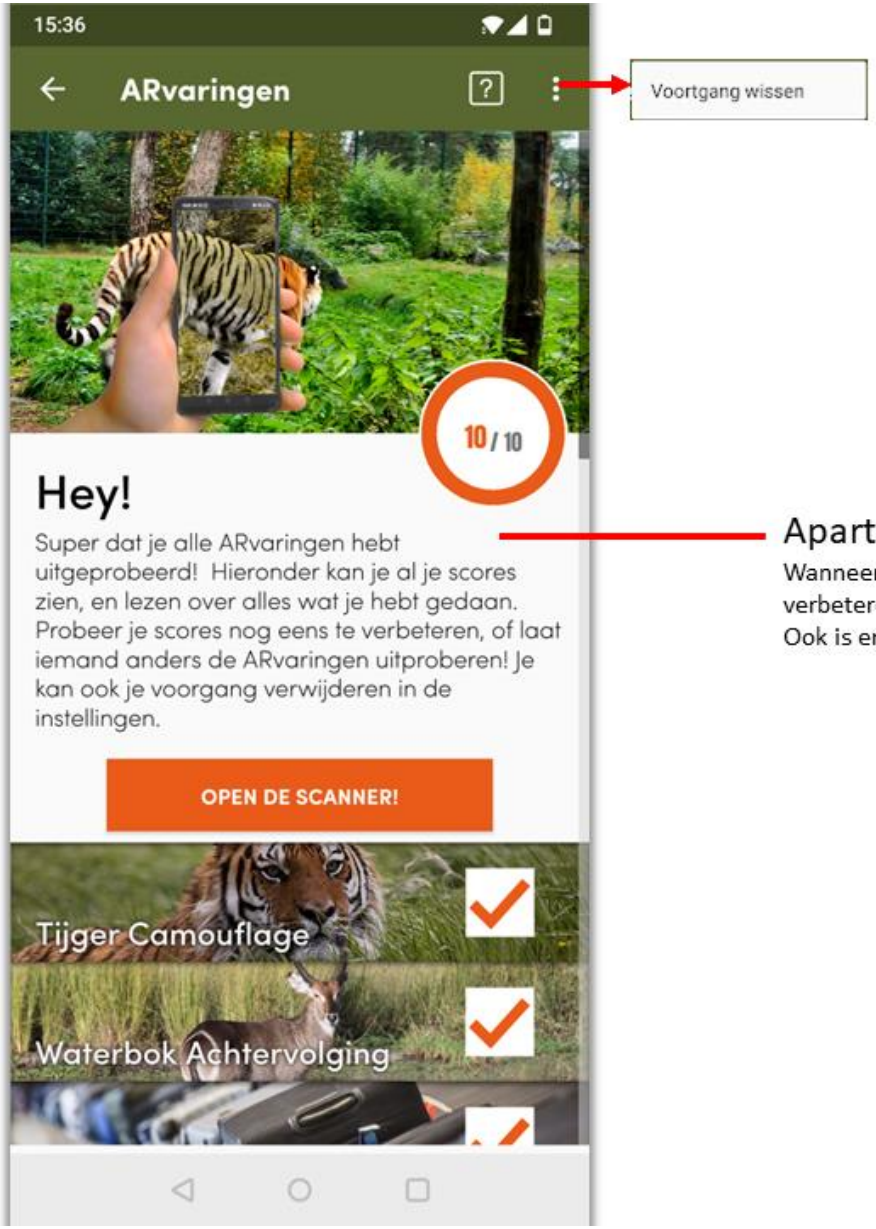
Dit is een andere "ARvaring" uit de lijst.

Deze ARvaring heeft een score, die ook onder wordt weergegeven wanneer de ARvaring voltooid is.

Score wordt hier weergegeven.
Hier passen verschillende verhaaltjes bij, afhankelijk van de score.

Verzameling

In deze ARvaring komt de gebruiker verschillende voorwerpen tegen, die kunnen ze hier op de pagina van de ARvaring terugvinden.
De ARvaring telt als voltooit wanneer alle voorwerpen gevonden zijn.



Aparte tekst - alles voltooid

Wanneer alle ARvaringen voltooid zijn wordt de gebruiker aangemoedigd zijn scores te verbeteren, of andere personen de ARvaringen uit te laten proberen.
Ook is er, net als bij het dierenspotten, de mogelijkheid om de voortgang te wissen.

Voorbeeld ARvaring

Foute Souvenirs

Bord

Deze ARvaring maakt gebruik van Image Tracking, de afbeelding aan de linkenkant van het bord wordt door de ARvaring herkent en als speeldveld gebruikt.
Deze afbeelding mag niet te repetitief zijn. Hiervoor zijn de koffers en tassen er op gezet, deze geven de afbeelding unieke herkenningspunten voor het programma.

In dit geval zijn de afbeeldingen getekend. Er kan gebruikt worden van dezelfde tekenstijl als de huidige borden, of van foto's.

Boodschap

De belangrijkste boodschap van de ervaring staat al op het bord.
"Koop deze souvenirs niet"
Welke souvenirs dat zijn kom je in de ervaring achter.

Afbeelding

Deze Afbeelding kan nog vervangen worden voor een afbeelding die weergeeft hoe het spel in werking gaat.

Bord (gezien in AR)

Wanneer het bord op de telefoon (in AR) word gezien, wordt de afbeelding overschreden door het spel.

Lopende Band

De lopende band zal van boven naar onder bewegen, en alle koffers met zich mee brengen.

Bagage

De bagage verschijnt aan de bovenkant van het speelveld, en verdwijnt weer aan de onderkant. Er komen steeds nieuwe tassen en koffers voorbij.

