Developing a Virtual Tour for the Santa Elena Cloud Forest Reserve

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Abstract

The recent COVID-19 pandemic has accelerated the global shift to online resources, especially within the travel and tourism sector. The goal of our project was therefore to create a virtual tour of the Santa Elena Cloud Forest Reserve (SER) in Monteverde, Costa Rica to expand their outreach and promote further donations. We designed our virtual tour based on data collected from past visitors, tour guides, and experts of the reserve. As we developed the tour, we sent out drafts and collected survey feedback from users to identify possible areas of improvement. We lastly presented several recommendations so the reserve can keep the tour updated and integrate a donation platform in the future.

Executive Summary

Introduction and Background

The Santa Elena Cloud Forest Reserve (SER), located in Monteverde, Costa Rica, is one of the country's well-known ecotourism attractions. As a whole, the reserve plays a fundamental role within the local community, receiving nearly 40,000 visitors annually. However, with the global outbreak of COVID-19, many countries rapidly closed borders and imposed travel bans, leading to serious economic repercussions for tourism-reliant communities like Monteverde. Our aim in this project was therefore to work with our sponsor, Mr. Walter Bello, to develop a virtual tour of the reserve so they could continue to reach international visitors and receive donations. The tour highlighted the reserve's key features and helped the reserve stand out as a unique attraction with its online presence.

Methodology

To fulfill our goals, we outlined several objectives to guide our methodology:

1. Determine the key features of the SER and why it appeals to visitors.
2. Identify the most effective means of digitally presenting the reserve to visitors.
3. Assess satisfaction with the virtual tour and integrate feedback to allow for future growth.
4. Determine ways for the tour to contribute financially towards the reserve.

We began by collecting data from past visitors, tour guides, and experts of the reserve to understand what makes the SER unique. Then, we established a plan for the tour itself and gathered necessary media, such as photos, videos, and audio clips, from both our sponsor and the reserve's social media platforms. This step allowed us to build the virtual tour with a clear picture of the Santa Elena Reserve in mind. We simultaneously worked on selecting a software to build the virtual tour, guided by several key criteria such as price range, interactive add-ons, maintenance, and compatibility across devices.

Once we selected the appropriate virtual tour software, we stitched together all the previously gathered media and information. As we developed the tour, we sent out cumulative drafts to users and gathered their feedback. We collected feedback in two different ways, which included using semi-structured interviews and surveys in order to cast a wide net and gain meaningful information. Semi-structured interviews with potential users provided us with a range of information about the usability, clarity, and accuracy of the tour. Quick surveys and scale ratings allowed us to collect surface level feedback and open-ended comments. We used this feedback to identify areas of improvement and iteratively refine the final product.

Lastly, we evaluated several donation platforms and financial strategies for the reserve to acquire revenue. We included a donation button in the virtual tour with instructions to link their chosen payment system, and we provided several recommendations for the reserve to obtain donations through other types of currency.

We used our established plan as a guide, setting down clear goals that were flexible enough to deal with unexpected situations. This collective knowledge base helped us make informed decisions and we communicated regularly with our sponsor to ensure that our project fully met the needs of the Santa Elena Reserve.

Findings and Results

After analyzing responses to surveys and polls that were previously sent out, we first determined that a virtual tour was widely anticipated by the followers of the SER Instagram. Eighty percent of those surveys responded 'yes' when asked if they would be interested in taking a virtual tour of the reserve. These polls and surveys described also provided us with information regarding specific features, wildlife, and topics that users wanted to see. For example, the reserve has a watchtower located on the Youth Challenge Trail that is used as an observation point and has a view of the surrounding area. This physical feature was featured in the reserve using a fully explorable 360° photograph scene.

To add interactivity to the virtual tour, we also used a plethora of hotspots in each 360° scene. Hotspots are clickable points that show the user different types of media attached to the reserve. These hotspots provide further information about a topic or area in the reserve. For example, the Quetzal, a rare bird species sometimes spotted in the reserve, is featured in the reserve using a hotspot. Clicking on the Quetzal hotspot in the tour shows the user an embedded captioned video of footage of the bird in the reserve. Hotspots are a crucial part of the virtual tour that add another layer of depth to the tour. The virtual tour is composed of twenty seven 360° scenes, with each scene containing at least one hotspot, as well as options to move between scenes.

As we developed our tour, we sent it out to users for input. We received two rounds of feedback and iteratively revised the issues that people pointed out. In our first round of feedback, four main concerns emerged: confusion with navigation, lack of hotspots, background audio repetition, and general technical problems. The most reported issue was navigation, highlighting the need to improve the navigation system and provide users with clearer instructions on how to use the tour. Users would click on a location hotspot, and the subsequent scene would be facing backwards. As a result, users sometimes got stuck in a loop switching between scenes. To fix the issue, we changed each scene to face forward as the user progresses through the tour, and vice versa for when the user goes back to previous scenes. Many users also wanted more information and media about flora and fauna, so we continued to add new hotspots showcasing the unique biodiversity of the park. Some users mentioned repetitiveness of background noise, overlap of sounds from videos and background, and an overall need for more diversity. To remedy this, we added longer and more varied audio clips from the reserve into each scene.

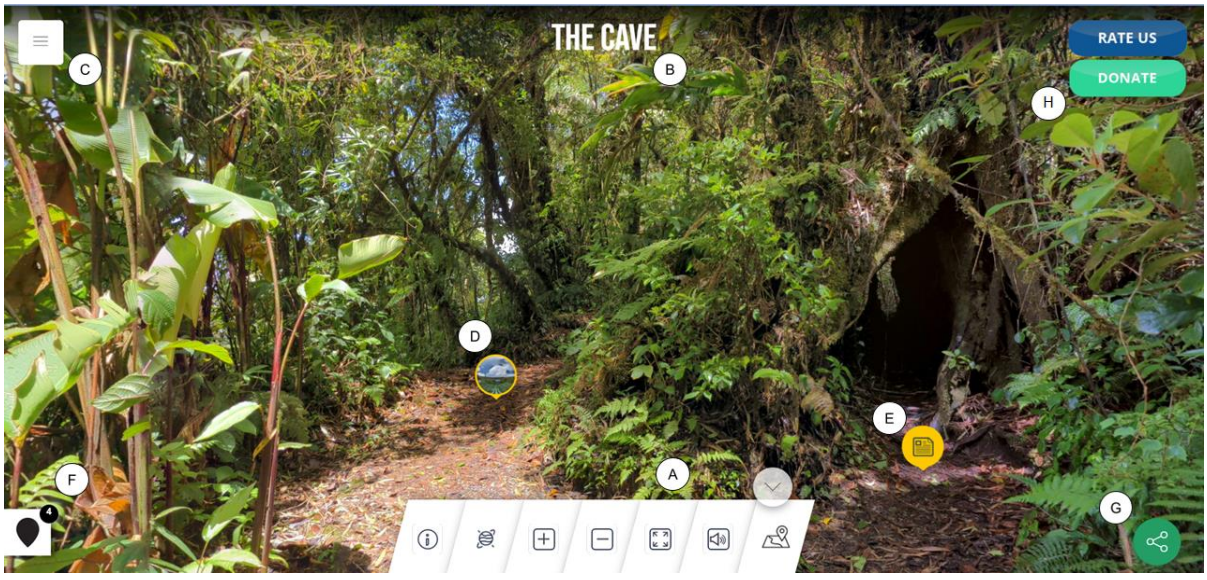
In our second round of feedback, we found that we had successfully addressed the reported issues. No navigation problems were reported, and the number of hotspots was deemed appropriate by most users, with only a minority wanting more. Some hotspots were added to scenes without any, slightly increasing the number of hotspots without changing the overall density of the tour. Edits to the sound clips were also successful, as all users enjoyed the background sounds with only one user reporting a minor inconvenience caused by the Lapentor design. The only issue reported was that some users sometimes needed to click and open a new window to view one of the reserve's embedded Instagram posts. No explanation was found, but

users still viewed and were interested in the post, so we decided to keep it. Some suggestions were minor edits we quickly performed, and others were recorded as possible options for the future, such as a quiz or a link to a gift shop. However, we confirmed the tour's main area of improvement: an autoplay option.

We originally worked to identify a donation platform for the reserve to receive credit/debit card donations online; however, we found that many popular donation platforms did not support Costa Rica and numerous institutional problems barred the reserve from implementing a general donation platform during our project's timeframe. Thus, we decided to focus our efforts on alternative forms of donations such as cryptocurrency and the Verdes Local Currency Program. We found that a feasible cryptocurrency option would be the Exodus wallet, which supports over a dozen popular cryptocurrencies. Once set up on a computer, SER established a district address for each cryptocurrency that they would like to receive. As a local donation option, we found that the Verdes local alternative currency could be useful for the reserve. Verdes is a new type of local currency being introduced to the Monteverde region aimed at giving more power to locals. The reserve may find the extra income of Verdes useful in the future as the currency matures. We additionally learned from Mr. Bello that the reserve does allow freelance tour guides to book and give tours, so they can offer their services and be compensated in Verdes.

Deliverables and Recommendations

Our main deliverable was the virtual tour of the reserve, as well as several recommendations for the SER to maintain the tour and collect donations in the future. Figure A displays a full screen view of an example scene from the tour, with labelled features.



A	**Control Bar**	**C**	**Scene List Menu**	**E**	**Informational Hotspot**	**G**	**Social Media Share Button**
B	**Scene Title**	**D**	**Location Hotspot**	**F**	**Hotspot List**	**H**	**Donate/Review Buttons**

Figure A: Labelled Full Scene View

The Control Bar (A) features seven different control options that the user can try. From left to right, these controls include: Introduction Pop-Up, Little Planet Feature, Zoom In, Zoom Out, Full Screen Mode, Toggle Background Sound, and Floorplan (Map) Layout. The scene titles (B) show the user which location they are in at any point. The interactive scene list (C) allows the user to scroll through different scenes and choose where they would like to go. The location hotspots (D) are another navigation feature; users can click on these to bring them to the next or previous scene in sequence. Informational hotspots (E) display wildlife from the reserve, historical anecdotes, or information unique to the location. The hotspot list button (F) on the bottom left opens a fly-out menu that allows the user to view all hotspots in a scene, The social media share button (G) can be used to share the tour link to Twitter, Facebook, or Linkedin. Finally, the donation and rate us button (H) lead to an "in progress" page and feedback survey, respectively.

Finally, we provided a number of recommendations for the reserve to sustainably manage the tour and integrate its donation platform. To keep the tour organized, we recommend the reserve maintain and update the shotlist we provided with hotspot locations and descriptions. Based on survey feedback, we also suggest the reserve look for ways to give users the possibility of an "auto-guided" tour. Since Lapentor (the software that used to build the virtual tour) did not offer this feature, one option could be to record a video of someone taking the virtual tour, and include it as an alternative to the tour on the reserve's website. Because user feedback was instrumental in our development of the tour, we also recommend that the reserve continue to collect feedback from virtual and in person visitors. Finally, we suggest that the tour itself be clearly and prominently embedded in the Santa Elena Reserve website and advertised through social media to provide easy access.

In terms of the reserve's donation page, we recommend that the reserve include two different sections. The first one should explain where the donations will be used by the reserve. This could also be coupled with a short video to add personality. The second section should explain how to donate, which would include both conventional currencies and the alternative cryptocurrencies. After the completion of this donation page, the reserve should link it to the donate button in the virtual tour.

With the completion of this project, we have provided the Santa Elena Reserve with a virtual tour that fits its needs, both immediate and future. The tour captured the reserve's key areas of interest and created a uniquely immersive experience for visitors. Even beyond the recent pandemic and subsequent decline in tourism, we hope this virtual tour will help the reserve adapt to a world where online services have become increasingly popular.

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1.0 Introduction

Since the year 2000, Costa Rica has seen steady economic gains from tourism (The Costa Rican Tourism Board, n.d.); however, there has been a sudden decrease during the COVID-19 pandemic as Costa Rica and many other countries have imposed international travel bans. Without income from in-person international tourism, many tourist operations are struggling to make ends meet.

The Santa Elena Reserve (SER), located in Monteverde, is one such organization that relies heavily on tourism to sustain itself. Currently, due to the rise of COVID-19 and the accompanying global economic shutdown, they are facing multiple issues with operation, exposure, and income. Guides are without work and visitor numbers are down significantly. Given this fact, the reserve is interested in creating an adaptive and fulfilling virtual experience with the potential to bring in further revenue. With the help of our sponsor, Mr. Walter Bello of the Santa Elena Reserve, our team worked together to create an interactive virtual tour that encapsulates the overall experience of the SER. Mr. Bello has worked as an environmental educator and guide in the reserve for nearly nine years, and is currently part of the Amigos del Ambiente initiative to involve local students ages 12-17 in projects relevant to the forest. His knowledge of the area and experience with engaging visitor interest helped guide our project in the right direction. With the virtual tour developed by our team we aimed to help the reserve increase outreach and solicit further revenue as they transition out of the pandemic.

While the Santa Elena Reserve is centered around ecotourism, the concept of providing visitors with a virtual tour was only recently introduced. The organization gave us some preliminary ideas of what this tour might look like: an interactive map, a sequence of 360° shots, a collection of QR codes placed throughout the park, and so on. These designs held potential individually but required further exploration to understand what combination will reap the greatest benefit. Our team has therefore studied the reserve and developed a tour tailored to their specific needs. To truly bridge the gap between a virtual tour and visiting the forest itself, we had to build upon previous work to provide visitors with a fully interactive experience and create a long-lasting product.

In the following sections, we detail our research process throughout the project. In the background, we introduce the surrounding context of the project, including information about the reserve and the impact of the COVID-19 pandemic on tourism. We also introduce the concepts of virtual tourism and virtual tours, highlighting the relevance of our project. Then, we describe our key objectives and the associated steps we took for each stage of our methods. In our findings and analysis section, we discuss the ideas and data that emerged from our research, and discuss how their analysis influenced the creation of the tour. Finally, we present our final product by walking through the virtual tour itself, and provide future recommendations we have for the reserve. The recommendations include best practices to maintain and update the tour, areas of improvement to focus on, and guidelines for the reserve's future donation page.

2.0 Background

This chapter has been separated into three relevant topics: Monteverde and the Santa Elena Reserve, COVID-19 and ecotourism, and finally virtual tourism. Starting with the reserve, we present a brief history of the park, as well as its importance in the Santa Elena and Monteverde community. To truly understand the greater context of how the Santa Elena Reserve fits into the surrounding area, we need to understand its roots, its function, and its beneficiaries. Next, we describe the COVID-19 pandemic and its impact on ecotourism in the reserve, specifically in accelerating the need for a shift to virtual platforms; to produce possible solutions, we first need to delve into the problem. Finally, we explore virtual tours and how they can positively influence the reserve by examining the past success of tours in parks, museums, and other similar attractions. Integrating this background knowledge will provide the foundation for a cohesive virtual tour that properly encompasses key elements of the reserve.

