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360 Degree Virtual Museum Tour Application in Tugu Pahlawan Museum

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Abstract. In an era where technology is rapidly evolving and diverse, which has resulted in the emergence of a new lifestyle, namely, wanting everything to be done quickly, coupled with the pandemic conditions that are still prevalent, Therefore, in this research, a 360 virtual tour application was created with the aim of making it easier for people in Indonesia and outside Indonesia to get to know more about museums in Indonesia. This virtual tour application starts with the museum survey stage, which involves taking 360 photos at the museum, making hotspot trips in a software called 3D Vista, and making applications. In addition, a standard medium is also needed so that different systems can communicate with each other. The media standard used is the API (Application Programming Interface). There are many types of APIs, but what will be used in this research is the REST (Representational State Transfer) API. The framework that will be used to create this REST API is Laravel 9. What will be produced from this research are APIs for login, register, refresh, logout, museum, and profile.

INTRODUCTION

Indonesia, as an archipelago country, has natural beauty, cultural variety and customs, and a rich historical past, all of which have significant tourist potential. Tourism is the fourth greatest source of income in Indonesia (4%) after oil and gas, coal, and palm oil [1]. Furthermore, the tourism industry can employ ten million people. As a result, tourism is critical to gaining great attention. In 2019, the government hopes to raise the number of tourists from abroad by 20 million, bringing in 260 trillion rupiah in income. Heritage tourism is one type of tourism that has not been well handled in Indonesia. Indeed, given the abundance of historical relics in Indonesia (temples, monuments, artifacts, coinage), religious relics (temples, monasteries, mosques, churches), and colonial relics (fortresses, weapons), this has enormous potential to be investigated. These relics are housed in museums all around Indonesia. The Indonesian government has undertaken various changes, including museum standards and classification (120 museums out of 400) [2] and museum rejuvenation initiatives (80 museums) [3]. To promote the museum, suitable supporting facilities and infrastructure are required, particularly promotion facilities and information on museums in Indonesia. A facility and infrastructure that may blend with the present, which is appealing to many people, particularly young ones. Given that museums are often associated with something dull and uninteresting, the events happened in the past and were not immediately tied to the present.

One of the existing issues is a lack of museum promotion efforts that are appealing to the public. How can visitors learn more about the museum and its artifacts. There have been many attempts to develop tourism information facilities based on internet technology and mobile devices, such as the Ranggawarsita museum in Semarang [4], and

an information application for the Perjuangan Republik Indonesia museum in Jakarta [5], Surabaya [6], and Trowulan [7]. Several Indonesian museums, like the Vredeburg Museum (vredeburg.id) and the National Museum, have also used website media to present existing collections (www.museumnasional.or.id). However, this implementation is not yet equipped with a virtual tour that can give the virtual visitor the experience of visiting the museum. The purpose of this research is to increase the potential of digital tourism in Indonesian tourism, specifically those presented by utilizing website technology with the ability to present 360-degree images so that visitors can interactively make virtual visits to museum locations in order to encourage visitors to visit the museum. The Tugu Pahlawan Surabaya Museum will be utilized as a museum data object in this research as a pilot project. Tugu Pahlawan is one of the museums that contains the history of the battles in the struggle for Indonesian independence. This museum is located in the city of Surabaya, which is also known as the "city of heroes."

LITERATURE REVIEW

Many museums across the globe, including the Louvre Museum (www.louvre.fr), the Smithsonian Institution (www.si.edu), and the National Museum of Singapore (www.nhb.gov.sg/nationalmuseum), have utilized the internet to establish museum content delivery capabilities. Whereas each museum provides visitors with information about the museum as well as information about its artifact collection. One of the most recent efforts is to create a virtual museum, such as the Google Arts & Culture application (artsandculture.google.com), where the museum's collection of art objects is enshrined in the form of a virtual gallery or online exhibit (in the form of pictures and videos) so that application users can view these collections.

Several additional studies have attempted to provide information services for museum visitors in various media, such as an electronic handbook for historical museums [8]. Audio information services that may be accessed by phone or online (website) and downloaded on cellphones (www.museumwithoutwalls.org), as well as mobile audio guides [9] Unfortunately, the development of these facilities has been fragmented, and they are still quite bland and boring, with no clear and complete contents, no interactive map of the museum, and no interesting elements (such as games or quizzes).