Bord (gezien door telefoon)

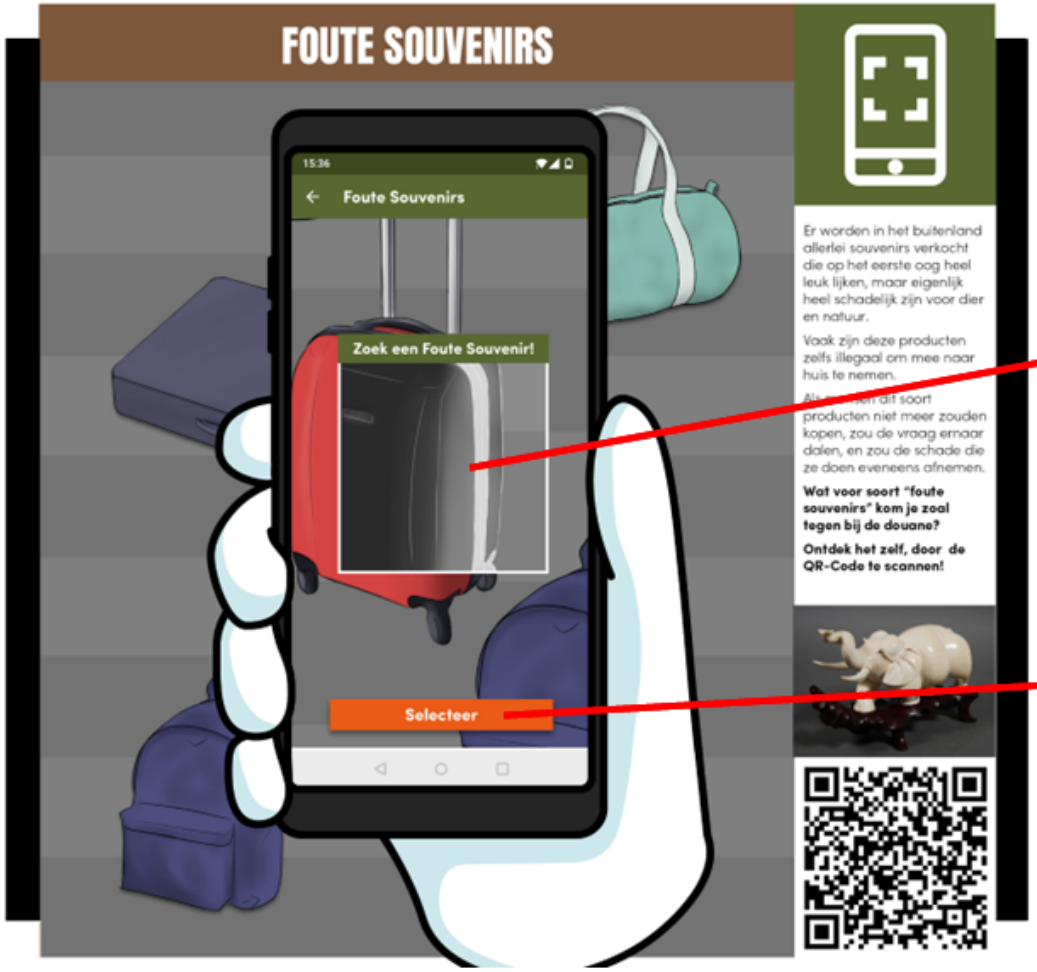
Het AR beeld is alleen te zien door een telefoon.

Startscherm

Zoals bij iedere ARvaring, krijgt de speler een startscherm voordat het spel begint.
Hier wordt kort uitgelegd wat ze zo te zien krijgen en wat ze moeten doen.

Spelscherm

Zodra het spel gestart wordt krijgt de speler een Xray gebied te zien op hun scherm. Binnen dit kader kunnen ze in tassen kijken om op zoek te gaan naar foute souvenirs.



Xray gebied

Selecteer Knop

Met deze knop kunnen spelers een koffer of tas selecteren om hem te openen.
Dit opent de tas die op dat moment in het Xray gebied zit, en laat zien of er inderdaad een foute souvenir in zat.

Koffer Selecteren

Wanneer een speler een koffer of tas selecteert springt deze open om te laten zien wat er in zat, in dit geval zat er niks in.

Koffer opent

Niks gevonden

Wanneer een speler geen souvenir vind, krijgen ze dit scherm te zien.

Bericht

"let goed op of je in andere tassen iets verdachts ziet"
Geeft de speler de hint dat ze op iets verdachts moeten letten.

Voortgang

Wanneer de speler een koffer of tas opent, krijgen ze steeds te zien hoe veel souvenirs ze nog moeten vinden.

Souvenir in Xray (armbandje)

Wanneer de speler een koffer tegenkomt met een foute souvenir er in ziet dat er zo uit.

Xray gebied

De foute souvenir is licht van kleur binnen het Xray gebied.
Buiten het Xray gebied zie je niks.

Souvenir Gevonden (armbandje)

Wanneer de speler een koffer of tas selecteert met een souvenir er in krijgen ze de souvenir te zien, en een korte uitleg over wat voor schade de souvenir aanbrengt.

Souvenir

Een plaatje van de gevonden souvenir

Boodschap

De boodschap is bij iedere souvenir hetzelfde:
"als mensen stoppen deze souvenirs te kopen, gebeuren deze slechte dingen niet meer"

FOUTE SOUVENIRS
Foute Souvenirs
Zoek een Foute Souvenir!
Selecteer
Er worden in het buitenland allerlei souvenirs verkocht die op het eerste oog heel leuk lijken, maar eigenlijk heel schadelijk zijn voor dier en natuur.
Vaak zijn deze producten zelfs illegaal om mee naar huis te nemen.
Als mensen dit soort producten niet meer zouden kopen, zou de vraag ernaar dalen, en zou de schade die ze doen eveneens afnemen.
Wat voor soort "foute souvenirs" kom je zoal tegen bij de douane?
Ontdek het zelf, door de QR-Code te scannen!