2.1 Santa Elena Cloud Forest Reserve

The Santa Elena Cloud Forest Reserve is one of Costa Rica's well-known ecotourism attractions. Located in the district of Monteverde and town of Santa Elena, the reserve covers and protects 765 acres of land at an elevation of 5250 feet, and has a large network of trails. With its roots going back to the 90s, the reserve's parcel was originally meant for agricultural use; however, when the initiative was unsuccessful (Vivanco, 2006), it was instead founded as a community ecotourism reserve on March 1st, 1992, with the help of Youth Challenge International, a Canadian organization. This was emphasized as a community project, with the local Santa Elena High School owning the land of the park as well as residents of Santa Elena taking part in administering the reserve. While protected, SER is not considered a national park, and is instead run as a private company.

As a whole, SER plays a fundamental role within the local community. With its close ties to the High School of Santa Elena, the reserve and community have maintained a symbiotic relationship. Since its establishment, the reserve has frequently worked on various initiatives aimed at the betterment of the Santa Elena community. The SER organizational history report outlines a number of programs to give an idea of its history (Herrera, 2017, p. 48-50). For example, "Programa de Becas" provided students of the Santa Elena High School with scholarships to cover their study costs in exchange for volunteer hours at the reserve.

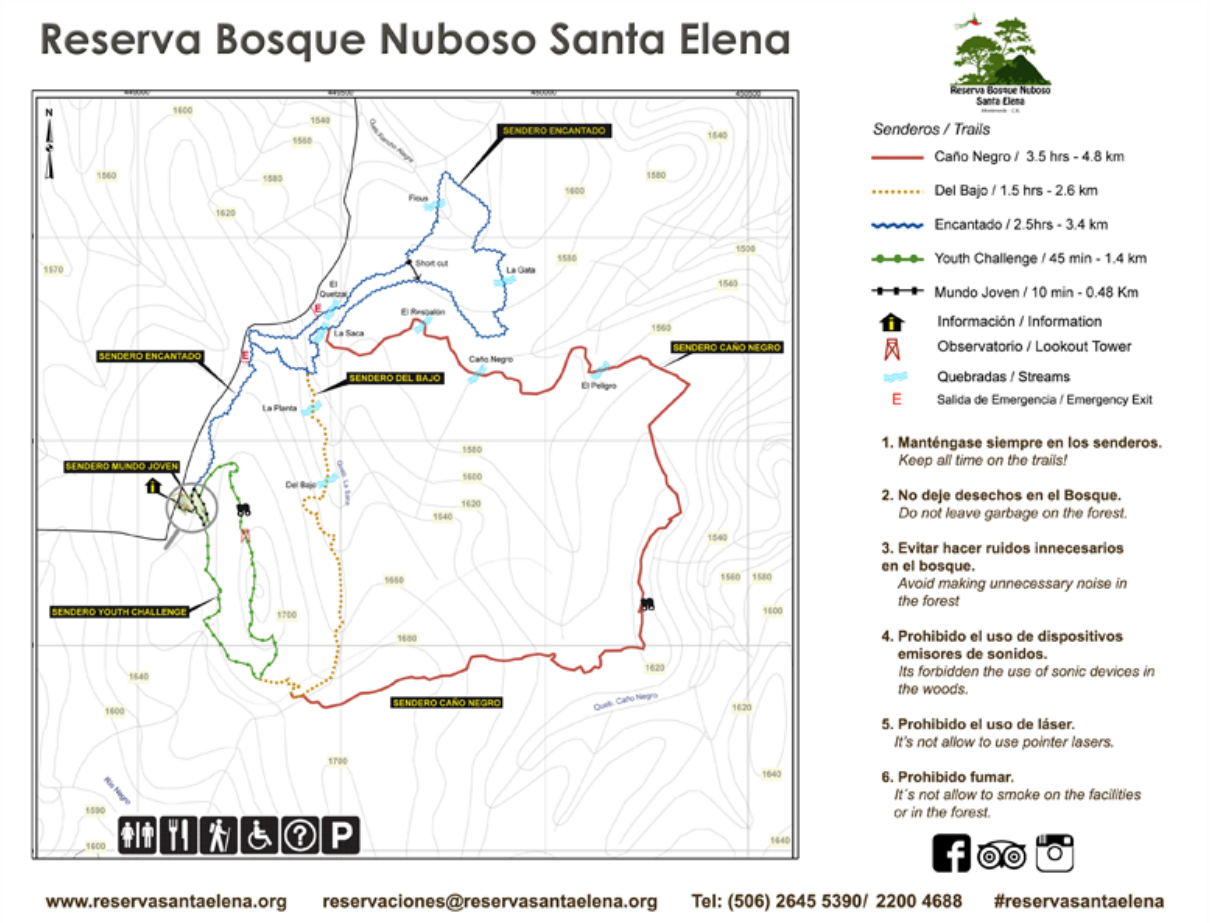


Figure 1: SER Trail Map, 2017, from reservasantaelena.org/Servicios.html

The cloud forest name comes from the high elevation of the forest, allowing for a cloud canopy to cover the surrounding area and vegetation with moisture (Monteverde's Cloud Forest, n.d.). The Santa Elena Reserve is often overlooked by tourists as there is a larger reserve, the Monteverde Cloud Forest, close by. However, the smaller and more secluded surroundings can provide a far more personalized visitor experience. In Figure 1, a map can be seen with the five trails available in the reserve to give an idea of its size. In the park, visitors will find trees covered completely by plants, all the way from the base to the highest point. The high elevation lends itself to the phenomena of horizontal rain. Therefore, plants can thrive on every layer and thus cover the park canopy. In addition to thousands of unique plants, visitors can observe a myriad of animals. Birdwatchers from all around the world travel to SER specifically to see its unique bird life including rare species such as the three-wattled bellbird and bare-necked umbrellabird (Santa Elena Cloud Forest, n.d.). The park even boasts an observatory tower with views across the entire forest and to two volcanos.

With an entrance fee of 16 USD, the Santa Elena Reserve earns a large sum of money from visitors alone. In addition to entry tickets, the reserve offers special guided tours and has a small restaurant, allowing it to build a significant ecotourism revenue stream in the surrounding area of the park as well as in Monteverde. With this, the local economy depends on the park and its visitors in order to make a living. Monteverde holds 4,100 inhabitants, most of which rely on

a steady stream of ecotourism (Censo, 2011). From cab drivers to tour guides, SER helps support a thriving tourist economy.

2.2 The COVID-19 Pandemic and Tourism

The recent outbreak of COVID-19 has had far-reaching effects across the globe, particularly within the travel and tourism industry. The first half of 2020 alone has seen an unprecedented decrease in international tourist arrivals as countries rapidly closed borders and imposed travel bans. This sudden drop translated to serious economic repercussions as well, since tourism is overall the third-largest export sector of the global economy (UNWTO, n.d). Currently, the World Tourism Organization expects spending by international tourism to drop between $910 billion and $1.2 trillion by the end of 2020, putting millions of direct tourism jobs at risk. For some countries, tourism represents a substantial portion of their GDP and supports the livelihoods of many citizens. Costa Rica, in particular, is one such country - nearly 8.2% of the country's GDP and 13% of jobs come from this sector. Now with current travel restrictions, the country has experienced a steep 96% drop in inbound tourist arrivals from April to June of 2020 (Instituto Costarricense de Turismo & DGME, 2020). This trend can also be seen with Costa Rica's unemployment rate. In the summer months of 2020, unemployment rose by 11.9% to 23.2% since previously in 2019 (INEC, 2020). While this increase in unemployment cannot be attributed solely to COVID-19, the fact remains that limited tourism overall has had a detrimental impact in Costa Rica.

2.2.1 Ecotourism and Economy in Monteverde

While every aspect of Costa Rica's tourism industry has been touched by the pandemic, the decline in ecotourism is especially significant. The country's vast national parks and rich biodiversity have lent themselves to the prevalence of ecotourism within the country's travel sector; in fact, it is estimated that up to 80% of all visitors come to Costa Rica for ecotourism-related activities ("About Costa Rica," n.d). With little to no financial support for maintaining biological reserves in the past year, many local communities such as Monteverde which rely heavily on ecotourism from nearby parks have suffered a substantial toll (Shah, 2020).

Monteverde as a community has already needed to enforce notably strict measures; as their healthcare infrastructure primarily consists of small state-run clinics with no intensive care units, an outbreak could inflict serious damage (Rocío Sáenz et al., 2010) As such, local residents are being hit even harder economically. In April of 2020, Costa Rica's central government sought to relieve individual financial burden by enacting Bono Proteger, a program to provide citizens with a portion of income for three months. Yet, in areas like Monteverde where tourism is so firmly tied to people's livelihoods, this aid may not be enough, given the community's heavy reliance on income from this sector. As described by Heidi Perez Bravo, director of Monteverde's Chamber of Tourism, the reserve has "too much tourism infrastructure" integrated within the local community already; thus, recovering from the pandemic economically will be a more gradual process than most (Shah, 2020, para. 8). In past years, the Santa Elena Reserve would receive roughly 40,000 visitors annually; but from April to September of 2020, they received none. Tour guides and park maintenance staff at the park have also dropped from 26 full-time workers to 11 part-time workers as of November 2020 (W. Bello, personal

communication, November 10, 2020). With fewer workers and facilities at the reserve, trail maintenance and general upkeep have become increasingly difficult.

2.2.2 Ecotourism and Local Conservation

Ecotourism has broadly served as an incentive for natural resource conservation as well as a source of education for international travelers, thereby promoting worldwide conservation efforts (Stronza et al., 2019). With this major source of income abruptly cut off and budgets for protected areas minimized, conservation has shifted out of focus, which is predicted to have extensive consequences even outside of Costa Rica (Corlett et al., 2020). Notably, there have been multiple positive reports of reduced human pressures, leading to sensitive wildlife populations having greater opportunities to breed and migrate. Simultaneously, however, there are still various conservation risks posed by decreased tourism. In some areas, for example, park rangers may not be able to monitor the grounds, leading to an increase in unregulated illegal activities such as hunting and poaching of threatened species, logging, and plant collection (Buckley, 2020). Moreover, the funding for programs that combat these issues are reliant on ecotourism as well. There are evidently a number of long-term implications that could result from the sustained lull in ecotourism and many uncertainties the biological community must continually respond to.

2.2.3 The Shift to Online Campaigns

While some of these issues may resolve themselves as communities start to recover from the pandemic, others will require a shift in priorities in response to the ever-changing situation. Despite current predictions pointing to upward trends in 2021, a return to 2019 levels in tourism would likely take between 2 - 4 years (Stacey, 2020); hence, as the international tourism market works toward recovery, many businesses have proposed turning to online platforms for support in absence of physical visitors. Most aspects of global society, from e-commerce to education to employment, have already transitioned online in the midst of the pandemic (Vlassis, 2021). The next logical step for many local nonprofit organizations would therefore be the same. Implementing a virtual interactive guide to reach international visitors has the potential to restore not only economic support but community initiatives as well (Raeymaeckers & Van Puyvelde, 2021).

Virtual tourism as a whole has already been on the rise even prior to the pandemic. Virtual reality (VR), in particular, has been at the forefront of this shift. VR involves any form of a computerized environment or projection that a user can experience visually and mentally, but not physically. Semi-immersive VR is the kind most commonly associated with virtual tours, in which a user can move about on their own using a computer, mobile device or compatible VR headset (Sultan, 2021). Despite the technology not having fully matured, VR has been shown to have many applications within the tourism industry, allowing potential visitors to gain a general understanding of what a location has to offer (Beck et al., 2019). The recent rise of the pandemic in an international context may act as a catalyst, accelerating an existing movement towards virtual tourism.

2.3 Virtual Tourism

2.3.1 Virtual Tour Interpretations

Virtual tours can be interpreted differently within various contexts; in essence, any interactive experience that simulates visiting a physical location can be deemed a virtual tour, regardless of varying format. As such, the structure of a virtual tour can be tailored to specific organizations or locations to suit their needs as best as possible. In the following subsection, we examine a number of case studies on virtual tours to understand how they can be uniquely personalized.

During the pandemic shutdown, the Smithsonian National Museum of Natural History in Washington D.C. opted for 360°, 3D virtual tours of past and present exhibitions, offered on its website (Virtual Tour | Smithsonian National Museum of Natural History, n.d.). This is a sound choice for a museum, as it allows rotation of in-person displays while still having old exhibitions available virtually. The Sydney Opera House, however, decided to incorporate a musical aspect to its virtual tour. As part of its tour, the creators filmed a 360° video accompanied with music performed by the Sydney Symphony Orchestra, highlighting not only the building's architecture but also its cultural purpose (Sydney Opera House, 2016). A virtual tour of the Tampines Chinese Temple in Singapore was developed as well, designed to help preserve the site's cultural heritage and historical knowledge (Mah et al., 2019).

Beyond virtual tours themselves, other virtual tools have been used by organizations to help bring attention to specific features they aim to highlight. A good example is the livecam page of the San Diego Zoo, showcasing live animal behavior of penguins, platypuses, and many more animals (San Diego Zoo, n.d.). This wide diversity of virtual formats shows that a virtual tour can include 360° videos, 3D models, photo galleries, informative text, or even sound recordings. Anything that may add to an authentic experience can be included, making virtual tours an incredibly flexible medium. Virtual tours can also have many other uses beyond merely replicating a visit experience. As an example, a virtual tour in the format of a video was used to reduce preoperative anxiety in children by showing them what would happen in the hospital, using cartoon characters as narrators (Ryu et al., 2017). In education, virtual reality can be a powerful tool to help involve students and motivate active learning. By combining and integrating different ways to teach, including virtual reality experiences, students have shown a greater involvement and understanding of the topics presented (Bennett & Saunders, 2019).

Why, however, would organizations go through the trouble of creating virtual tours even when in-person visits are available? The answer lies in the many benefits that virtual tours can bring.