PHOTOGRAPHY TECHNIQUE IN THIS RESEARCH

We take photographs using an Insta360 One X3 360 camera. This camera has a 72-megapixel sensor and can take 360-degree photographs. To capture images with this camera, we link it to their official app, which is accessible for both Android and iOS, and once connected, all you have to do is hit the photo button to shoot 360-degree photos. The photo's findings will be shown in the program, and the file will be saved on the camera's storage medium in the form of a micro SD card. We also use a tripod and tweak the tilt and elevation to obtain the best image possible when capturing these shots.



FIGURE 1. Example of taking a 360 photo

360 PHOTO CREATION AND HOTSPOT PLACEMENT

We utilize 3D Vista software to create 360-degree photographs. Existing photographs will be converted into spherical panoramas that may be viewed in 360 degrees (Fig. 1 and Fig. 2). Hotspots are hyperlinks that move from one 360 picture to another. Each snapshot has a hotspot in every corner (Fig. 3).

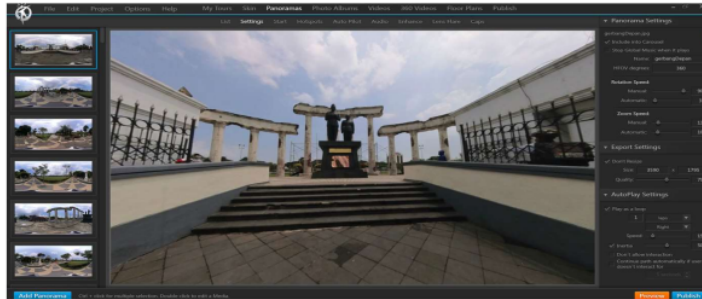


FIGURE 2. 360 degree photos creation

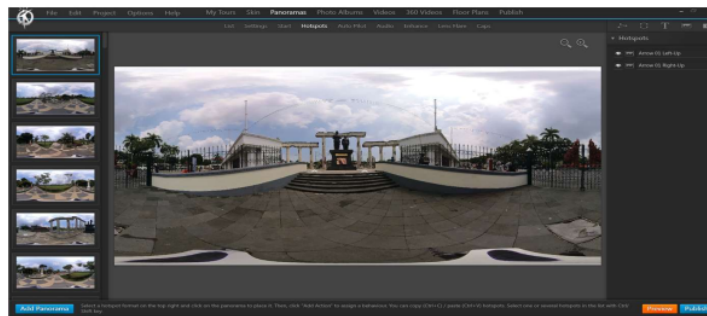


FIGURE 3. Hotspot creation

360 VIRTUAL TOUR EXPORT AND EMBED TO THE APP

After the virtual 360 creation is complete, we export the virtual tour as a website. The HTML file is then uploaded to a web server. After that, we embed the HTML link into our application that uses Flutter (Fig 4).

APPLICATION CONNECTION USING API AND REST API

An application programming interface (API) is software that connects applications together. The purpose of the API itself is to be able to share data between one application and another and to make the process of developing and creating applications faster because separate functions are available and there is no need to create these functions again (Fig. 4). The Representational State Transfer (REST) API is an architectural design that resides within the API. The way the REST API works is that the REST client will access data on the REST server. Each piece of data will be identified by a Universal Resource Identifier (URI) or a global ID (Fig. 5). REST APIs consist of several formats, such as JSON, XML, and text. Recently, JSON has been the most widely used format. JSON consists of key-value pairs separated by a comma. The following is an example of JSON (Fig. 6).

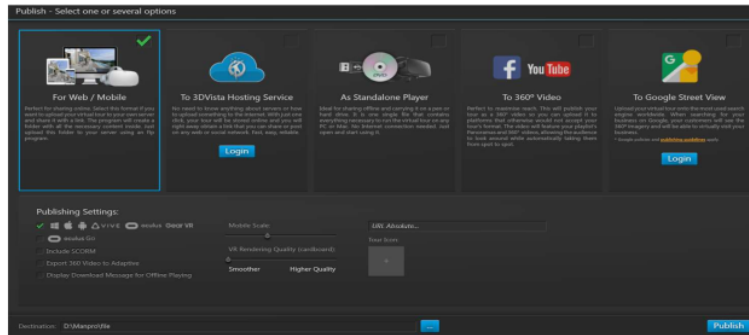


FIGURE 4. Doing export virtual tours

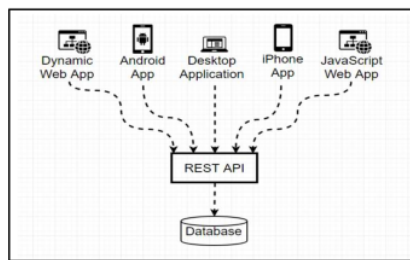


FIGURE 5. REST API overview

```
{
  "name": {
    "FirstName": "Bill",
    "LastName": "Bush"
  },
  "age": 30,
  "children": {1: O3, 2: O4}
}
```