FOUTE SOUVENIRS
Foute Souvenirs
Ivoren Beeldje
De stoottanden van een olifant zijn van ivoor. Het is veel geld waard, en dus worden er veel olifanten voor gedood. De handel in ivoor is verboden, behalve voor oud ivoor. Dit maakt het naleven van deze regels moeilijk.
Vooral in Azië worden er nog veel beeldjes, sieraden en eetstokjes van ivoor verkocht.
Als mensen stoppen met het kopen van deze souvenirs, zullen er minder olifanten gestroopt worden.
Souvenirs gevonden:
2/5
Ga Verder
Er worden in het buitenland allerlei souvenirs verkocht die op het eerste oog heel leuk lijken, maar eigenlijk heel schadelijk zijn voor dier en natuur.
Vaak zijn deze producten zelfs illegaal om mee naar huis te nemen.
Als mensen dit soort producten niet meer zouden kopen, zou de vraag ernaar dalen, en zou de schade die ze doen eveneens afnemen.
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FOUTE SOUVENIRS
Foute Souvenirs
Zoek een Foute Souvenir!
Selecteer
Er worden in het buitenland allerlei souvenirs verkocht die op het eerste oog heel leuk lijken, maar eigenlijk heel schadelijk zijn voor dier en natuur.
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Wat voor soort "foute souvenirs" kom je zoal tegen bij de douane?
Ontdek het zelf, door de QR-Code te scannen!

FOUTE SOUVENIRS
Foute Souvenirs
Exotische Veren
Exotische vogels kunnen prachtige kleuren hebben. Hun veren worden hierdoor veel gebruikt voor sierraden, pennen, maskers of hoofdtooien. Vaak zijn de vogels waar deze veren van afkomstig zijn beschermd, en worden ze voor hun mooie veren gedood. Koop dus niets met deze veren om de vogels te beschermen.
Souvenirs gevonden:
2/5
Ga Verder
Er worden in het buitenland allerlei souvenirs verkocht die op het eerste oog heel leuk lijken, maar eigenlijk heel schadelijk zijn voor dier en natuur.
Vaak zijn deze producten zelfs illegaal om mee naar huis te nemen.
Als mensen dit soort producten niet meer zouden kopen, zou de vraag ernaar dalen, en zou de schade die ze doen eveneens afnemen.
Wat voor soort "foute souvenirs" kom je zoal tegen bij de douane?
Ontdek het zelf, door de QR-Code te scannen!

FOUTE SOUVENIRS
Foute Souvenirs
Zoek een Foute Souvenir!
Selecteer
Er worden in het buitenland allerlei souvenirs verkocht die op het eerste oog heel leuk lijken, maar eigenlijk heel schadelijk zijn voor dier en natuur.
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FOUTE SOUVENIRS
Foute Souvenirs
Traditionele Medicijnen
In veel culturen denkt men dat dierlijke onderdelen speciale krachten hebben. De botten van tijgers zouden brandwonden of reuma genezen. De snorharen tandpijn verhelpen. Dus worden ze verwerkt in allerlei 'medicijnen'. In China leven meer dan 6000 tijgers op boerderijen, waar ze gefokt worden voor dit soort medicijnen. Als mensen deze medicijnen blijven kopen komen er alleen maar meer van deze tijgerboerderijen.
Souvenirs gevonden:
6/8
Ga Verder
Er worden in het buitenland allerlei souvenirs verkocht die op het eerste oog heel leuk lijken, maar eigenlijk heel schadelijk zijn voor dier en natuur.
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Wat voor soort "foute souvenirs" kom je zoal tegen bij de douane?
Ontdek het zelf, door de QR-Code te scannen!

FOUTE SOUVENIRS
15:36
Foute Souvenirs
Zoek een Foute Souvenir!
Selecteer
Er worden in het buitenland allerlei souvenirs verkocht die op het eerste oog heel leuk lijken, maar eigenlijk heel schadelijk zijn voor dier en natuur.
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FOUTE SOUVENIRS
15:36
Foute Souvenirs
Reptielen
Er is veel vraag naar exotische huisdieren. Mensen willen de vreemdste reptielen in huis halen. Vaak worden deze dieren uit het wild geplukt en meegesmokkeld. Ze worden ingepakt, in tassen geprop en als bagage meegenomen. Deze dieren belanden dan in dierenwinkels of online webshops. Als mensen stoppen met het houden van deze dieren als huisdieren, stopt dit ook de illegale handel er in.
Souvenirs gevonden:
5/5
Ga Verder
Er worden in het buitenland allerlei souvenirs verkocht die op het eerste oog heel leuk lijken, maar eigenlijk heel schadelijk zijn voor dier en natuur.
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Wat voor soort "foute souvenirs" kom je zoal tegen bij de douane?
Ontdek het zelf, door de QR-Code te scannen!