2.3.2 The Positive Impacts of Virtual Tours and Tools

Increased Accessibility and Sustainability

Virtual tours are often used to visit remote sites such as museums, monuments, or even caves that would otherwise be inaccessible due to cost, pandemic restrictions, or other constraints. A virtual tour might be chosen over an in-person visit for a number of reasons: it may be easier to access for people with reduced mobility (Duclos & Cousillas, 2013) or in faraway places, it is often more affordable, and can help spaces that are vulnerable or have

limitations on visitor numbers remain accessible (A. Hall-Phillips, personal communication, November 23, 2020). Other virtual tools can also be used to complement in-person visits, providing information or guidance. Examples include audio recordings of a guided tour to listen to while visiting, QR codes with useful information, or maps to help direct visitors. Additionally, an unprecedented amount of people started turning to virtual experiences to make up for missed vacations, to help expose their children to new views or concepts, or even just as a way to maintain good mental health during this pandemic (*Virtual Experiences Let People "Travel" Safely During The Pandemic*, 2020). Thus, either by simulating a visit or complementing one, virtual tours allow for a greater access to culture, nature, or even entertainment.

The development of virtual tours and virtual experiences may also prove beneficial in the long term, as virtual tourism has less impact on the environment. Increased concerns about global warming and sustainability might also benefit this new form of tourism in the future (*Is Virtual Travel Here to Stay, Even after the Pandemic Subsides?*, 2020).

Increased Exposure and Financial Benefits

Virtual tourism and its associated tools have the potential to help organizations achieve greater exposure. Well-advertised locations are generally far more likely to draw in visitors, and nowadays, the most successful marketing takes place online. As Palmer and McCole observe in their study on "virtual" tourism destinations, "tourism-related services have emerged as a leading product category to be promoted and distributed to consumer markets through the Internet" (2000, p.2). As such, efficiently capitalizing on the trend of online publicized industry is crucial for a site such as the Santa Elena Reserve that thrives on tourism. Moreover, the mere process of developing and promoting a virtual experience has been shown to increase publicity for both online platforms and the associated physical locations (Claudio et al., 2004).

Another advantage of virtual tools is their potential as sources of revenue. With help from platforms such as *PayPal* and *Cash App*, the exchange of digitized currency and the global e-commerce market as a whole is a massive income stream. In fact, global e-commerce sales topped $29 trillion in 2017, which was an increase of 13% from the previous year (UNCTAD, 2019). The tourism and business-to-consumer industries directly benefited from this increase and had seen a steady increase in traffic over the past few years prior to the pandemic. Therefore, the ability for a touristic site to virtually connect and tap into the reservoir of online sales is a groundbreaking achievement in the digital era, as organizations relying on tourism can now diversify the way in which they obtain money. The popularity of digital transactions in the context of virtual tourism bodes well for various local organizations in incorporating their own donation or payment platforms. As an example, when trying to make a donation to the Louvre, users are able to pay directly on the museum website, a feature powered by the iRaiser platform (Louvre Museum Official Website, n.d.). However, the platform used by one organization might not be a good fit for another, and a careful selection needs to be made.

Increased Information Retention

Beyond financial considerations, it was important to determine if virtual tours are effective ways to convey information. One study tested the effectiveness of virtual tours in information retention and entertainment as compared to other approaches. Test subjects were given a tour of the Illinois State Capitol Building, which was delivered using one of three media methods: two-dimensional video, 360-degree video, and a physically present tour (Wagler & Hanus, 2018). All forms of the tour also included audio to accompany the different viewing

experiences. The study measured variables such as emotional engagement, tour outreach intentions, and sponsor satisfaction to gain a sense of how individuals digest information by taking the same tour on three different mediums. Upon examining the results of the experiment, they concluded that "both real-world and immersive 360-degree video tours scored equally on all measures, answering the research question and establishing that 360-degree video experiences are viewed very similarly to real-world experiences" (Wagler & Hanus, 2018, pp. 461-462). This study proved that virtual tours can still adequately communicate information and provide a "real-world experience" for visitors, even if they are not at the physical location. Furthermore, the study supports the theory that VR is the most effective way to do this, as the experience merges video and audio stimulation with a degree of spatial awareness. These results are promising in terms of our own project, because they clearly highlight the potential of virtual tours. Being able to provide virtual visitors with close to the same experience as in-person visitors and have them retain as much information is what we fundamentally aim to do. Virtual tours have been shown to be a viable strategy to accomplish this goal.

This information cemented the idea that a virtual tour would be helpful to the Santa Elena Reserve. The flexibility and usefulness of virtual tours make them ideal for our project, as the experience we aim to create should help the reserve gain more exposure and be more accessible while also effectively imparting knowledge of the forest to visitors. Additionally, turning to virtual tourism has proven to be a sound approach to generate revenue, one that fits the current situation of global tourism, but more importantly of the reserve.

3.0 Methods

The goal of our project was to create a virtual tour of the Santa Elena Reserve (SER) to assist in generating additional income and exposure during the COVID-19 global pandemic and help set it apart once this period of transition subsides. The tour was designed to be an accurate representation of a visit, highlighting the reserve's unique characteristics and educating the visitors about the cloud forest. The methods we used to reach this goal underwent a review by the WPI IRB to ensure their ethicality, and are presented in this chapter. To help develop our plan for the project, we have outlined the following objectives:

5. Determine the key features of the SER and why it appeals to visitors.
6. Identify the most effective means of digitally presenting the reserve to visitors.
7. Assess satisfaction with the virtual tour and integrate feedback to allow for future growth.
8. Determine ways for the tour to contribute financially towards the reserve.

3.1 Determine the Key Features of the SER, and Why it Appeals to Visitors

In order to create a virtual tour that is attractive to visitors and an accurate representation of a visit, we needed to identify what features of the reserve were most attractive. In other words, why do people visit the SER? Since the forest is fairly large, it was not realistic to include everything. We interviewed WPI user experience (UX) professors Soussan Djamasbi and Adrienne Hall-Phillips to better understand this part of the design process.

To determine the key features of the reserve, we then set up a video call with our sponsor, Walter Bello for a guided tour of the forest. Using his camera, he was able to give us a glimpse of what makes the reserve unique. In doing so we gained a better understanding of some noteworthy features that could be integrated into the virtual tour. While this tour of the reserve provided us with a substantial starting point, we continued to gather information from direct resources throughout our project to ensure that we represented all relevant features of the SER.

We began gathering our information via semi-structured interviews as they have generally been successful for coding and gathering valuable open-ended feedback (Charla & Payne, 2018). We interviewed Professor Luis Vivanco, Professor Laurie Kutner, and one of the Monteverde IQP teams from last year, who have all conducted research at the Santa Elena Reserve and Monteverde. Through these interviews, we wanted to understand how they viewed the reserve's key features and what they thought we should include in the tour. Our interview questions and our consent script are included in Appendix A.

We conducted one semi-structured interview in English with a tour guide, knowing that they would be a significant source of information about the reserve and tourist behaviors. We opted to send out a survey to the other guides due to several factors (Evans & Mathur, 2005). One issue was the language barrier, as we may have been unable to respond and build upon interview responses accurately. We also found it difficult to contact guides due to scheduling conflicts and time constraints. Sending out a survey translated into Spanish allowed for more recorded responses and allowed the tour guides to answer on their own time. This survey is included in Appendix B.

We also tried to contact past visitors through TripAdvisor and Google Reviews, but our messages were flagged as spam. We then decided to use the SER Instagram and Facebook page to get visitor opinions on the reserve's key features (Moreh, 2019). These two pages cumulatively have around 6000 followers and we expected the majority of them to have already visited the park. Using this platform we posted various polls asking which features should be included in the virtual tour as well as a direct link to our survey where past visitors can answer more thoroughly. Samples of these social media posts and surveys can be found in Appendix C.

We decided to post a series of Instagram stories, since they have the advantage of being able to carry interactive features, such as polls that can be placed over photos. These polls can either be multiple choice or open response; the Instagram account could therefore be utilized to do what we had been doing already with the Qualtrics surveys, but on a larger and broader scale. We implemented both a yes/no voting poll to gauge visitor interest in the virtual tour and an open response poll to ask for visitor opinion on the key features of the reserve.

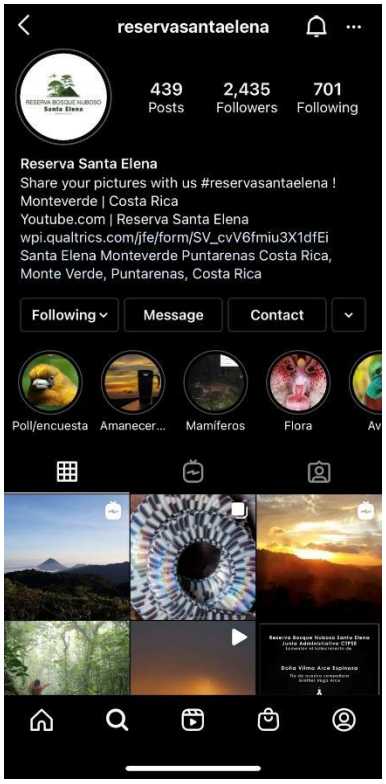


Figure 2: The Official Instagram Page of the Santa Elena Reserve

We then began designing the stories to be informative, eye-catching, and convenient. One consideration was the ease at which an individual could participate in the survey. We thought that the easier to answer the survey, the more people that would, leading to a larger amount of data. Shown in Figure 3 is an example of some of the stories we posted on the story of the Instagram account. This process was repeated twice to collect as much data as possible and to target the people that may have missed the story on the first 24 hour run. In order to sort through the responses, we first tabulated the responses and translated them into English. One strategy that we took advantage of is the manual coding of data, in which themes are drawn from larger works by selecting words or phrases that are dominant or hold prevalent meaning within the larger

writing. Therefore, we relayed this information to Mr. Bello in order to capture 360° shots of these areas and highlight the best aspects the reserve has to offer.

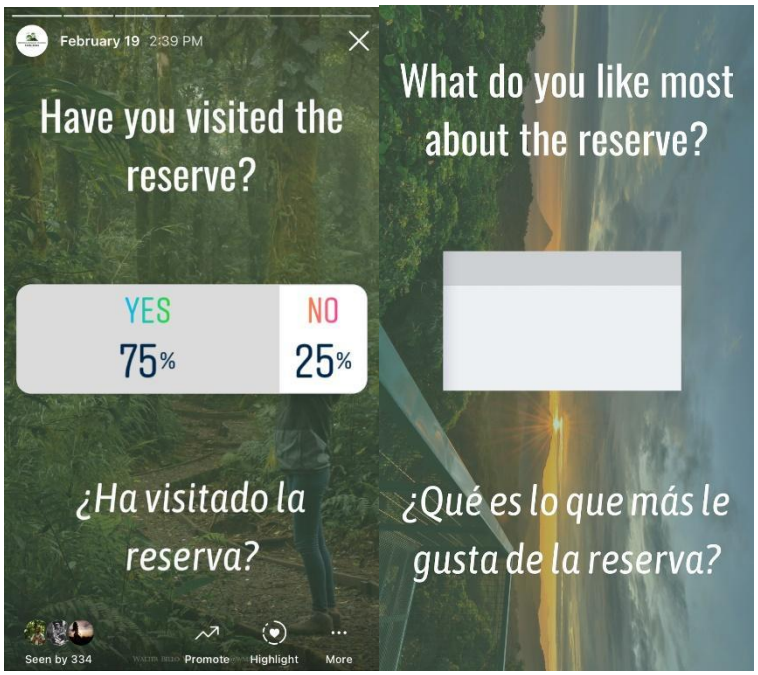


Figure 3: Example of Instagram Story Polls on the Santa Elena Reserve Instagram Account

3.2 Identify the Most Effective Means of Digitally Presenting the Reserve to Visitors

3.2.1 Obtaining and Organizing Media

A significant aspect of the virtual tour outside of 360° scenes are the "geotags." Geotags are multimedia attachments, such as photos, videos, audio clips, links, or informational text, that can be tagged to a geographical location within the tour (*Creating an Interactive Story Map*, 2015). The use of geotags leaves room for creativity in how we can show information to a user, such as audio, video, and linked articles. During our initial meeting, our sponsor shared a folder with us over Google Drive containing all of his photography and videography from the reserve, so we were able to extract most of our media from there. Through the surveys we sent out to guides, our interviews with local area experts, and our own comparative analysis, we compiled various informational and historical anecdotes from the SER to include in our geotags.

3.2.2 Mapping Out the Tour

Before we integrated any media into the tour, we took several steps to ensure that the tour itself was comprehensively planned:

1. Storyboarding: Prior studies of virtual tours have placed importance on first mapping the site, whether a museum, park, or real estate, and labeling points of interest to create a blueprint of sorts (Bonacini, 2015). Similarly, we plotted the various scenes that the user can interact with by dragging markers onto an image of the reserve map indicating

locations, as shown in Figure 4. We marked each of these locations based on the list of features created in Objective 1. This process of storyboarding allowed for each scene to lead into the next as a continuous and seamless experience (*Virtually There,* 2020).

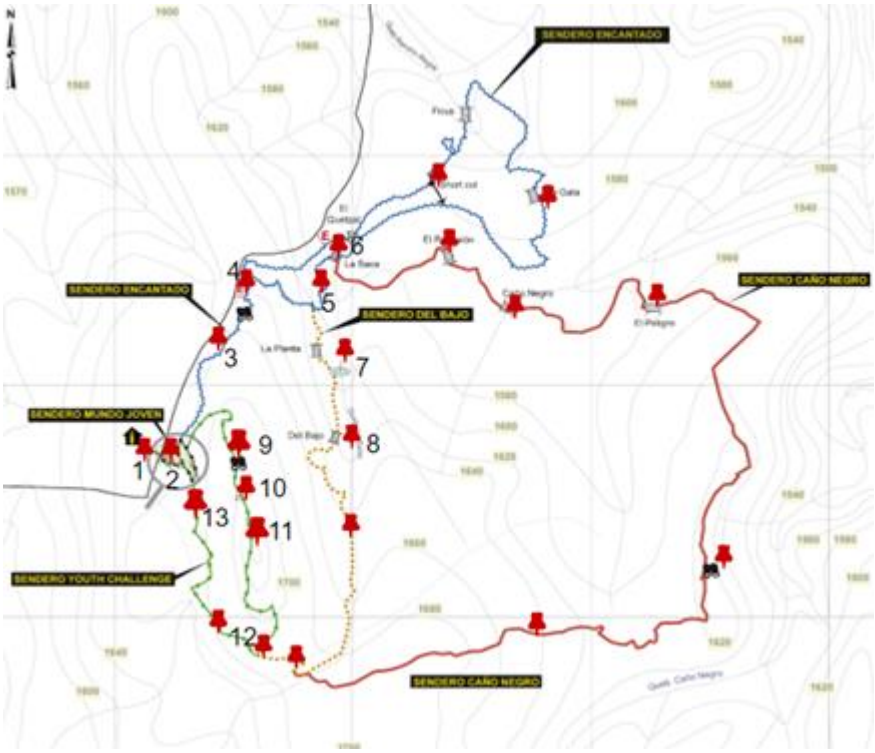


Figure 4: A map of the reserve with markers to delineate each scene of the tour

2. Scene descriptions: We then wrote descriptions to accompany each scene, organized within a shot list as shown in Appendix D. Some of these descriptions were updated as the shots were taken and we discovered new points of interest.
3. Planning the shots: We reviewed potential scenes with our sponsor before he created the shots. We shared the map of the reserve with him which contained our pins specifying the location of 360° scenes. In the process, we also asked that he update the map as well if he knew of any other scenic locations or points of interest.
4. Taking and Organizing Photos: We organized each shot and description into folders based on their scene number on the list as we received them, making sure to pay close attention to the individual locations.