FIGURE 6. JSON format

For the API register, we will receive input in the form of JSON, which contains 4 fields: name, email, password, and password confirmation. This API register will check whether the email entered is already in the database or not; if it is, then the account creation will be rejected; if it is not, then it will proceed to the next checking stage. Here is the output to be issued if the email is not unique (Fig. 7).

```
{
  "email": [
    "The email has already been taken."
  ]
}
```

FIGURE 7. Email taken

The next step is to verify that the password and password confirmation are identical; if they are not, the account will be rejected; if they are, the account will be successfully created. The following is the output that will be issued if the password and confirm password are not the same (Fig. 8).

```
    {
      "password": [
        "The password confirmation does not match."
      ]
    }
  ]
}
```

FIGURE 8. Passwords don't match

9. If all of these steps have been completed, the email will be successfully created and will return output like in Fig.

```
  "message": "User created successfully",
  "user": {
    "name": "Eric",
    "email": "eric2@gmail.com",
    "updated_at": "2022-11-27T12:23:11.000000Z",
    "created_at": "2022-11-27T12:23:11.000000Z",
    "id": 5
  }
}
```

FIGURE 9. Successfully created user

For API login, we will accept input in the form of JSON, which contains two fields: email and password. If the email and password sent by the user match those in the database, then we will return a JSON object containing a JWT (JSON Web Token). JWT is a long string used to authenticate requests sent by logged-in users (Fig. 10). We set the validity of this JWT for 1 day, aka 24 hours. So, if the user does not open the application for more than 24 hours, then they will have to re-login. The following is an example of the output of the login API if the user has successfully logged in.

```
  "token": "eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJpc3MiOiJodHRwOi8vMTI3LjAuMC4xOjgwMDAvYXpL2F1dGgvcG9naW4iLCJpYXQiOiJlNjE4NTMsImV4cCI6MTY2OTYzODI1MywiImJmIjoxNjY5NTUxODUzLCJqdGkiOiJyYVlVS2U1QUZ5MTBacmhmIiwic3ViIjo4NSIsInBydiI6IjIzYmQ1Yzg5NDlmNjAwYWRiMzllNzAxYzQwMDg3MmRlN2E1OTc2ZjciOiJ1El1zNeeOhlbCkYfnjAw96Lnh1dUoH9ad3EHspMAXBw",
  "token_type": "bearer",
  "token_validity": 86400
}
```

FIGURE 10. JSON Web Token

For the refresh API, it will update the JWT token every time they open the app. If they open the application for less than 24 hours, they will get the latest JWT, and the old JWT will expire. This is very important, so they don't have to type in their email and password to log in every 24 hours. For the logout API, we will accept JWT input and deactivate the JWT so that it can no longer be used to request resources from other APIs. For the museum API, there will be 2 APIs: the first is the list museum API, which will return all lists of museums available in the application. This API will be useful for displaying all museums in the Home section of the museum application. The second API is the museum details API, which will receive the museum ID parameter and return museum details such as the name, description, location, and the museum's 360 virtual tour link. For the API profile, it will return the name of the user so that on the profile page, they can see their name. All APIs are only accessible if they include a valid JWT.

We tested the application prototype on 30 museum visitors who were visiting the Tugu Pahlawan museum at the time. The test results are reported in Table 1. It is possible to infer that the application created entices people to come and learn more about the Tugu Pahlawan museum (80%).

TABLE 1. Respondents' Responses toward Respondents' Interest in the Application

	Very Not Interesting	Not Interesting	Interesting	Very Interesting	Total Respondents	Respondent Percentage
Age 6-12	0	1	6	1	8	26.67%
Age 13-24	0	0	0	12	12	40.00%
Age 24-70	0	0	3	7	10	33.33%
Total Respondents	0	1	5	24	30	100.00%
Percentage Answer	0.00%	3.33%	16.67%	80.00%	100.00%	

CONCLUSION AND DISCUSSION

It is intended that the construction of the 360 virtual tour application would broaden the public's chance to observe and learn from this virtual museum tour. This is intended to promote the museum and its artifacts, as well as attract visitors to the museum. In addition, suitable hotspot placement and the usage of a 360 camera can aid in the creation of virtual tour images. According to the results of the test, 80% of people were interested in the application. Future research and development will add more pictures of museum artifacts. Development can also be done by adding a virtual guide to artifact information from the museum.

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