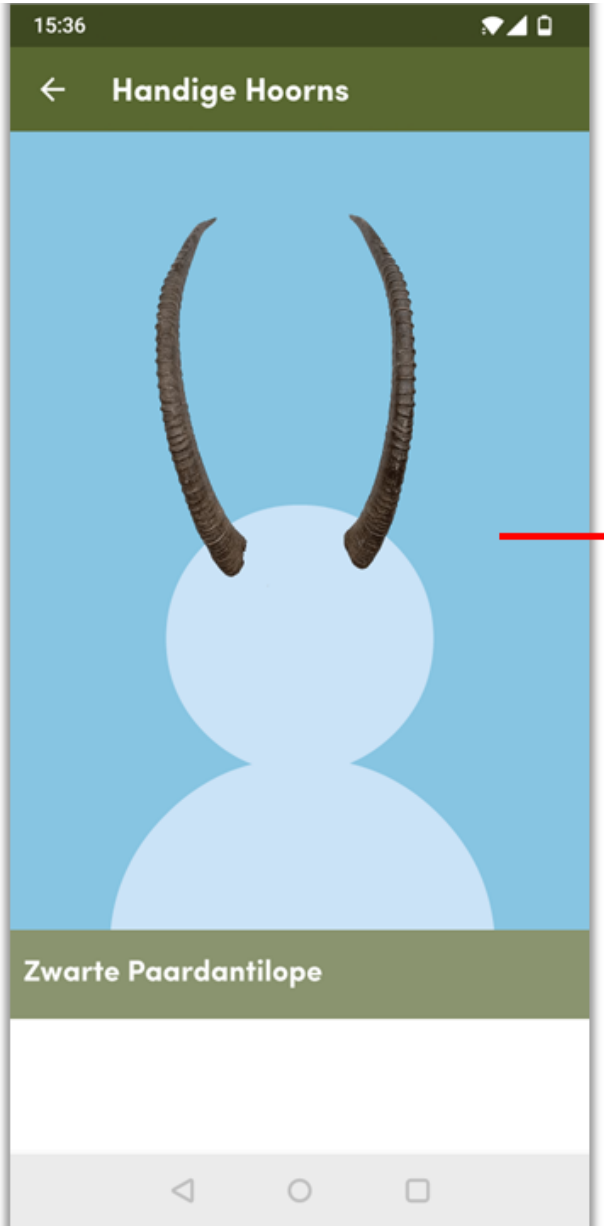
Alles gevonden

Wanneer de speler alle souvenirs gevonden heeft krijgen ze de mogelijkheid om verder te gaan met het scannen van bagage, en worden ze erop gewezen dat ze kunnen lezen over wat ze geleerd hebben op de ARvaringen pagina.

Boodschap

Nog een keer de boodschap

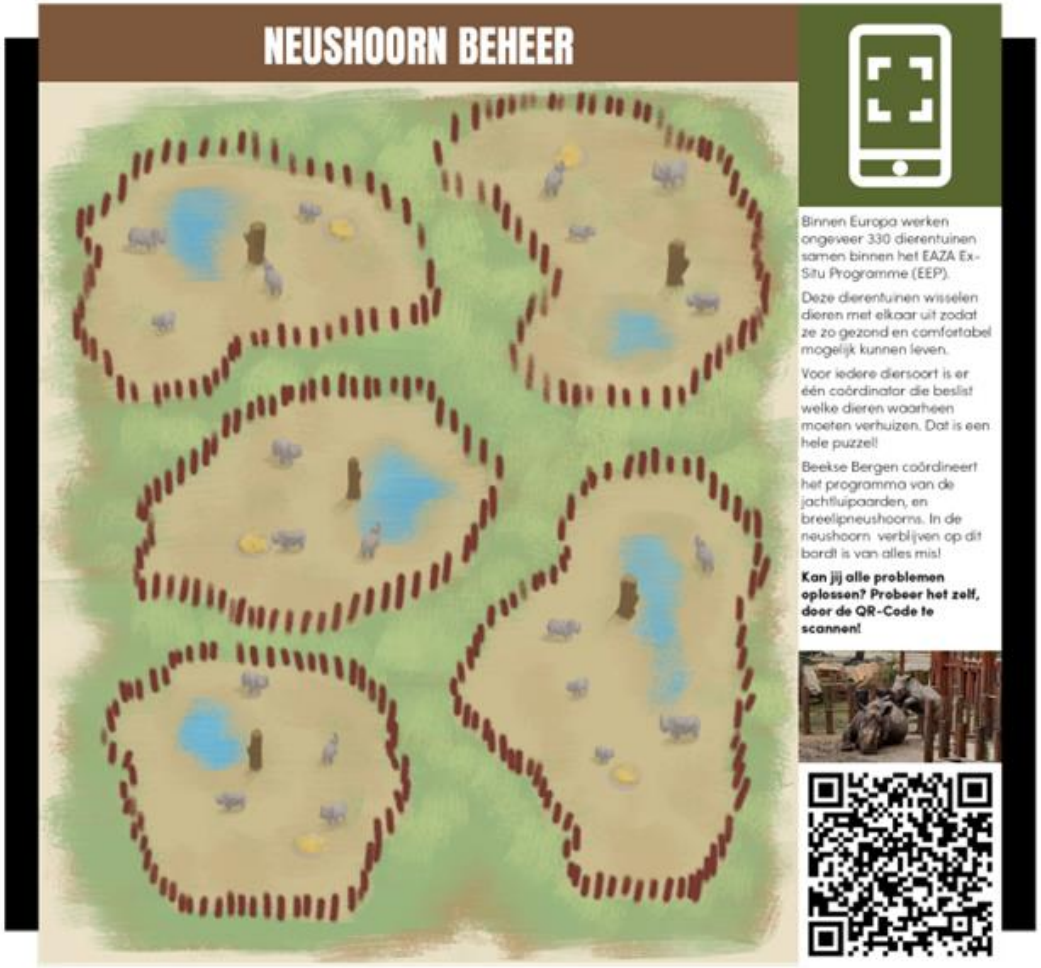
Andere ARvaringen



Handige Hoorns

Deze ARvaring gaat over de verschillende functies van hoorns. De hoorns zullen met behulp van face tracking op het gezicht van de gebruiker worden geplaatst.