After compiling and organizing all of our shots and descriptions, we moved on to selecting software that could effectively present the virtual tour.

3.2.3 Identifying Software to Create 360° Tour

Initially, we discussed the idea of the SER investing in a camera or lens that would be capable of taking 360° photos. However, through more research, we determined that most equipment was too expensive to both purchase and ship in on time. Instead, we shifted our search

towards smartphone applications and we found an alternative in Google Street View, which does not require any additional equipment and automatically stitches together photos taken from a smartphone into a full 360° scene. Using this app, our sponsor created the 360° shots in each of our marked locations and shared them with us via Google Drive and WhatsApp for us to organize into folders with all of our supplemental media.

We followed a slightly different process in our search for virtual tour software. In total, we compared seven different software options to find one that most closely fit the needs of the Santa Elena Reserve. We ranked each software and listed out pros and cons based on the following criteria:

1. Cost: We created three categories ordered most preferred to least preferred
    a. Free or open-source
    b. One-time payment
    c. Subscription
2. Customization: We created a list of features that would preferably be included with the software, ordered most important to least important
    a. Hotspots or geotags
    b. Embedded media - images, videos, links
    c. Background sound
    d. Custom buttons for external sites
    e. Reference map
3. Sustainability: Does the software allow for future additions and revisions to the tour and transfer to our sponsor?

After evaluating each software option based on this criteria, we selected the one that ranked highest within each category and overall best fit the needs of the reserve - Lapentor. We created a short sample tour to present to Mr. Bello to provide an idea of what the final product might look like and familiarize ourselves with the software features. Not only is Lapentor free to use, it offers all the customization options we wanted. The tour can also be hosted on Lapentor for free and accessible via a link, or directly embedded in the reserve's website for a one time $10 payment.

3.3 Assess Satisfaction With the Virtual Tour and Integrate Feedback to Allow for Future Growth

Getting feedback is an integral part of the development of a virtual tour, as it allows the tour to grow and continuously improve. To ensure the feedback we received was varied and representative of the variety of people who might use the tour in the future, we decided to use two avenues to collect feedback. We first used the reserve's social media pages to post a link to the virtual tour, along with a link to our feedback survey (Instagram post presented in Appendix E, survey in Appendix F). The link to the feedback survey was also embedded in the tour, and the survey was offered in 4 languages - English, Spanish, French, and German. This allowed us to collect a high number of survey responses in a short amount of time, from people we would otherwise not be able to contact. Simultaneously, we carried out interviews about the virtual tour with potential users around us, trying to include people of varying age and occupation (interview

script in Appendix G). If an interview was impossible, users were simply directed to the feedback survey.

Gaining honest and useful feedback from users can be difficult if the questions asked are too direct. Thus, we decided to also indirect or hypothetical questions as they can sometimes help respondents be more honest and provide much more useful feedback (Teng, 2007). We focused our questions on the ease of navigation of the tour, its design, and how informative the content was. We often asked people if they would do anything differently or change anything in the tour, to help guide future edits. In order to also collect surface level feedback, we included satisfaction scales in our surveys. While this form of feedback is not as comprehensive as an open ended question, users are more likely to quickly choose a rating rather than write a few sentences. Consistently low ratings imply the presence of a problem with the tour, while high ratings are a good sign (A. Hall-Phillips, personal communication, November 23, 2020).

We performed this cycle of collecting and integrating feedback twice, a cycle being defined as the collection and integration process. Once we integrated the first cycle of feedback into the tour, we repeated the process of collecting feedback in order to gauge how well the tour was adapted to the changes that participants wished to see. The feedback survey and interview script were adapted for the second cycle (respectively presented in Appendix H and I). This cyclical process helped ensure that we took into account the input of all participants. It also guaranteed that the tour did not evolve too quickly and accumulate errors; the changes were gradual and judged over time through this cycle system.

Throughout the process of building the virtual tour and iterating through cycles of feedback, we documented the steps needed to build upon the project and how to integrate any changes. We noted the key steps in shooting 360° photos in the Google Street View App, as well as our procedures on Lapentor to create scenes, add geotags, and compile feedback through Qualtrics. In the Lapentor software, geotags are known as “hotspots,” and they create more depth of interactivity within the tour. We shared these notes and access to the accounts with our sponsor to provide him with knowledge of how the tour works as well as an opportunity for building upon the tour in the future. This allowed our project to remain sustainable and gave the reserve the necessary tools to be self-reliant in the future.

3.4 Determine Ways for the Tour to Financially Contribute to the Reserve

3.4.1 Selecting and Integrating a Virtual Donation Platform that Fits the Needs of the SER

Before integrating a donation platform to the tour, we had to select one that fit the means and the needs of the reserve. We started by looking for documentation to guide this selection, but we mostly found websites offering rankings of donation platforms (*The Top 8 Payment Processing Tools*, 2020), nothing that would help with designing a selection process. Thus, we decided to have a discussion with our sponsor to gain a better understanding of the reserve’s needs; what the reserve had used or was currently using; and what criteria the reserve had for a donation platform. Using this information, we determined a list of criteria to guide our research. The platform needed to be available in Costa Rica; it also needed to be affordable and easy to use as well as maintain. Further, it had to accept donations nationally and internationally and be compatible with a variety of currencies and languages. We investigated the Monteverde Cloud

Forest Biological Reserve to determine what platform(s) they used and gain a sense of the popular options in the Monteverde area. Finally, once we identified viable candidates, we presented them to our sponsor so that he may make an informed decision. While we offered recommendations as to which options seemed to be the best fit for the reserve, the final say was with Mr. Bello and the administration of the SER.

Through an interview with WPI UX professor, Adrienne Hall-Phillips, we learned about donor behavior and what strategies we could implement to maximize the amount of donations received by the reserve. Thus, we determined how to design and where to locate the donation button on the website to offer the most visibility.

3.4.2 Giving the Reserve Additional Exposure and Access to a Novel Local Currency

By collaborating with another WPI student-led project team, we learned of a new local currency circulating in Monteverde, called the "Verde." Through discussion with this team and our own research, we determined that the SER could make use of the Verde and its platform, Cambiatus. Cambiatus aims to reinvigorate Monterverde's economy by introducing the Verde into the local economy. This recent effort to introduce a local currency into the Monteverde economy has multiple benefits, many of which would be useful for the reserve. We compiled a list of ideas for the reserve to make use of the Cambiatus platform, and presented it to our sponsor. We present our findings and analysis in the next chapter.

4.0 Findings and Analysis

In order to provide the Santa Elena Reserve with a means of gaining exposure and income in the most effective way possible, the team analyzed data gathered from polls, surveys, and interviews in order to create a virtual version of the SER. We focused on creating the most realistic experience of the cloud forest that could be achieved through a screen. To make the data simpler to digest, we sorted our key features findings by theme: physical features, wildlife, and social topics. We then present the feedback data we collected and the changes we implemented in response. Finally, we present different approaches we found for the reserve to collect donations in the future.

4.1 Determining Key Features of the SER Through Different Perspectives

4.1.1 Physical Features

In order to identify physical features to include in the tour, we decided that we needed to amass a large number of responses from people who had been to the SER. The team decided to turn to the SER Instagram account in order to assess the responses from our previously posted stories.

Out of 100 voters, 80 stated that they would be interested in a virtual tour - a promising number for our project. The open response poll (shown on the right in Figure 3) received about 30 responses of varying detail. We decided that a word cloud would be useful to sort out this information, as it is much easier to use a visual to see the magnitude of certain words used in the responses. The word cloud for the open response survey “What did you like most about the reserve?” is shown below in Figure 5. The data highlights features that users feel should be included in the virtual tour.

Figure 5: Word Cloud Made from Responses to Instagram Poll

From the data we collected, it is easy to see that past visitors enjoyed the watchtower, forest, trails, and certain wildlife the most, since those words are among the larger phrases in the word cloud. A tour guide also highlights in a survey response that the tower is always a feature that the visitors cherish. Because of these findings, we decided that the watchtower should be a main focus in the tour. We informed Mr. Bello that users heavily enjoyed the unique feature of the watchtower in the reserve. Due to this communication, he provided us with not only a 360° photo from the top of the watchtower, but also pictures and videos he has taken from this location in the past and information about the surrounding land that can be seen from the watchtower. The 360° photo is shown in Figure 6 below. We also learned that the tourist map of the SER that visitors receive contains binocular symbols that point to areas that have a good view of the forest from that location. The watchtower is one of these physical locations.

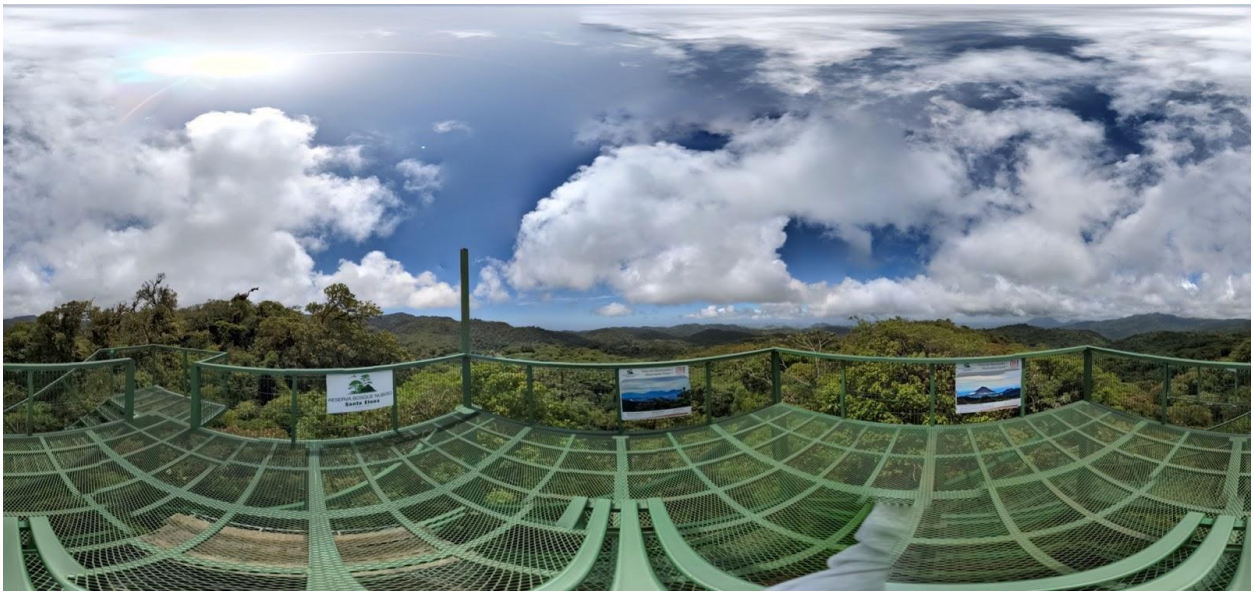


Figure 6: A 360° Photo from the Watchtower in the Reserve

Along with these features, we also learned from Mr. Bello that the reserve has built birdhouses in some areas in order to attract specific bird species. A 360-degree photo of an area containing one of these birdhouses was then collected and integrated into the tour, along with a hotspot that draws attention to this feature and provides a captioned video containing information on the birdhouse.

4.1.2 Wildlife

Through our interviews and surveys with people such as Professor Laurie Kutner (a professor from the University of Vermont that has visited and worked with the Monteverde community for many years), Instagram users, and tour guides, we found that wildlife was one of the main points of excitement that visitors connect with in the tour. Professor Kutner pointed out some examples of the diverse wildlife during our interview. From her perspective, she stated that guided tours are much different than non-guided tours, as guides will point out specific species that someone who is new to the reserve would not recognize or even spot altogether. Features in the tour can act as a tour guide and showcase certain species of wildlife in the tour, such as the Quetzal (L. Kutner, personal communication, February 4, 2021). Through this interview, we found that the Quetzal, a rare bird species sometimes spotted in the reserve, is one elusive feature of wildlife that visitors are hopeful to see when taking a tour. She took this suggestion to another level, suggesting that the virtual tour should find a way to share the vast ecosystem that the cloud forest has to offer.

Tour guides spoke almost exclusively about wildlife as well. They emphasized how they provide visitors with stories and facts about the cloud forest and its inhabitants. One tour guide stated that the Quetzal does get a lot of attention, which is backed by our other response data, but people also ask about other wildlife, such as sloths and toucans. By communicating with tour guides, we found that the reserve is teeming with different species of wildlife. Another tour guide was shown the virtual tour and walked through each scene, where he pointed out for us

certain areas where specific species are commonly observed. For example, the beginning of the Caño Negro trail is known for puma sightings. When brought to the waterfall scene in the Del Bajo tour, he talked about specific species of frogs that can be found in the water, such as the Meadow Tree Frog and the Mexican Tree Frog. These findings were supported by media supplied by Mr. Bello and included in the tour to allow users to observe and learn about the forest, just as a physically guided tour would provide in person.

4.1.3 Social Topics

Aside from physical features and wildlife, we also wanted to focus on the social topics, such as history and changes the reserve has endured throughout its duration within the virtual tour. We found this information from two that had made many trips to the reserve in the past and had an abundance of knowledge from their many trips to Monteverde: Professors Luis Vivanco and Laurie Kutner from the University of Vermont. Their understanding of not just the reserve, but the surrounding area of Monteverde provided us with a valuable foundation in our research.

Luis Vivanco first visited the reserve in 1992 and wrote a book on the Monteverde community based on his experiences (Vivanco, 2007). Through asking questions such as "what aspects of the reserve do you believe are its key points of interest?," we found that Professor Vivanco thought the extensive history of the reserve should be included in the virtual tour (L. Vivanco, personal communication, February 3, 2021). This is one aspect of SER that may be difficult to show, but could be conveyed through information we gathered from tour guides. Professor Vivanco was most interested in the social history of the SER, such as the struggle for control of the land between the "Fundacion" and the local high school. He also suggested that the tour guides could serve as narrators for information like this (L. Vivanco, personal communication, February 3, 2021). Laurie Kutner also suggested we show the history of the SER and how it ties into Monteverde as a whole (L. Kutner, personal communication, February 4, 2021). Through these interviews, we found that we should not only showcase what the user can see in the reserve, but also what they can learn about its history when visiting. Using this strategy, the user can be fully engaged with the reserve by learning certain facts about its history.

One seasoned tour guide mentioned in the survey that the reserve has changed since she began her relationship with the cloud forest. The guide said that she is always sure to mention how the reserve has changed over the years due to global warming and how the ecosystem has been affected when giving tours. Although she did not provide specifics when addressing this topic, the team has invested in following up on this point and conveying to users the harms of global warming and pollution on the reserve. For example, the reserve recently announced a ban of the entry of single use plastics into the reserve via the Instagram account. This ban includes things such as plastic bags, water bottles, and straws. These facts can be displayed in the tour using a hotspot to display a flier for this information.

4.2 Elements of an Effective Virtual Tour

Our second objective was to determine the most effective means of presenting the tour to visitors. In particular, we focused on identifying strategies to make the virtual tour especially engaging for visitors. We first present the advice given to us by User Experience (UX) experts, before summarizing the data from user feedback and the subsequent edits to the tour.

4.2.1 User Experience Experts' Advice

Common themes emerged as we discussed the design process with UX experts, professors, and virtual tour owners. The main recommendation we received was to keep our target audience in mind. In other words, who visits the reserve and what do they want out of a visit? Professors Djamasbi, [WPI] emphasized the need for product designers to be in touch with their user base (S. Djamasbi, personal communication, December 4, 2020), a practice exemplified by the Ecotarium (Worcester, MA) during the creation of their virtual tour. They explained to us how they created an Excel sheet to categorize each level of the tour and note the most popular exhibits in each level, as well as any geotags they planned to place (J. Isperduli, personal communication, December 4, 2020). The knowledge of what visitors wanted to see guided the construction and refinement of the virtual tour. Additionally, accommodations should be made for a broad audience - some people might be used to virtual tools, others might struggle to use a computer, and others might not be able to read. Adapting a product to be available to the widest range of people possible is critical in making that product popular (A. Hall-Phillips, personal communication, November 23, 2020).

From our interview with Professor Hall-Phillips, [WPI] we determined that most people tend to gravitate towards interactive products with sights and sounds to provide for a more realistic experience (A. Hall-Phillips, personal communication, November 23, 2020). Alongside this idea, Professor Hall-Phillips discussed creating a flowchart for the tour with a series of "stops" so that the user feels a sense of hiking through the trails and completing a trip. Once more, the concept was reinforced by the design process followed by the Ecotarium. They connected each scene and translated their notes into a visual story. This use of visual storytelling elements in the virtual tour allowed for an overall more cohesive and immersive experience.

4.2.2 Feedback Collection and integration

First Feedback Round

In order to gather meaningful and diverse feedback about the tour, we used a combination of surveys and interviews. We conducted 3 interviews where the user walked through the tour and gave us live feedback and received 19 responses to our feedback survey, giving us 22 respondents in total. While 19 users reported an enjoyable experience, four main issues were highlighted by the feedback collection, shown below in Figure 7.

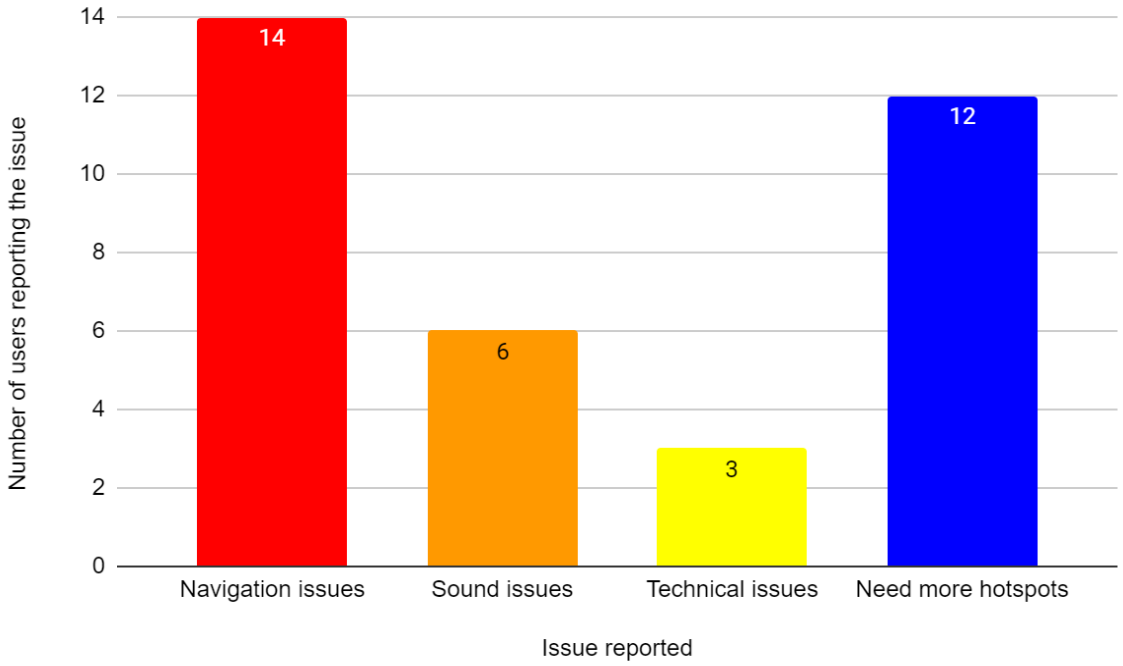


Figure 7: Main Issues Reported by Users - Round 1

The most reported issue was navigation, highlighting the need to improve the navigation system and provide users with clearer instructions on how to use the tour. We found that some were confused about their location on the map. Thus, we displayed the scene title in each location for the user to refer to as they look at the map. A preferable solution might have been to highlight the user's location on the map, or have a different colored marker, so the user does not have to hover over various points and refer to the scene title; however, Lapentor did not offer this feature in the free version. Confusion when navigating between scenes was also common. Users would click on a location hotspot, and the subsequent scene would be facing backwards (in the direction they just came from). As a result, users sometimes got stuck in a loop switching between scenes, taking away from their immersion. To fix the issue, we changed each scene to face forward as the user progresses through the tour, and vice versa for when the user goes back to previous scenes.

Regarding the educational content available, 12 of 22 users wanted more information and media about flora and fauna, highlighting a lack of informational hotspots in the tour. In response, we added more hotspots showcasing the unique biodiversity of the park. While 11 of 22 users reported enjoying the immersion provided by the forest sounds, 6 users mentioned problems: repetitiveness of background noise, overlap of sounds from videos and background, and an overall need for more diversity. To remedy this, we used longer sound clips for the background sound and added water flowing sounds in scenes with water. Only 3 users reported technical issues - two reported pictures not loading, an issue caused by them viewing the tour as we updated the pictures; another user's browser (Firefox Fedora 32) did not support the tour and they had to go through another one. As the most widely used browsers support Lapentor, this was not believed to be a serious issue. Throughout this round, some users seemed to not be

aware of some control features, so we highlighted them in a “Useful Tips” section to ensure visitors knew of their existence and how they worked. This ensured visitors know how to use the tour in an optimal way.

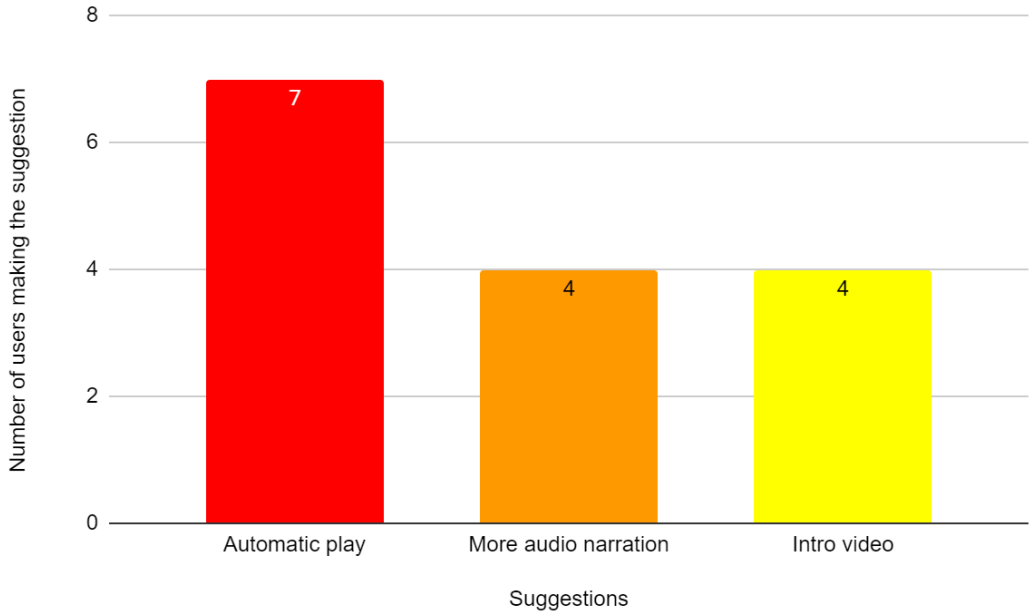


Figure 8: Main User Suggestions - Round 1

We also received interesting suggestions, presented in Figure 8 above. 7 users suggested an automated walk through the tour; while Lapentor offers a way to view and change scenes automatically after a period of inactivity, users would still have to click on hotspots. Additionally, this option would have to be enabled for all users. We added a question asking users what they would prefer in the second feedback survey. 4 users suggested having an option to have written information narrated to them instead of having to read it, and 4 suggested an introduction video from reserve workers. Other suggestions included a checklist of flora and fauna hotspots, or a quiz for visitors to test their newly acquired knowledge. Using the ideas that seemed most feasible in our time frame, we added a list of hotspots for each scene, and Mr. Bello recorded an introductory video. After making our edits, we moved on to the second round of feedback collection.

Second Feedback Round

Using the same format of feedback collection, we interviewed 3 users (2 who were interviewed during the first round) and received 18 survey answers, for a total of 21 respondents. All users enjoyed the tour, and we successfully addressed the hotspot, navigation, and sound issues, as shown in Figure 9 below. In fact, only one user reported some difficulty navigating and 19 users thought that the number of hotspots was adequate, with only 2 wanting more. To prevent overcrowding scenes, we added hotspots to those without any. This increased the number of hotspots without changing the general hotspot density. Edits to the sound clips were also successful, as all 21 users enjoyed the background sounds. One user reported the sound

turning back on after navigating between scenes with different sounds, a feature of Lapentor we are unable to circumvent. We only found one main issue; 3 users were unable to see one of the reserve's Instagram posts embedded in a hotspot and had to click on it to see the post directly. No explanation was found, but users still viewed and were interested in the post, so we decided to keep it.

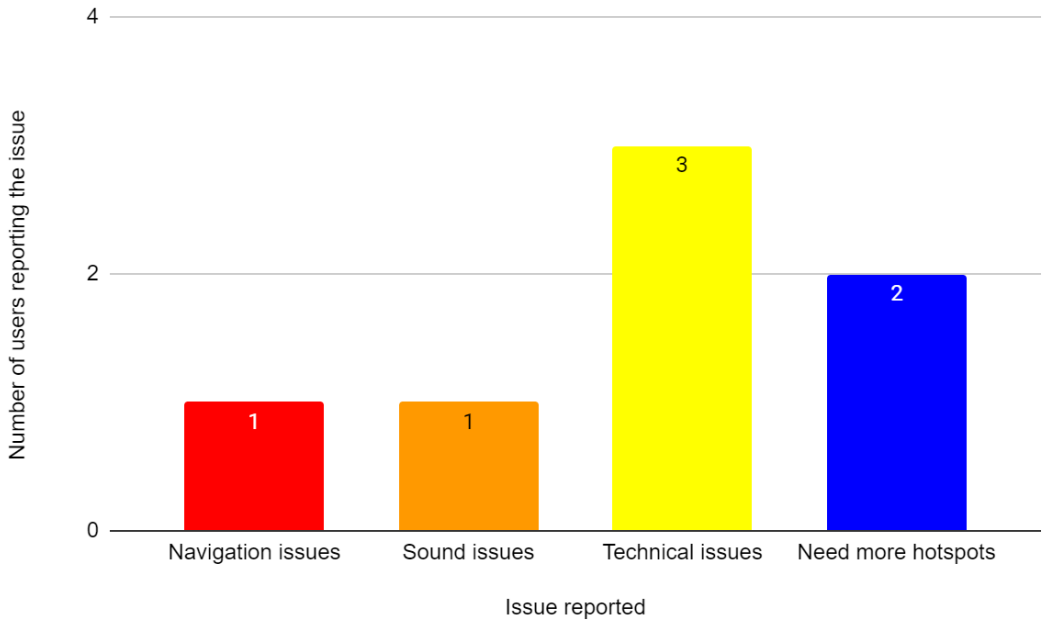


Figure 9: Main Issues Reported by Users - Round 2

Some comments suggested minor edits we quickly addressed, such as fixing inconsistent capitalization or adding a title to one hotspot that was left blank. The main suggestions we received are presented below, in Figure 10. Almost half of users did not find the tiny planet button useful. As this button is optional and has helped some users navigate the tour, we decided to keep it. Users who do not wish to use it can simply choose not to. Then, the idea of having a quiz for users to test their knowledge was mentioned by 4 users, something that could be added later on. Including a link to an online gift shop was mentioned by 2 users, something the reserve does not presently have. Finally, only two users wanted audio narration for hotspots, while all others did not. The addition of more videos was thus effective in adding narration to the tour.