Gezicht met hoorns



Neushoorn Beheer

In deze ARvaring neemt de speler de rol van coordinator in het fokprogramma van breedlipneushoorns. Er is van alles mis met de neushoorn verblijven op het bord, en dat moet de speler oplossen. Dit doen ze door de verblijven op het bord te selecteren en neushoorns tussen te verblijven te verplaatsen.

Boeren Beschermen

In deze ARvaring wordt de speler benadert door een aantal Afrikaanse boeren. Deze hebben allemaal een probleem met wilde dieren (akkers aangetast, vee aangevallen). De speler moet de juiste oplossing voor hun probleem aanwijzen op het bord.

Geen gezicht

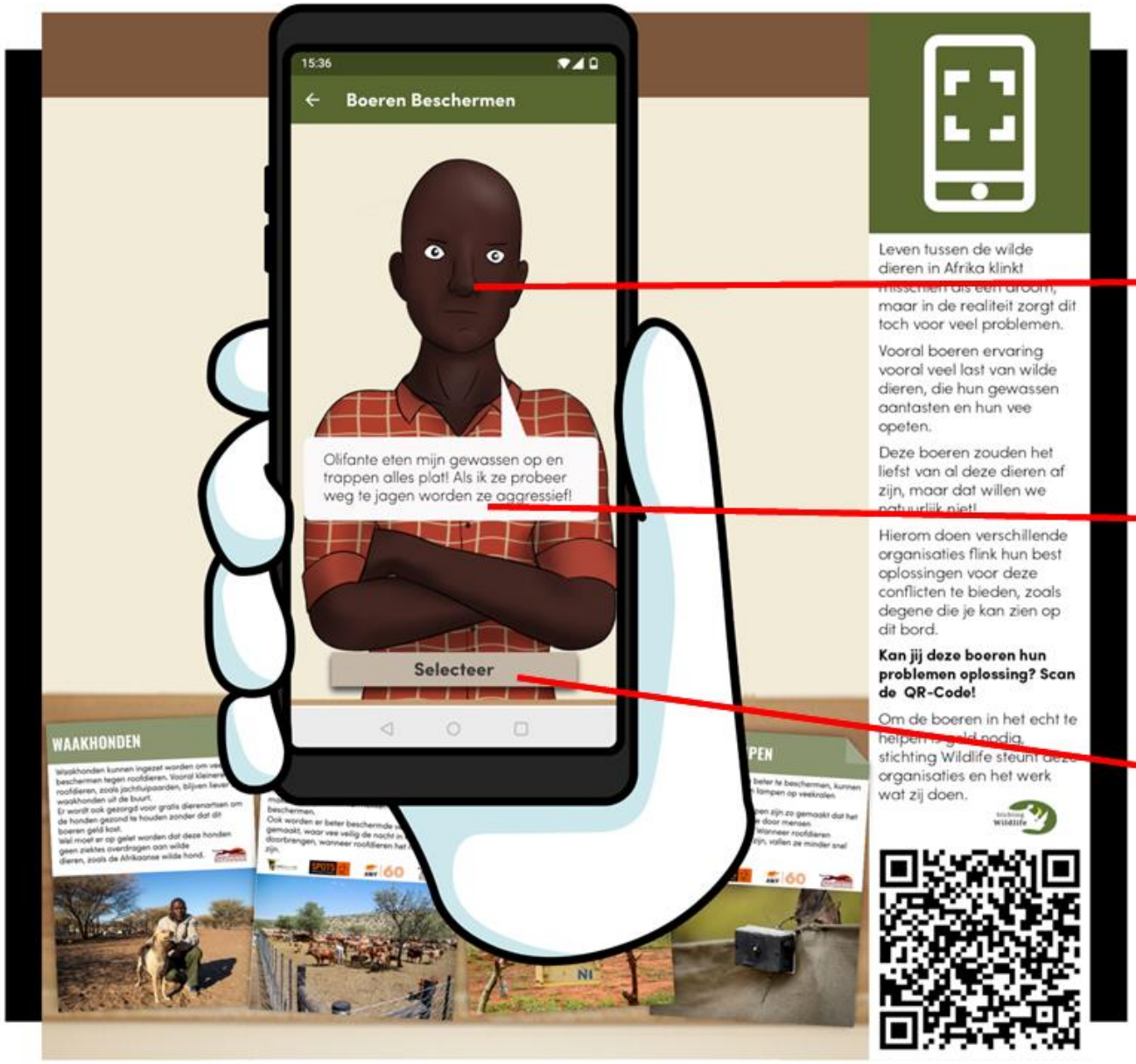
Op het bord heeft de boer nog geen gezicht, deze krijgt hij in AR
Er komen verschillende boeren met verschillende problemen

Antwoorden

De oplossingen voor de probleme (antwoorden voor de quiz) staan op het bord. Dit maakt het makkelijker om te lezen.

Startscherm

Net als de andere ARvaringen heeft dit spel een Startscherm met wat informatie.



Boer

In AR krijgt de boer een uiterlijk. Iedere boer zou een ander gezicht en kleur shirt krijgen om de indruk te geven dat het verschillende mensen zijn.

Probleem

Het probleem van de boer staat in een spraakwolkje. Dit spraakwolkje beweegt mee als de speler zijn telefoon verplaatst, zodat het altijd naar de mond van de boer wijst.

Selecteerknop

De selecteerknop is nu donker, omdat er geen antwoord wordt aangewezen.