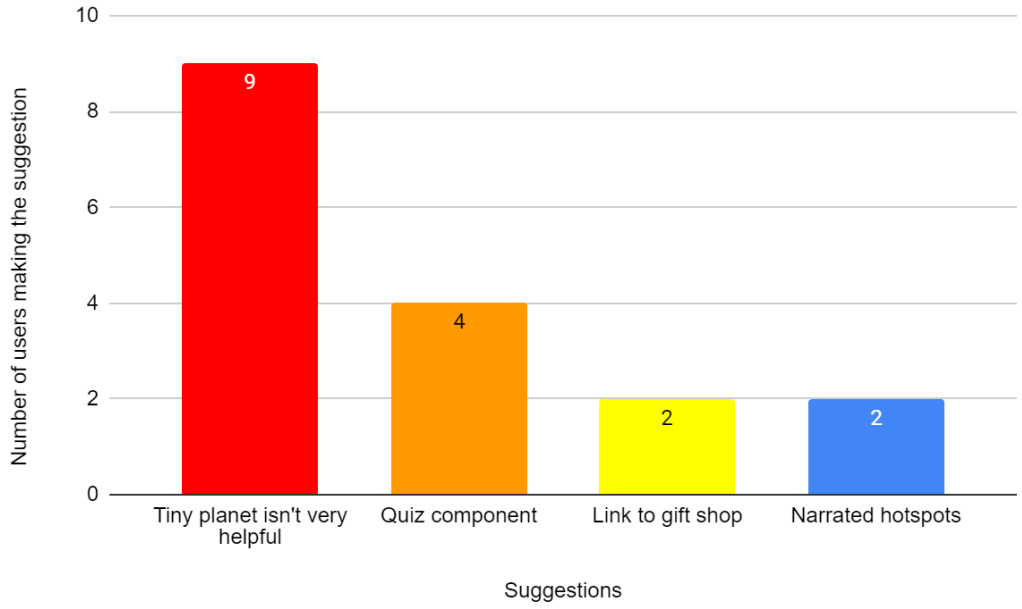


Figure 10: Main User Suggestions - Round 2

Finally, we confirmed the tour's main area of improvement for the future: an autoplay option. In fact, when asked if they wanted to go through the tour manually or automatically, 6 users chose manually while 10 wanted both options to be available. This highlights a need for a way to move automatically through the virtual tour, something that is impossible using Lapentor. We build upon this issue more in our recommendations.

4.3 Determining Ways for the Tour to Financially Contribute to the Reserve

We originally worked to identify a donation platform for the reserve to receive credit/debit card donations online; however, we found that many popular donation platforms, such as GoFundMe, did not support Costa Rica. Then, we set out to identify what local businesses used as payment or donation platforms near the reserve. In doing so, we found that Pay-me was used by the Monteverde Reserve to sell tickets, and Mr. Bello told us that the Santa Elena Reserve also used it to pay its employees. However, Pay-me is used for commercial transactions only, and it is unclear if using it as a donation platform is possible. Thus, we rejected the idea of using Pay-me as a donation platform, but it is worth noting that it can be used to sell tickets online, something the reserve might want to do in the future.

We then identified PayPal as a fitting way to receive donations; it is widely known, available in Costa Rica, and accepts many currencies. However, after discussing opening a PayPal account for the reserve with its bank (Banco Nacional de Costa Rica), Mr. Bello informed us that the agreements between PayPal and the bank were discontinued, making the creation of a PayPal account tied to the reserve difficult.

It became apparent that institutional problems barred the reserve from implementing a general donation platform during our project's timeframe. Thus, as our sponsor expressed interest in cryptocurrencies, we decided to focus our efforts on cryptocurrency donations. Fortunately, cryptocurrency transfers are decentralized and do not require a 3rd party for transactions (Hsieh, 2018). Therefore, with our help, the reserve set up an Exodus wallet, supporting over a dozen popular cryptocurrencies. This wallet has two district addresses, strings of letters and numbers; one to receive Bitcoins and the other for the other supported cryptocurrencies. In addition to this, a unique QR code was obtained for each address.

Finally, as a local donation option, we found that the Verdes local alternative currency could be useful for the reserve. Verdes is a new type of local currency in Monteverde aimed at giving more power to locals. One benefit of this new currency is that it can rally the community to earn the currency by achieving certain objectives (Cambiatus). The hosting platform, Cambiatus, gives an example of this in its "frequently asked questions" section on their website. They relate the currency to current world problems, such as global warming. As an example, if a community sets an objective to combat global warming, it can establish a currency that people can earn by performing tasks furthering that goal, such as riding bikes instead of using motor vehicles that contribute to greenhouse gas emissions (Cambiatus). After meeting with the IQP team working on this Verdes system and discussing how the reserve could implement it, we learned that the Verdes system is still in its infancy. The currency is currently being used to offer services, such as dog-walking or house-cleaning, or to buy items from local vendors. Despite the novelty of this system, we still see value in introducing the Santa Elena Reserve to Verdes. First, posting an announcement about the virtual tour on the platform will help with the reserves exposure - the more people that know about the reserve and its services, the better. Additionally, a call for voluntary Verdes donations could be included in the announcement. The reserve may find the extra income of Verdes useful in the future as the currency matures. Second, we learned from Mr. Bello that the reserve does allow freelance tour guides to book and give tours. Freelance tour guides could offer their services on Cambiatus and be compensated in Verdes.

Through our research and analysis, we were able to obtain a strong foundation for developing a virtual tour for the Santa Elena Reserve. Using interviews, surveys and polls we gathered data on what type of features would be most suitable to include in the tour. Next, we researched virtual tours as a whole and what elements are required for success by interviewing UX experts and current virtual tour developers. Then, by receiving and integrating two rounds of feedback, we identified problems in our virtual tour, allowing us to continuously improve our final deliverable. Finally, we assessed donation platforms and developed a plan to provide the reserve with an ability to receive financial support online. With these findings, we were able to finalize our virtual tour, along with recommendations for the reserve.

5.0 Deliverables, Recommendations, and Conclusion

Once we finished our data collection and analysis, we focused on developing the virtual tour deliverables as well as using recommendations to ensure that the tour is a useful resource in the future. We start by walking through the virtual tour itself, describing its features and organization. Visuals provide a way to label and explain the nuances that come with the tour through the Lapentor software. Every feature that allows the user to navigate and learn is included in this section along with a description. The recommendation section that follows serves as a plan for the reserve staff to continue to add to and evolve the virtual tour in the future if they deem necessary.

5.1 Walkthrough of the Virtual Tour

The virtual tour can be accessed in multiple ways. The tour will primarily be located on the reserve website through the following link once Mr. Bello integrates a virtual tour section into the site. It can also be accessed on the Santa Elena Reserve Instagram through the link in the page's description.

When the user first opens the tour, they are presented with a short introduction pop-up to provide a brief overview as shown in Figure 11. The introduction contains a "Helpful Tips" section with instructions for how to navigate and interact with hotspots.

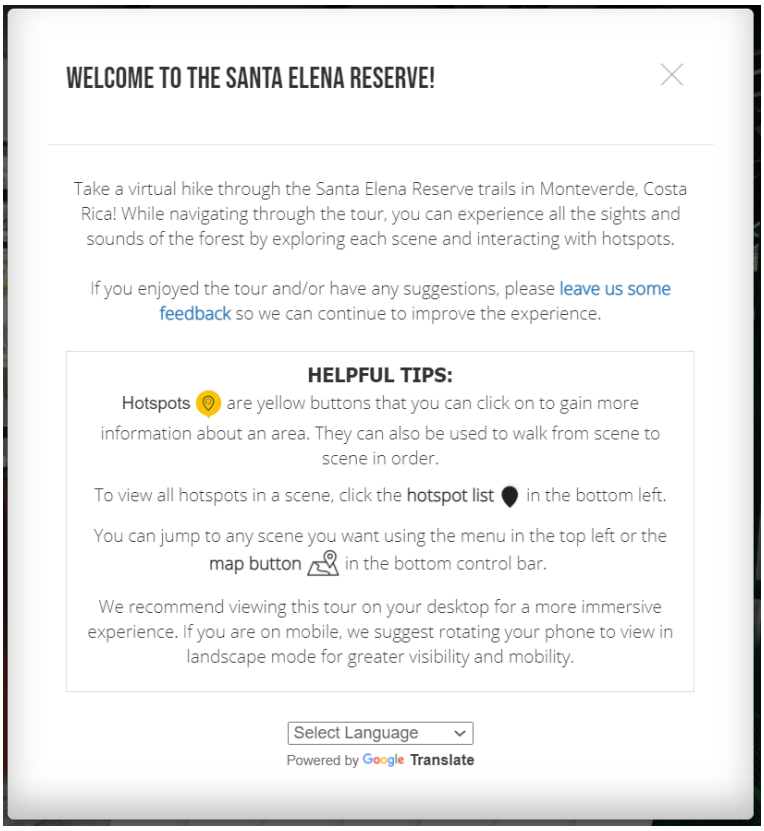
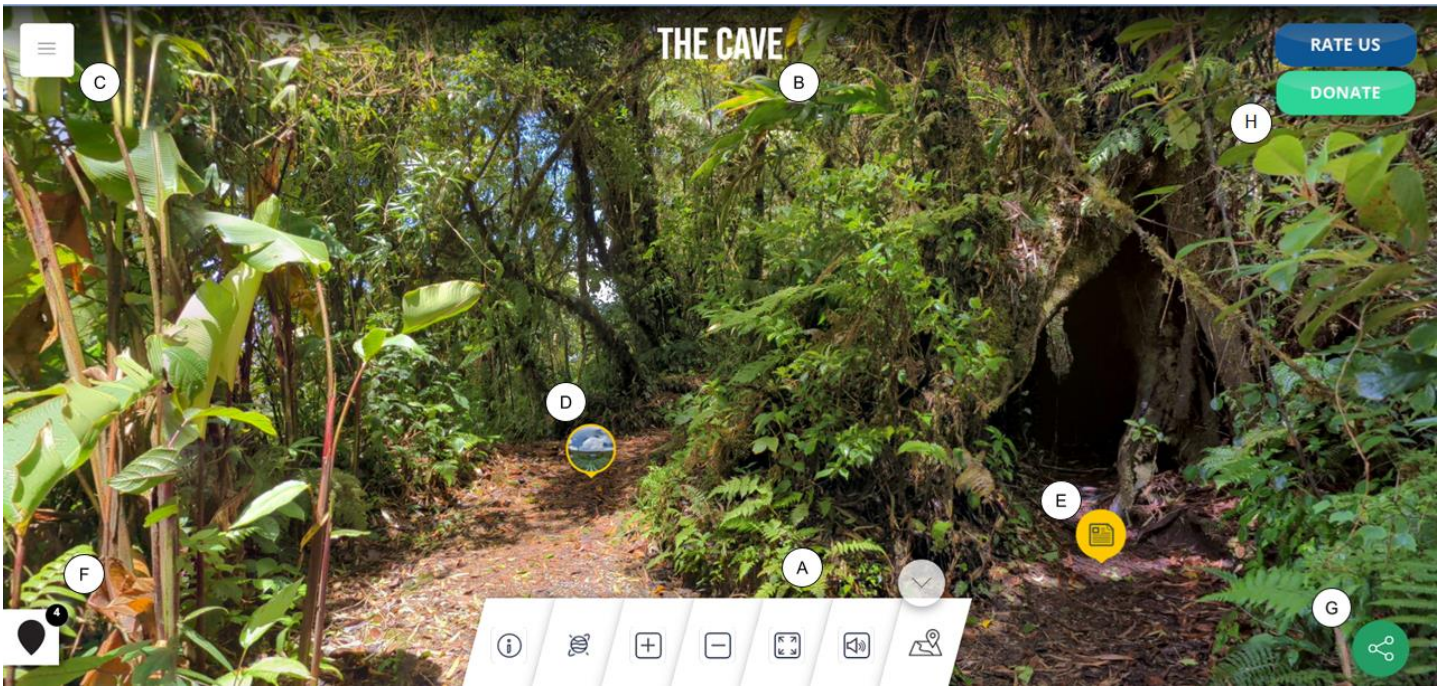


Figure 11: Virtual Tour Intro Pop-up

The introduction also includes an embedded link to the feedback survey. We will keep this link available even after the completion of our project so that the reserve can continue to collect responses and gauge visitor opinions. At the bottom of the pop-up there is a Google Translate dropdown (with 108 language translation options available) that translates all text within the tour to accommodate for different target audiences. A slight limitation here is that these translations may not be completely accurate as they are fully reliant on Google Translate. Users can, however, leave suggestions to improve translations on the Google plugin itself, which may prove useful as the tour grows.

Once the user exits out of the introduction pop-up, they are presented with a full screen view of the tour, an example of which is shown in Figure 12, with labelled features.



A	**Control Bar**	**C**	**Scene List Menu**	**E**	**Informational Hotspot**	**G**	**Social Media Share Button**
B	**Scene Title**	**D**	**Location Hotspot**	**F**	**Hotspot List**	**H**	**Donate/Review Buttons**

Figure 12: Labelled Full Scene View

The Control Bar (A), shown close up in Figure 13, features seven different control options that the user can try. From left to right, these controls include: Introduction Pop-Up, Little Planet Feature, Zoom In, Zoom Out, Full Screen Mode, Toggle Background Sound, and Floorplan (Map) Layout. The user can use the arrow on the top right or click anywhere on the screen to toggle hiding/showing the bar.

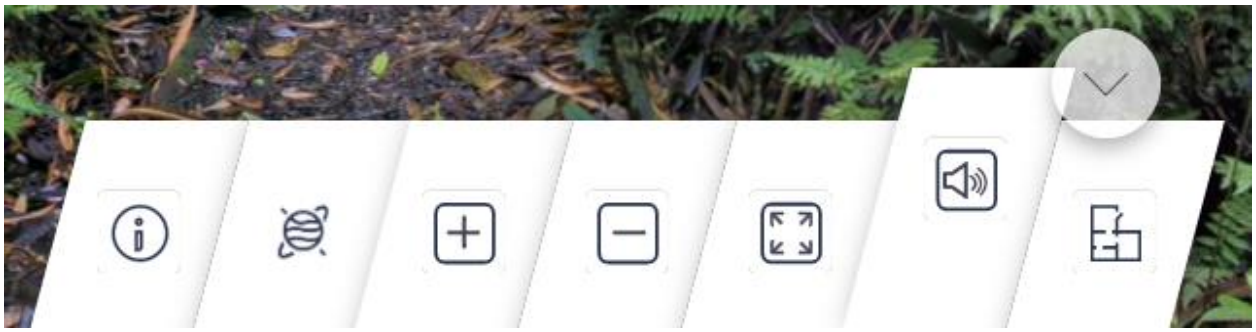


Figure 13: User Control Bar

The “little planet” feature allows the user to zoom out completely and view the scene as a sphere, as well as the location hotspots in the scene. This can be helpful for users to reorient themselves. An example little planet mode view is shown in Figure 14.

Figure 14: Little Planet View Mode

The floorplan feature is generally used for building layouts in real estate virtual tours; however, we used it alternatively as an interactive map feature. We removed the background of the Santa Elena Reserve Map to display only the lines of the trails, and then placed hotspot markers at the location of each scene as shown in Figure 15. The user can hover over any point on the map to see the scene name and click on it to bring them to that scene.

Figure 15: Interactive Map Pop-up with Scene Hotspots

Figure 16 shows the interactive scene list (C), categorized into each key region of the reserve, including (in order): the Visitor Center, the Encantado Trail, the Del Bajo Trail, the Youth Challenge Trail, and the Caño Negro Trail. Similar to the map, the user can scroll through different scenes and choose where they would like to go. Notably, this menu feature does highlight the user's current location, which makes their progress clear.

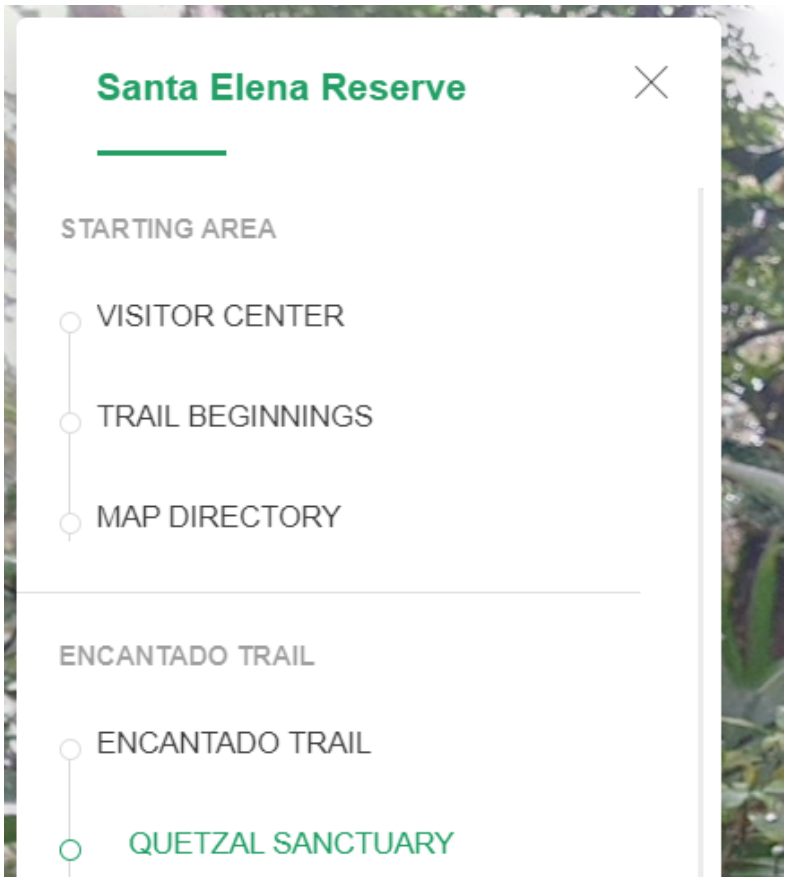


Figure 16: Interactive Scenes List Menu

The location hotspots (D) are another alternative for navigating between scenes which incorporates more of a sense of "walking" through the trails. As shown in Figure 17, in any given location there will be labelled hotspots leading to either the previous scene or the next scene that the user can click to bring them there.

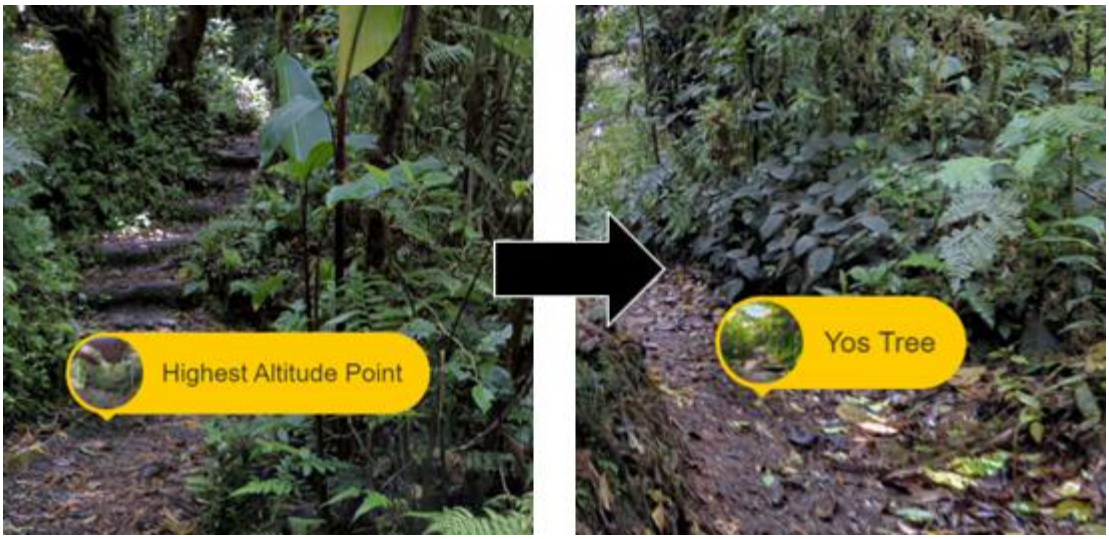


Figure 17: Navigating Between Location Hotspots

Informational hotspots (E) are another type of geotag placed throughout the tour. Many of these hotspots display wildlife from the reserve, historical anecdotes, or information unique to the location. For example, the second scene on the Encantado Trail, Quetzal Sanctuary, shows birdhouses built by the reserve in order to attract the resplendent quetzal species, so we included an informational hotspot (as shown in Figure 18) placed next to one of these birdhouses that includes an embedded video of two quetzals in a tree.

Figure 18: Example Informational Hotspot

The video of the quetzal was captured by a reserve tour guide and is hosted on the reserve's Youtube channel. Since these hotspots integrate multiple forms of media, they can provide exposure to the reserve's various social platforms and increase outreach.

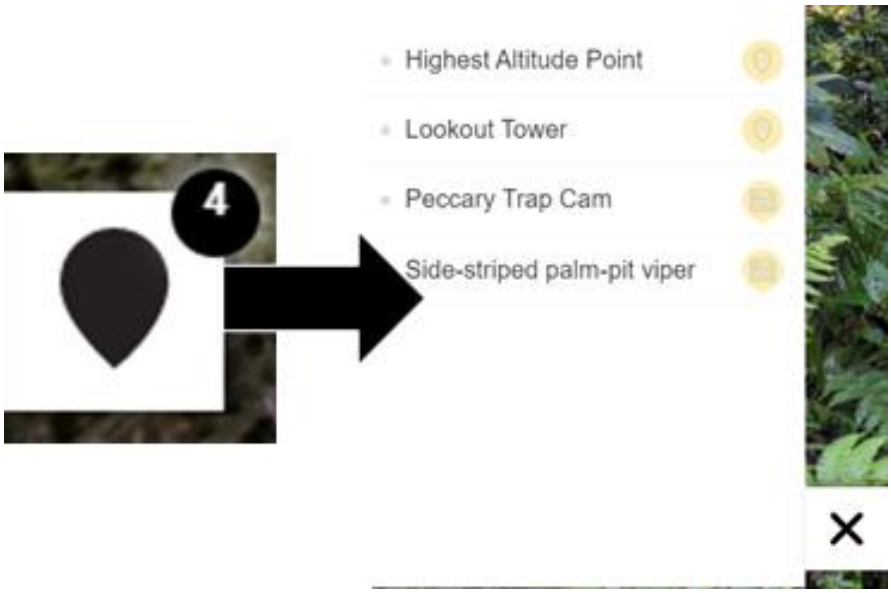


Figure 19: Hotspot List Fly-out Menu

The hotspot list button (F) on the bottom left opens a fly-out menu that allows the user to view all hotspots in a scene, as shown in Figure 19. If the user clicks on one of the hotspots, the viewframe moves to where the hotspot is located. This feature can be useful if the user has difficulty finding certain hotspots in a scene and wants to look through each one.

The social media share button (G) can be used to share the tour link to Twitter, Facebook, or Linkedin. This button is placed in the bottom right and is distinctly colored as a way of attracting users' attention.

To maximize the visibility of the donation and feedback buttons (H), we decided to place them in the top right corner of the tour. This ensured that they would be seen by all visitors during their visit. However, the reserve encountered institutional problems hindering the creation of a donation platform. As such, the donation button linked to a temporary donation page that included the reserve's cryptocurrency wallet information. It also stated that the reserve was working on more conventional donation platforms, and invited users to return later.

Figure 20: Temporary Donation Page

5.2 Recommendations

In order to keep the tour organized and easy to maintain, we provided Mr. Bello with an organized list of every scene, along with hotspot locations and descriptions. We suggest the reserve maintain and update this list as edits to the tour are made, as it proved to be a good organizational resource. From survey feedback, we found that users were interested in the idea of audio and video narrations by tour guides; as such, we suggest adding in these types of hotspots throughout the tour to improve user experience. Finally, we recommend that the tour itself be clearly and prominently embedded in the Santa Elena Reserve website and advertised through social media. This would allow for greater visibility and access to the tour.

User feedback was instrumental in our development of the tour. Thus, to guide and gauge future edits to the tour, we recommend that the reserve continues to collect feedback from virtual and in person visitors. This will allow them to quickly take note of any new scenes or features that can be incorporated into the tour and identify any issues that may arise during virtual visits.

During our feedback collection, we found that we had the most success with receiving multiple responses through Instagram polls and open responses. Hence, if our sponsor wanted to modify the survey or get opinions from visitors, posting stories on the Instagram page could provide better metrics.

Additionally, users wanted a way to go through the tour automatically. As this is impossible to do in Lapentor, we recommend that the reserve look for alternative ways to give users this possibility. One option could be to record a video of someone taking the virtual tour, and include it as an alternative to the tour on the reserve's website. If a tour guide was willing to record this video, they could add some interesting commentary during certain parts, simulating a guided tour and adding to the experience.

Due to time and institutional constraints, we were unable to implement a donation platform for the reserve. As such, the reserve will need to update its donation page to reflect its future donation options. In this page, we recommend that the reserve include two different things. First, having an explanation of what the donations will be used for is central to increase donor trust in the transaction, leading to more donations (Burt, 2011). A short video or a text with pictures would be effective. Then, the different means to donate should be embedded on the page - not only the main donation platform for conventional currencies, but also the QR codes or addresses leading to the reserve's cryptocurrency wallet. Once the reserve builds this donation page on its website, the donation button in the tour should then link to it.

5.3 Conclusion

With the completion of this project, we aimed to provide the Santa Elena Reserve with a virtual tour that fit its needs, both immediate and future. The tour captured the reserve's key areas of interest and created a uniquely immersive experience for visitors. Moreover, the tour is easy to update and maintain. In the future, the reserve should be able to integrate a donation platform to the tour so it can continue to promote itself and receive donations in coming years. Finally, we established our recommendations not as a detailed plan, but rather as general guidelines so that the reserve still has creative freedom however they decide to expand upon the tour. Even beyond the recent pandemic and subsequent decline in tourism, this virtual tour should help the reserve adapt to a world where online services have become increasingly popular.

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Appendix A - Expert Interviews Script

Hello, we are a team of students from Worcester Polytechnic Institute working with the Santa Elena Reserve in Monteverde, Costa Rica, to develop a virtual tour.

We are conducting this interview as part of our project. We are interested in any insight you can provide us. The information from this interview will be used in our project research which will be later published in the WPI public database, but it will be completely kept anonymous. The recording itself will not be distributed to anyone besides our team. Your participation is completely voluntary, so we would like to get your permission before asking any questions and recording. Would you be willing to participate? (If yes, continue. If no, thank them for their time and end the call.) Are you also willing to be recorded? (If yes, start recording. If no, take notes.)

Thank you for agreeing to take part in our interview! Do you have any questions before we start? (Answer any of participant's questions)
If you also happen to have any questions after the interview, you can reach out to us via our email gr-ser-mv21@wpi.edu. You may also reach out to either of our advisors, Professor Sarah Strauss (sstrauss@wpi.edu) and Professor Melissa Belz (mbelz@wpi.edu).
(Continue on to interview questions)

Interview with SER/Monteverde Researchers	
Main discussion point/goal	**Sample questions**
Gain background knowledge about their work at the SER.	• What does your research involve in Monteverde, specifically the Santa Elena Reserve? • Did you visit with a tour guide?
Gain understanding of what attracts tourists, or what the iconic parts of the reserve are.	• What kinds of sights and sounds did you find most memorable in the reserve? • In your opinion as someone who has worked extensively at the SER, what aspects of the reserve do you believe are its key points of interest? What do you think visitors find most exciting? • Do you use virtual tours?
Ask for their opinion about what to include in the tour.	• What interactive features would you like to see highlighted in a virtual tour of the reserve that might appeal to visitors? • Is there something you think should definitely be included in a virtual tour of the SER? (Specific wildlife, locations, sights and sounds)

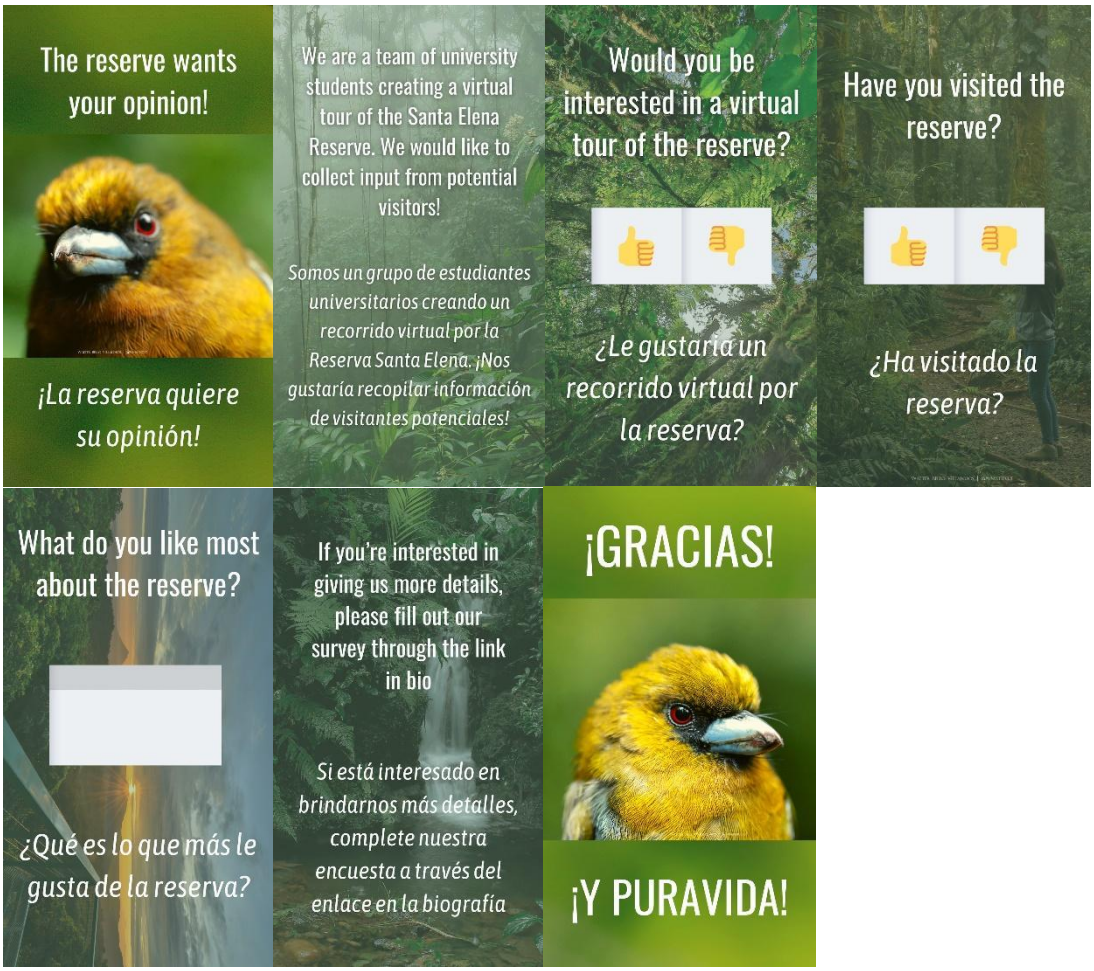
Appendix B - Key Features Survey for Tour Guides

Thank you for taking part in our survey! By answering the following questions, you are providing consent to participate in this survey. Your responses will be collected as part of our research and will be completely confidential.
¡Gracias por participar en nuestra encuesta! Al responder las siguientes preguntas, está dando su consentimiento para participar en esta encuesta. Sus respuestas se recopilarán como parte de nuestra investigación y serán completamente confidencial.