Selectiekader

Het selectiekader verschijnt wanneer de gebruiker de telefoon richting de antwoorden wijst.

Selectieknop

De selectieknop is nu actief, omdat een antwoord word aangewezen

Fout antwoord

Niet ieder antwoord is correct. Ieder probleem heeft een oplossing, het is aan de speler om de juiste te vinden.

BOEREN BESCHERMEN
15:36
Boeren Beschermen
Olifante eten mijn gewassen op en trappen alles plat! Als ik ze probeer weg te jagen worden ze aggressief!
Hoe lossen we dit probleem op?
WAAKHONDEN
BIJEN-HEKKEN
Selecteer
Leven tussen de wilde dieren in Afrika klinkt misschien als een droom, maar in de realiteit zorgt dit toch voor veel problemen.
Vooral boeren ervaring vooral veel last van wilde dieren, die hun gewassen aantasten en hun vee opeten.
Deze boeren zouden het liefst van al deze dieren af zijn, maar dat willen we natuurlijk niet!
Hierom doen verschillende organisaties flink hun best oplossingen voor deze conflicten te bieden, zoals degene die je kan zien op dit bord.
Kan jij deze boeren hun problemen oplossing? Scan de QR-Code!
Om de boeren in het echt te helpen is geld nodig, stichting Wildlife steunt deze organisaties en het werk wat zij doen.

BOEREN BESCHERMEN
15:36
Boeren Beschermen
Goed gedaan!
De bijen in bijenhekken houden olifanten weg, bestuiven gewassen en leveren boeren geld op door de verkoop van honing! Allemaal voordelen, voor een goedkope oplossing!
Boeren geholpen:
1 / 4
Ga Verder
WAAKHONDEN
HEKKEN
Leven tussen de wilde dieren in Afrika klinkt misschien als een droom, maar in de realiteit zorgt dit toch voor veel problemen.
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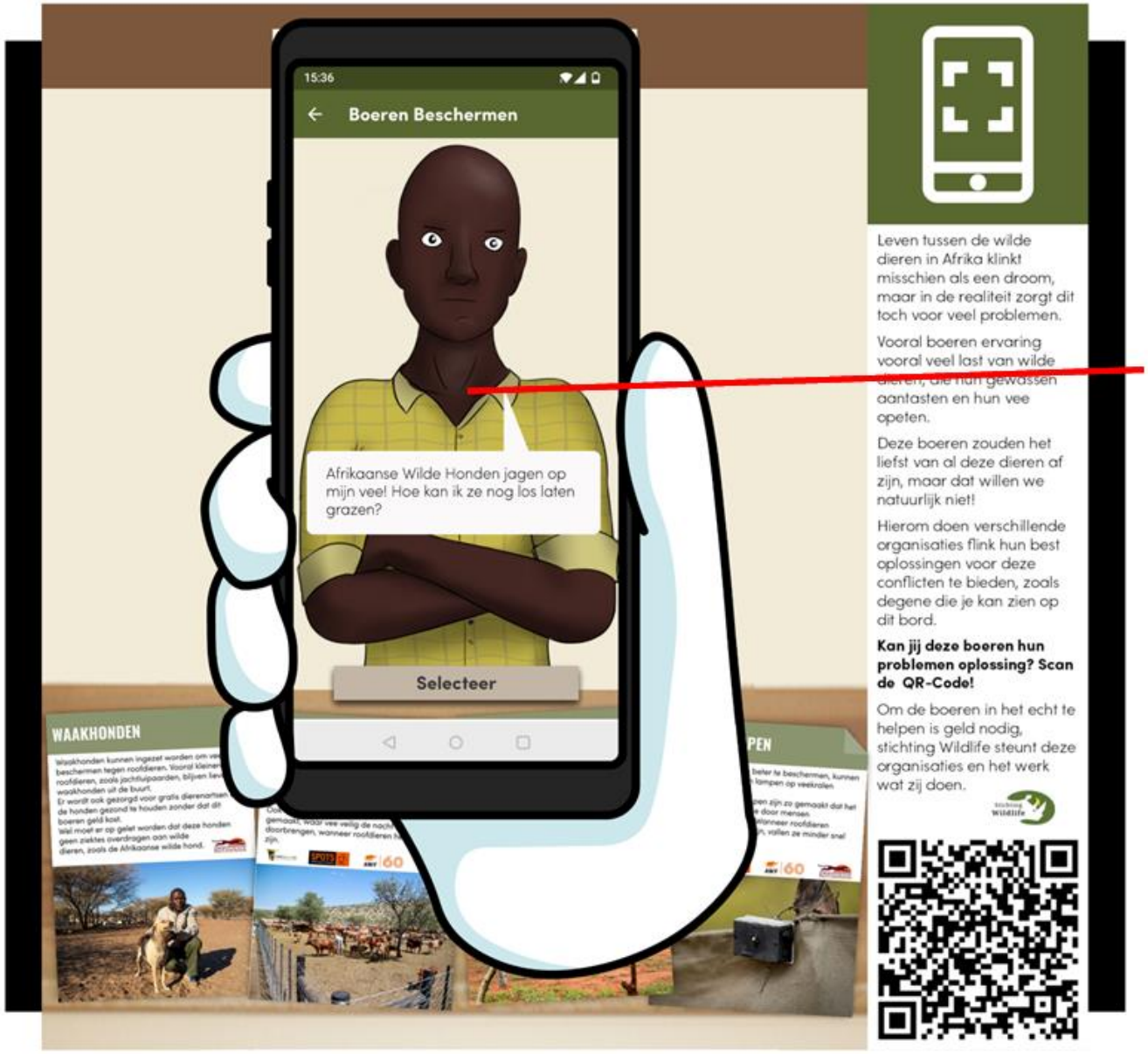
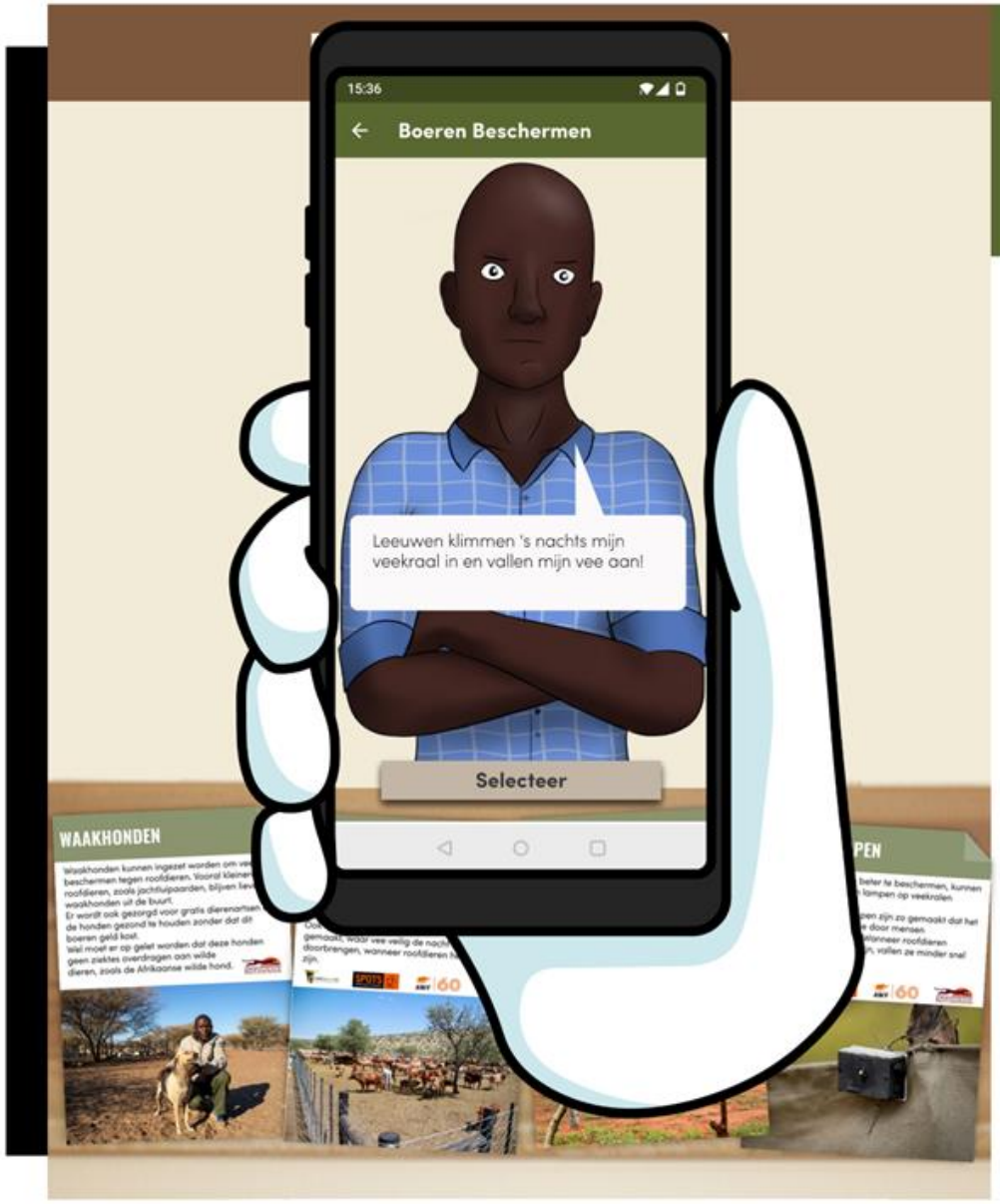