1. What is your name?
   ¿Cuál es su nombre?
2. Based on your experience with visitors, what do you believe are the key points of interest in the forest; in other words, what is most popular with tourists?
   Según su experiencia con los visitantes, ¿cuáles cree que son los puntos clave de interés en el bosque? en otras palabras, ¿qué es lo más popular entre los turistas?
3. During tours, do you focus on certain parts of the reserve more based on their popularity? If so, which areas?
   Durante los recorridos, ¿se concentra más en ciertas partes de la reserva en función de su popularidad? Si es así, ¿en qué áreas?
4. Do you have stories or talking points that you always mention to visitors?
   ¿Tiene historias o temas de conversación que siempre menciona a los visitantes?
5. What do you believe should definitely be included in the tour? (Specific locations, views, history of the reserve?)
   ¿Qué cree que debería incluirse definitivamente en la gira? (¿Ubicaciones específicas, vistas, historia de la reserva?)
6. How do you think we can best capture the park and its attraction digitally? (Specific sounds, pictures, videos?)
   ¿Cómo cree que podemos capturar mejor el parque y su atracción de forma digital? (¿Sonidos, imágenes, videos específicos?)

If you have any questions, you can contact us at gr-ser-mv21@wpi.edu. Thank you!
Si tiene alguna pregunta, puede contactarnos en gr-ser-mv21@wpi.edu. ¡Gracias!

Appendix C - Social Media Post and Key Features Survey



Thank you for taking part in our survey! By answering the following questions, you are providing consent to participate in this survey. Your responses will be collected as part of our research and will be completely confidential.
¡Gracias por participar en nuestra encuesta! Al responder las siguientes preguntas, está dando su consentimiento para participar en esta encuesta. Sus respuestas se recopilarán como parte de nuestra investigación y serán completamente confidencial.

1. Have you ever visited the Santa Elena Reserve?
   Ha visitado la Reserva Santa Elena?
   a. Yes / *Sí*
   b. No
   c. No but I want to / *No pero quiero visitarla*
2. Around when did you visit, and why?

¿Cuándo visitó y por qué?

3. Thinking back to your visit, is there any aspect of it that you remember more? Anything that stands out from the rest?
   Pensando en su visita, ¿hay algún aspecto que recuerde más? ¿Algo que se destaque del resto?
4. Is there anything you'd like to see in a virtual tour of the reserve? (sounds, animals, sites...)
   ¿Hay algo que le gustaría ver en un recorrido virtual por la reserva? (sonidos, animales, lugares...)
5. Do you have anything else you would like to tell us?
   ¿Tiene algo más que le gustaría decirnos?

If you have any questions, you can contact us at gr-ser-mv21@wpi.edu. Thank you!
Si tiene alguna pregunta, puede contactarnos en gr-ser-mv21@wpi.edu. ¡Gracias

Appendix D - Shot List

360 Scenes	Location Hotspots	Informational Hotspots
Starting Area		
Visitor Center	Orchid Garden	Reserve Website (URL)
		About the Reserve (Article)
		Inside View (Image)
		Intro Video (Article)
Orchid Garden	Visitor Center	Cope's Coffee Snake (article -Insta)
	Trail Beginnings	Utricularia alpina (image)
		Pitcairnia brittoniana (image)
Trail Beginnings	Orchid Garden	
	Map Directory	
	Encantado Trail	
Map Directory	Trail Beginnings	Map (Image)
	Lookout Tower	Canopy (Image)
	End Of Youth Challenge Trail	
Encantado Trail		
Encantado Trail	Trail Beginnings	Spectacled Owl (article)
	Quetzal Sanctuary	Golden Jewel Scarab Beetle (article)
		Encantado Trail Walk (article)
Quetzal Sanctuary	Encantado Trail	Quetzal (article)
	Frijolillo Tree	Quetzal in Flight (image)
		Guide Video - Queltzal (Article)

Frijolillo Tree	Quetzal Sanctuary	View (image)
	Trails Intersection 1	Spider Monkey (article)
		Scale-Crested Pygmy Tyrant (article)
Trails Intersection 1	Del Bajo Trail	
	La Saca	
	Frijolillo Tree	
La Saca	Trails Intersection 1	Slingshot spider (article)
	Trails Intersection 2	Tayra (article)
Trails Intersection 2	La Saca	
	La Gata	
	El Resbalon	
La Gata	Trails Intersection 2	
	Encantado Shortcut	
Encantado Shortcut	La Gata	
	Trail Beginnings	
Del Bajo Trail		
Del Bajo Trail	Trails Intersection 1	Common Mexican tree frog (article)
	Waterfall	Capuchin (article)
Waterfall	Del Bajo Trail	Waterfall (image)
	Tree Hollow	Swimming Frogs (video)
		Orange-bellied trogon (video)
Tree Hollow	Waterfall	

	Cano Negro Trail	
Youth Challenge Trail		
Lookout tower	Map Directory	View (image)
	The Cave	View (image)
		Tower View Video (video)
		Volcano View (article - Instagram)
The Cave	Lookout Tower	Peccary Trap Cam (article)
	Highest Altitude Point	Side-Striped Palm-Pit Viper (article)
Highest Altitude Point	The Cave	Altitude Point
	Trails Intersection 3	
Trails Intersection 3	Highest Altitude Point	
	Yos Tree	
	Cano Negro Trail	
Yos Tree	Trails Intersection 3	Bare-Shanked Screech Owl
	End of Youth Challenge Trail	Three-Wattled Bellbird
End of youth Challenge Trail	Yos Tree	Map Directory (article)
	Map Directory	Lebeau's Rothschildia (article)
Caño Negro Trail		
Caño Negro Trail	Tree Hollow	Tarantula Hawk Wasp (article)
	Trail Clearing	Shinrin-Yoku (Forest Bathing) (video)
	Trails Intersection 3	

Trail Clearing	Caño Negro Trail	The Reserve's Public Bathroom (article)
	Volcan Arenal	Three-Toed Sloth (article)
Volcán Arenal	Trail Clearing	King Vulture (article)
	El Peligro	Arenal Volcano (article)
El Peligro	Volcán Arenal	King Vulture (article)
	Black Spout Bridge	Arenal Volcano (article)
Black Spout Bridge	El Peligro	Epiphytes (article)
	El Resbalón	Red-Eyed Tree Frog (article)
El Resbalón	Black Spout Bridge	Cordyceps (article)
	Trails Intersection Bridge	Puma Trap Car (video)

Appendix E - Feedback - Social Media Post

Post caption: ¡Va al árbol de enlaces (linktr.ee) en nuestra bio para acceder al tour!

Spanish version

English version

Appendix F - Feedback Round 1 - Survey

Thank you for taking part in our survey! By answering the following questions, you are providing consent to participate in this survey. Your responses will be collected as part of our research and will be completely confidential.

1. On a scale of 1-10 (1 being least enjoyable and 10 being most enjoyable), how would you rate your experience with the virtual tour?
2. What feature did you find most interesting about the virtual tour?
3. What feature did you find least helpful about the virtual tour?
4. How easy is the virtual tour to navigate on a scale of 1-10? (1 being very difficult and 10 being very easy)
5. Would you recommend this virtual tour to others? (Yes/No)
6. How educational was this tour? Did you learn anything new?
7. What feature could we add to the tour to make it more interactive or educational?
8. What would you change about the tour, if anything? Would you do anything differently?
9. Do you have any other questions, comments, or concerns?

If you have any questions, you can contact us at gr-ser-mv21@wpi.edu. Thank you!

Note: A drop down menu provided the user with an option to view this survey in English, Spanish, French, or German

Appendix G - Feedback Round 1 - Interview Script

Hello, we are a team of students from Worcester Polytechnic Institute working with the Santa Elena Reserve in Monteverde, Costa Rica, to develop a virtual tour.

We are conducting this interview as part of our project. We are interested in any insight you can provide us. The information from this interview will be used in our project research which will be later published in the WPI public database, but it will be completely kept anonymous. The recording itself will not be distributed to anyone besides our team. Your participation is completely voluntary, so we would like to get your permission before asking any questions and recording. Would you be willing to participate? (If yes, continue. If no, thank them for their time and end the call.) Are you also willing to be recorded? (If yes, start recording. If no, take notes.)

Thank you for agreeing to take part in our interview! Do you have any questions before we start? (Answer any of participant's questions)
If you also happen to have any questions after the interview, you can reach out to us via our email gr-ser-mv21@wpi.edu. You may also reach out to either of our advisors, Professor Sarah Strauss (sstrauss@wpi.edu) and Professor Melissa Belz (mbelz@wpi.edu).
(Continue on to interview questions)

Getting feedback about the tour from users	
Main discussion point/goal	**Sample questions**
Inquire about technical difficulties, and gauging ease of navigation.	• Did you experience any technical difficulties while using the virtual tour? • Was the loading time acceptable? • Did you have difficulties navigating the tour? • On a scale of one to ten, how easy was it to navigate the tour? • Was anything unclear?
Gain information about their experience, what they enjoyed or would like to change.	• Did you enjoy any part of the tour more than others? • Would you change anything about the tour, if you could? Do you have any suggestions? • On a scale of 1 to 10, how enjoyable was your experience?
Closing questions	• Do you have any questions for us? • Do you have anything else you'd like to add that was not mentioned?

Thank you for taking the time out to answer our questions today!

Appendix H - Feedback Round 2 - Survey

Thank you for taking part in our survey! By answering the following questions, you are providing consent to participate in this survey. Your responses will be collected as part of our research and will be completely confidential.

1. On a scale of 1-10 (1 being least enjoyable and 10 being most enjoyable), how would you rate your experience with the virtual tour?
2. What feature did you find most interesting about the virtual tour?
3. What feature did you find least helpful about the virtual tour?
4. How easy is the virtual tour to navigate on a scale of 1-10? (1 being very difficult and 10 being very easy)
5. Were you able to find the donate button easily?
    a. If not, how could we make it easier to find?
6. Were you able to find the feedback (Rate Us) button easily?
    a. If not, how could we make it easier to find?
7. Were you able to find the map button easily?
    a. If not, how could we make it easier to find?
8. Would you prefer an audio narration for any scenes or hotspots?
    a. If so, which ones?
9. Did you enjoy the background sounds of the reserve?
10. Were you able to find the background sound switch on/off button easily?
    a. If not, how could we make it easier to find?
11. Were you able to find the hotspot list for each scene easily?
    a. If not, how could we make it easier to find?
12. Would you prefer the option for an auto-guided tour (the tour transitions by itself)?
    a. I want the tour to play automatically.
    b. I want to navigate the tour by myself.
    c. I want both options.
13. What did you think of the number of informational hotspots?
    a. Too few.
    b. Right amount.
    c. Too many.
14. How educational was this tour? Did you learn anything new?
15. What feature could we add to the tour to make it more interactive or educational?
16. Would you recommend this virtual tour to others? (Yes/No)
17. What would you change about the tour, if anything? Would you do anything differently?
18. Do you have any other questions, comments, or concerns?

Note: A drop down menu provided the user with an option to view this survey in English, Spanish, French, or German.

Appendix I - Feedback Round 2 - Interview Script

Hello, we are a team of students from Worcester Polytechnic Institute working with the Santa Elena Reserve in Monteverde, Costa Rica, to develop a virtual tour.

We are conducting this interview as part of our project. We are interested in any insight you can provide us. The information from this interview will be used in our project research which will be later published in the WPI public database, but it will be completely kept anonymous. The recording itself will not be distributed to anyone besides our team. Your participation is completely voluntary, so we would like to get your permission before asking any questions and recording. Would you be willing to participate? (If yes, continue. If no, thank them for their time and end the call.) Are you also willing to be recorded? (If yes, start recording. If no, take notes.)

Thank you for agreeing to take part in our interview! Do you have any questions before we start? (Answer any of participant's questions)
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(Continue on to interview questions)

Getting feedback about the tour from users	
Main discussion point/goal	**Sample questions**
Inquire about technical difficulties	• Did you experience any technical difficulties while using the virtual tour? • Was the loading time acceptable?
Gauge ease of navigation and of use	• Did you have difficulties navigating the tour? • On a scale of one to ten, how easy was it to navigate the tour? • Were you able to find the donation/rate us/map/hotpot list/toggle sound buttons easily? • Was anything unclear?
Gain information about their experience, what they enjoyed or would like to change.	• Did you enjoy any part of the tour more than others? • Would you change anything about the tour, if you could? • Do you have any suggestions?

	• On a scale of 1 to 10, how enjoyable was your experience? • What did you think about the hotpots? The sounds?
Closing questions	• Do you have any questions for us? • Do you have anything else you'd like to add that was not mentioned?

Thank you for taking the time out to answer our questions today!