Kleur

Zoals eerder gemeld, ieder probleem komt met een nieuwe boer in een nieuw jasje.



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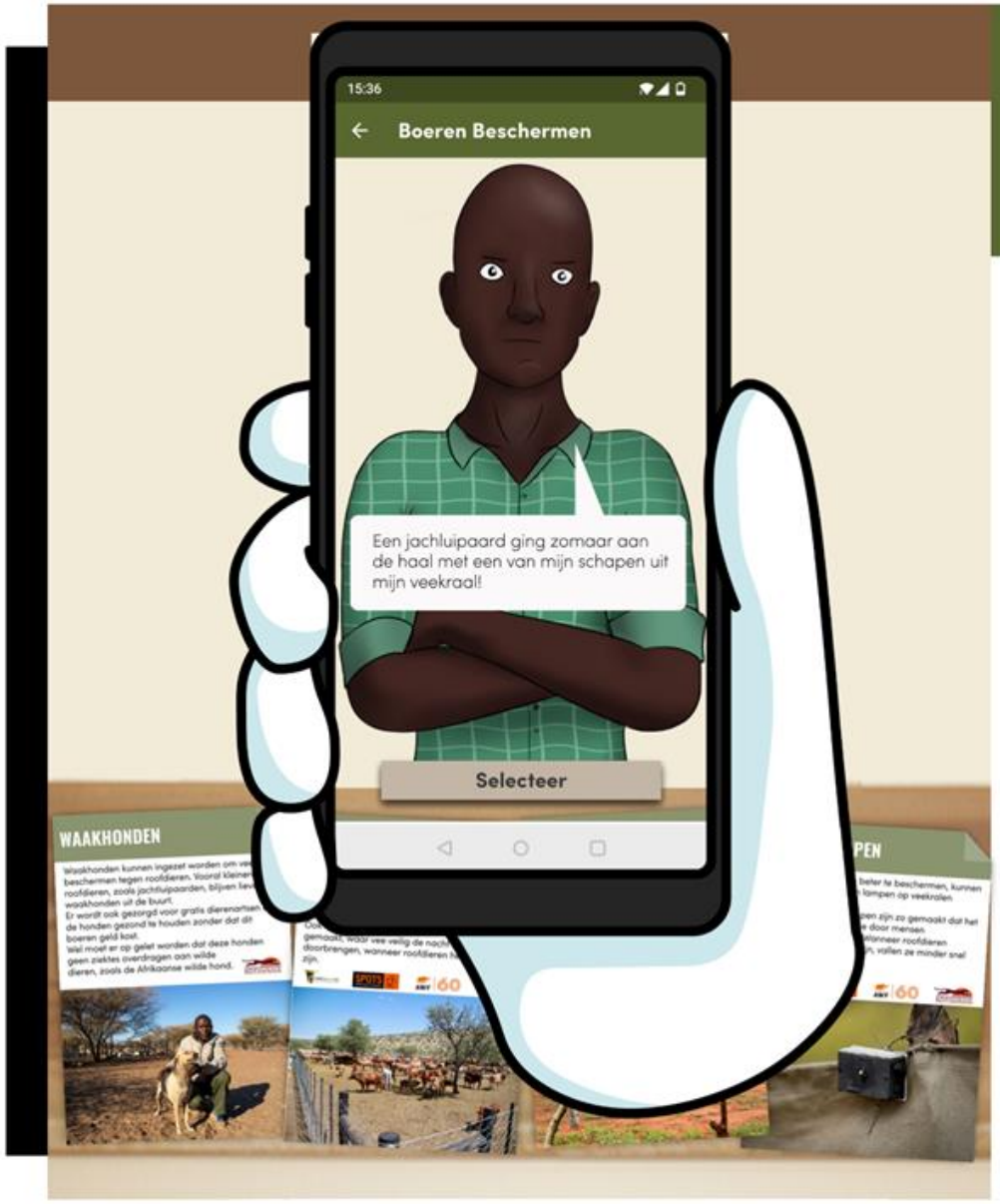

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Klaar

Wanneer alle boeren geholpen zijn komt er wat extra informatie, en kan de speler kiezen opnieuw te spelen.

APPENDIX C – QUESTIONNAIRE USER TESTS

Namens Safaripark Beekse Bergen doe ik onderzoek naar nieuwe vormen van interactieve educatie, met het gebruik van mobiele telefoons. Graag stel ik u een aantal vragen over de ervaring die u zojuist heeft geprobeerd.
Uw antwoorden zullen anoniem worden verwerkt, en worden gebruikt om de ervaringen te evalueren.

Door deze vragenlijst in te vullen geeft u hiervoor uw toestemming.

Geef aan hoe eens u het bent met de volgende stellingen:	Helemaal niet mee eens -3	-2	-1	0	1	2	Helemaal mee eens 3
Ik vond deze ervaring erg leuk om te doen	○	○	○	○	○	○	○
Deze ervaring had een toegevoegde waarde	○	○	○	○	○	○	○
Het was makkelijk te achterhalen hoe je de ervaring moest gebruiken	○	○	○	○	○	○	○
Ik voelde me voldaan na het voltooien van deze ervaring	○	○	○	○	○	○	○
Ik had voor mijn gevoel de keuze om deze ervaring wel of niet te doen	○	○	○	○	○	○	○
Ik heb deze ervaring zo goed mogelijk uitgevoerd	○	○	○	○	○	○	○
Ik vond deze ervaring erg interessant	○	○	○	○	○	○	○
Tijdens de ervaring kon ik kiezen hoe ik het wilde doen	○	○	○	○	○	○	○
De besturing van deze ervaring was voor mij duidelijk	○	○	○	○	○	○	○
Ik vond het duidelijk wat ik moest doen	○	○	○	○	○	○	○
Ik deed wat ik wilde doen terwijl ik bezig was met de ervaring	○	○	○	○	○	○	○
Ik denk dat ik best goed was in deze ervaring	○	○	○	○	○	○	○
Ik heb me tijdens deze ervaring vermaakt	○	○	○	○	○	○	○
Ik vond deze ervaring makkelijk te besturen	○	○	○	○	○	○	○
Ik zou dit soort ervaringen vaker willen proberen	○	○	○	○	○	○	○
Ik zou dit soort ervaringen sneller gebruiken als ze in de Beekse Bergen App zaten	○	○	○	○	○	○	○
Ik maak me zorgen over het datagebruik van de ervaring	○	○	○	○	○	○	○
Ik heb iets nieuws geleerd tijdens deze ervaring	○	○	○	○	○	○	○
Ik vond deze ervaring passend voor in de dierentuin	○	○	○	○	○	○	○
Ik zou deze ervaring ook buiten de dierentuin willen doen	○	○	○	○	○	○	○
Ik vond deze ervaring te kinderachtig	○	○	○	○	○	○	○
Ik zou graag een overzicht van alle mobiele ervaringen in het park kunnen zien (bijv. in de Beekse Bergen App)	○	○	○	○	○	○	○
Ik zou in dit overzicht mijn eigen voortgang willen bekijken	○	○	○	○	○	○	○
Ik zou in dit overzicht terug willen lezen waar de ervaring over ging	○	○	○	○	○	○	○

Opmerkingen/toelichtingen: