A REPORT

ON

IMPLEMENTING A QR CODE BASED INFORMATION SYSTEM IN MUSEUMS

BY

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AT

BITS Pilani, Dubai Campus
Dubai International Academic City (DIAC)
Dubai, U.A.E

Second Semester 2018 - 2019

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Abstract: This is a project report which discusses the feasibility analysis for implementing a QR Code based information system in Museum for easy access of information and making the visits more interactive. Preservation of information is a very important area of discussion in the digital age and years to come. Digitization of museums will prove to be helpful in keeping information safe for future generations to study. QR code-based systems will prove to be cost efficient as well in doing so. Modern day museums face challenges such as cost optimization and space optimization. This project aims to address these issues and further provide an effective solution with the help of technology.

Signature of Student **Signature of Supervisor**

Date: **Date**

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Sagar Agarwal
Signature of the Student
Date: 15-05-2019

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CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

This is a project report which discusses the feasibility analysis for implementing a QR Code based information system in Museum for easy access of information and making the visits more interactive. Preservation of information is a very important area of discussion in the digital age and years to come. Digitization of museums will prove to be helpful in keeping information safe for future generations to study. QR code-based systems will prove to be cost efficient as well in doing so.

1.2 NEED FOR THE STUDY

The literature review and methodology give us a detailed insight into the process of digitization of museums and how it can be helpful for generations to come. This era is all about digital data and while everything is undergoing digitization, so should museums.

1.3 OBJECTIVES

The project report aims to help in information preservation and improve user interaction during a museum visit. This project had been divided into phases, it started with the literature review and designing a model website to resemble that of an actual museum. Over the course of this semester, additional features were added to the museum website to make it more appealing and QR codes were generated linked to each parameter associated with this website. Furthermore, a blueprint of the museum called Archaic was drafted. This blueprint was later designed into a model museum

1.4 SCOPE

Implement a QR code-based information system in museums for making it easier for people to access information on their fingertips. In this decade everybody has access to the internet through smartphones, and hence we can use this technology to make Museum visit more fun for people by providing them information about everything on their fingertips with just a scan. Phones like the iPhone already have a QR scanner built in its camera, whereas Android users can download it for free from the Google Playstore.

1.5 LIMITATION

The system discussed in this project report has to be well implemented for it to be effective. There has to be a proper source of data collection and the right QR code scanner with the user to be able to use this technology. The information put up on the museum site has to be well researched and user rights have to be acquired. QR code technology has earlier been tried with advertisements on billboards, but the audience may not have the right application installed to scan it and may just pass by it.

These QR codes may also be used for spreading malicious information, also referred to as "attagging." Since anybody can access this technology of generating the QR codes, they could code a malware and tag this code over a legitimate one.

1.6 REPORT PREVIEW

This report has a detailed analysis of every aspect treated in this project from literature review to the methodology adopted for the deigns. It also discusses the need of such technology in museums for space and cost optimization in years to come. Lastly, this report also discusses the Future Scope of this project and how it can be improved upon with advancements in technology.

CHAPTER 2

LITERATURE REVIEW

2.1 QR CODE

The acronym for Quick Response Code is QR code. This is similar to the already present barcodes tagged on products with some additional features. This is a two-dimensional code with the ability to store more information than the conventional bar codes. This is a huge upgrade as more information can now be stored for user interface.

The user needs to click a picture of this code with the adequate application on their smartphones, which directs them to the picture, website, contact information or advertisements. If the user already has an application installed, this proves to be a real quick and simple process. Today all iPhones have a QR code scanner already installed in their mobile camera application and android users can download it from the Google Playstore. There are no additional steps required from the user side.

There are multiple online resources where one can easily design their customized QR codes free of cost or at a nominal value, in case of a paid commercial purposes. The QR codes for website and phone number can be generated free of cost.

It is also possible for the user to have special codes designed for their demands with customized contact information or say location tracking. These specialized codes are programmed to enhance your business goals and one can track thousands of them as per the requirements.

Lastly, even though one can create personalized QR codes for their brands, it has an upper margin of 30% error to be read by most applications and smartphones. One has to keep their customizations within this range for it to be effective and have most people use it. Company logo, color themes etc. can be added as long as it is within this 30% error margin.

2.1.1 DEVELOPMENT

Quick Response Code was originally developed by Denso Wave, a subsidiary of Toyota motors in the year 1994 targeted to track vehicles in the assembly line and scan the vehicle components at fast speeds. This is a trademark name for the 2-dimensional system. Even though the company has this technology patented, it is published online to be used without any charge to anybody.

Figure 2.1 is the QR code for the model site created for this project. It will direct one to the museum website titled – Archaic. This code was tested on the iPhone preinstalled camera and the applications downloaded on Android applications.

Figure 2.1 – QR Code

Not only can the Quick Response Code hold hundred times more information than the conventional barcodes, it has the possibility of a digital scan. In the figure 2.1, the small black and white square are rear by the phone's sensors and subsequently interpret by the processors. The three larger squares present on the corners in the code are for adjusting alignment for digital reception. The smaller black square in the bottom right is for size normalization and shot angle. Since not everybody will hold the camera as required with patience, these alignment blocks play a key role in the whole reception process. The strips close to these blocks serve the purpose of information formatting, while the other space is the actual information. This data is converted to binary bits and later checked for any errors that may be present before display. The data that is encoded could be of one of the primary data types namely, alphanumeric, Kanji, byte or numeric. It is also possible now to display any other type of data format than that listed before with appropriate information extension.

With evolution in the Quick Response Code technology, it became possible for them to contain more data. The first version was limited to 21 square pixel and could only accommodate four characters of data units. The latest version boats of holding up to 1852 data units with size of 177 square pixels. This is more than adequate of allowing few pages worth of data. All these versions present today made it feasible to be implemented in this project, and to direct user to the museum website upon digital scan through the smartphone camera.

Over the years since its development for usage in the automobile industry, the Quick Response Code has found its application in various other industry sector. They are being used in supply chain management systems for logistics, package tracking etc. online content creators use QR codes to promote their content on YouTube for their events and flash sales. Business houses use this model in collaboration with Google Maps for directions to their offices or share their contact information. They also use this technology for advertisements. e-Commerce giants use this to promote their upcoming sales etc.

A wildlife sanctuary in Florida has Quick Response Code tags stamped along their hiking trek that contain information about the local flora and fauna.

2.1.2 IMPLEMENTATION AROUND THE WORLD

There have been beta version trails of implementing this Quick Response Code system in the museums over the years. The most common of them was invented by the research and development wings of the UCL, Edinburgh, University of Dundee, Salford University and the University of Brunel. They named it the Tale of Things which aimed at storing information in the form of media – "tale", that the users had to say about the objects. They linked the QR code system to this media.

Tale of Things is being used in museums in Europe, such as the National Museum of Scotland and as part of the QRator project at UCL's Grant Museum of Zoology and Museum of Egyptology.

Co-creation and sharing are said to be the two tenets of a modernized, forward-looking museum, and bring about a certain type of excitement and rage which would make this particular system a surefire hit. It enables people to record their personalized views and reflections on the artifacts present in the museum and goes on to 'attach' these reflections to those artifacts for future visitors to see, who in turn will be able to respond by attaching their own reflections based on their perspective.

The fact that QR codes have potential to open up a whole new path of communication with the museum visitors as well as the ability to break away from the 'usual one-way traffic of information, was recognized by Alison Taubman (a principal curator of communications at the National Museum of Scotland). She also acknowledged that in Scotland's latest project- "Tales of a Changing Nation"-this type of two-way dialogue has been scant so far.
It would seem that regardless of the countless appeals, museums are having a hard time believing in this type of technology due to a few restrictions faced during the implementation of the system along with the lack of awareness of the public.

After experimenting quiet, a bit with the QR codes, the Power House Museum located in Sydney realized that only a handful of their visitors had a suitable QR code scanner installed on their smartphones. They then came up with the idea of designing a reader into a specific mobile application which would then serve as a database as well as a QR code scanner for the multiple artifacts present in the museum. This application also supports the museum's current Love Lace exhibit by enabling the visitors to access the artifacts catalogue entry by simply scanning the QR code which is present on the physical exhibit.

Although this system appears simple, it is hiding technological pitfalls. If, due to some clerical mistake, the codes printed are smaller than the optimal size, the scanner along with the phone camera will have difficulty understanding them. If the lighting is poor, or if shadows are present, or even if another visitor's reflection is caught on camera along with the QR code a problem is encountered. This was discovered by the Powerhouse during their experimenting phase. Another potential difficulty is the provision of free Wi-Fi to the hundreds of visitors in the museum.
However, since QR codes are relatively straightforward to manufacture and even easier to use, assuming that a visitor already has the application for the scanner installed in their smartphones and that Wi-Fi connectivity does not pose a threat and is readily available, the advantages outweigh the disadvantages.

2.1.3 PRESENCE IN THE UAE

In the last decade the QR code has gained immense popularity and is being used in almost every sector of the industry, hence it is safe to say that the usage is also rising in the UAE. In the report by the leading market research agency, TNS Mena, over 19% of consumers use the Quick Response Code almost every day. The report went on to state that the over 28% consumers are expected to be using this service in the future.
QR codes have been incorporated in many industries in KSA and other parts of the Middle East. Given below are the five sectors that have successfully implemented the QR code system in the UAE.

- *In Banking*

Back in May 2017, Emirates NBD, one of the largest banking group in United Arab Emirates announced the incorporation of QR codes to their cheques. They called this "Check Chain", which mainly targeted to counter cheque forgery since now the cheque could be traced back to the holder. Along with the QR code system, this cheque also uses the Blockchain technology.

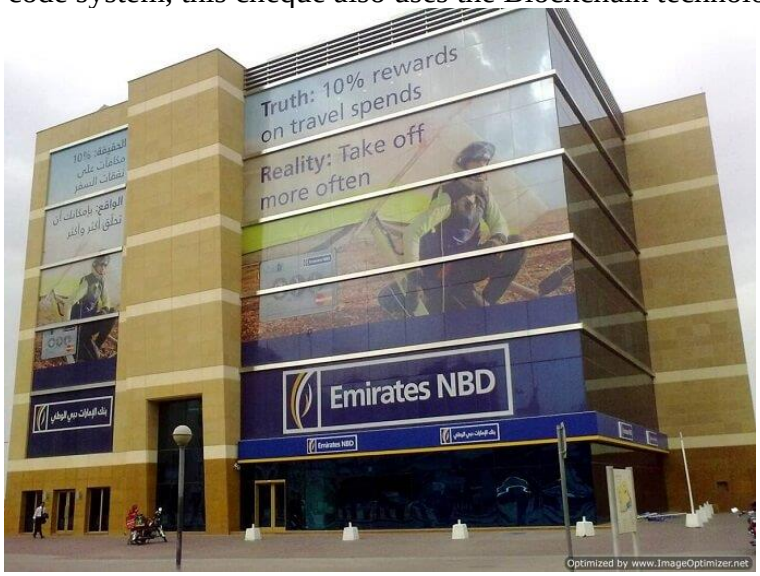

Figure 2.2 – NBD

The code on the issued cheque would be synced to the bank's Blockchain database. Through this, before encashing, the banker could check upon the authenticity and the source.

- *In Stores*

As of May 4, 2017, E-city- an electronics store chain based in UAE- launched a latest in-store technology. This new technology was introduced across all of the eight stores present in UAE. During the revamp all the stores had multiple interactive screens installed across all the aisles. Apart from the interactive screens, a QR code was installed next to each electronic item. The customers then are able to scan the QR code and learn all about the product.

Figure 2.3 – e-City

- *In Marketing*

Gulf News which happens to be UAE's most leading English daily, collaborated with a Canadian fast food chain-Tim Hortons. Sleeves (shown in the figure below) for Tim Hortons to-go coffee cups were produced by Gulf News. The interesting part about the sleeves was that each individual piece came along with a trending headline from Gulf News' Twitter page and also a QR code, which once scanned would allow customers to read the complete news article.

Figure 2.4 – Tim Hortons

The campaign turned out to be a huge success, Gulf News' webpage reportedly received a 40% rise in traffic.

- *On Buildings and Streets*

Onwani Addressing System

The department of Municipal Affairs in Abu Dhabi (DMA) had approximately 66,000 new number plates installed in 2015. As part of a modernized addressing system-Onwani-these

number plates were installed on multiple buildings. All of the plates consisted of a QR code which was linked to a map that shared the location of that particular building. Residents of the building were then able to scan the QR code and share their location to friends and family via their smartphones.

Figure 2.5 – Onwani

Besides this, new street name boards with QR codes were also installed by the municipality. When these were scanned by pedestrians or tourists, they were able to acquire more information about the location and the history of that particular place. This system makes it extremely convenient for delivery men to reach their desired location.

Makani

A system bearing resemblance to the Onwani Addressing System was initiated by the Dubai Government called Makani. This made it convenient for people to their desired location in Dubai. Each Makani board consists of a specific 10-digit ID number along with a QR code. Upon scanning the code present on the board, a map of the location will appear. Along with the map it will also show places of interest.

Figure 2.6 – Makani

- *In Real Estate*

A Dubai real estate firm by the name of Asteco printed ads in newspapers consisting of QR codes. When people scanned the QR code it led them to a website which would:
Allow them to learn more about the property
Request sales agents for call backs
Provide a listing of their property

Figure 2.7 – Real Estate

Every year approximately 9 million tourists visit Dubai as well as Abu Dhabi. Majority of them are from countries like china, US and UK where QR systems are extremely famous. Therefore, it would be profitable for UAE based print marketers to add QR codes while campaigning as to never miss an opportunity for better engagement with not just tourists but also locals.

2.1.4 PRESENCE IN MUSEUMS

Even though over the years Quick Response Code have been associated with on-site marketing and advertisements, this system could also be well implemented in the museums for better interaction enhancement.

Museums' management can use the Quick Response Code to offer multimedia experience for people. Through the content label, an exhibit is limited to provide information due to space constraints. This is exactly where one can implement the QR code system, since this code can store additional information such as video, picture or even a combination of the above-mentioned media for the user.

The area required for tagging the Quick Response Code is not only moderate but much smaller than the space designated to the exhibit label in a museum, this proves to be space efficient along with user friendly. Usually a museum does not spend much on maintenance and upgrading to the current trend audio-visual aids, implementing Quick Response Code system can be a reasonable option, they could be programmed with additional information and presentations than that already

present. This is also a cost-efficient way for brick-and-mortar museum, that do not target on generating profits from the ticket revenue collection.

With experience in the past by many organizations, it is safe to say that updating the digital information online is a much effortless and a swift process than changing the whole exhibit label. With time, each year the trend changes in the market, new digital content comes up, like virtual reality and augmented reality and it is easier to update this on aa digital platform. The Quick Response Code focuses upon the multimedia content, which can easily be updated and monitored. As the event starts and with each new day, if there is an update required in the schedule, this system proves to be the best one out there for its effectiveness.

These codes could also be exploited by using them to arrange and rearrange the exhibits in a museum. It is a very easy and a simple process to remove a tag and place it in its new location than to tear down the entire out of date exhibit and redesign it. If done properly, museum staff can save up on monetary expenses, additional time and of course on the energy investment for the whole renovation process. Quick Response Code can be used to refurbish the museum for the audience experience yet be cost efficient.

The Fort Wayne Museum of Art and The Los Angeles County Museum of Art

These are one of multiple museums that incorporated the QR Code system. The exhibits are tagged with the code and allow the patrons to digitally scan it using their smartphones to view the biographic information about the artist. They could also watch a documented presentation about their other popular artwork. These are usually stationed next to or below the already existing label of the exhibit.

The Cleveland Museum of Art

This museum decided to not make tourists spend extra on tickets for a virtual tour, instead they uploaded their virtual tour on the website. the patron would scan the tag and benefit from this. This not only saved a huge monetary investment aspect for the museum but for the tourist as well with no additional ticket price. By a simple scan of this code, the user could hear more about the work of the artist and about the artist himself like a documentary.

The Smithsonian National Museums in Washington DC

In addition to their existing mobile application for iPhones and Android users, they adopted the QR system to make their exhibits more interactive. On their 100th anniversary they organized a scavenger hunt by making use of the Quick Response Code. Their exhibit of the Neanderthals man was tagged with a QR code stamp which people could use to figure out how they would have looked back then and subsequently share that picture on social media platforms.
]
The Brooklyn Museum
They decided to use the QR code system for more than just their exhibit information displays. They started to experiment with their personalized tags for accessibility to a point where they printed two sets of museum maps: one conventional and one with the QR code. This museum was the first to use this technology in maps for enhancing user experience and hospitality. It made it easier for people to locate artifacts, and other parts of the museum.

Today, the Quick Response Code is not only an integral part of the advertising and marketing community, but the have been well incorporated in museums to sync both education and entertainment. Some museums now have put tags on their maps and information desk making it easier to tourist to find the whereabouts. QR codes have come a long way and shall be proved more useful in other sectors with years to come.

CHAPTER 3

METHODOLOGY

3.1 METHODOLOGY

The methodology adopted in this project has been discussed in detail below:

3.1.1 DATA COLLECTION

The data was collected through online research medium as to how many people have access to smartphones and internet during a museum visit. Mobiles that support the QR code reader, i.e., if it is built in or external application download based.

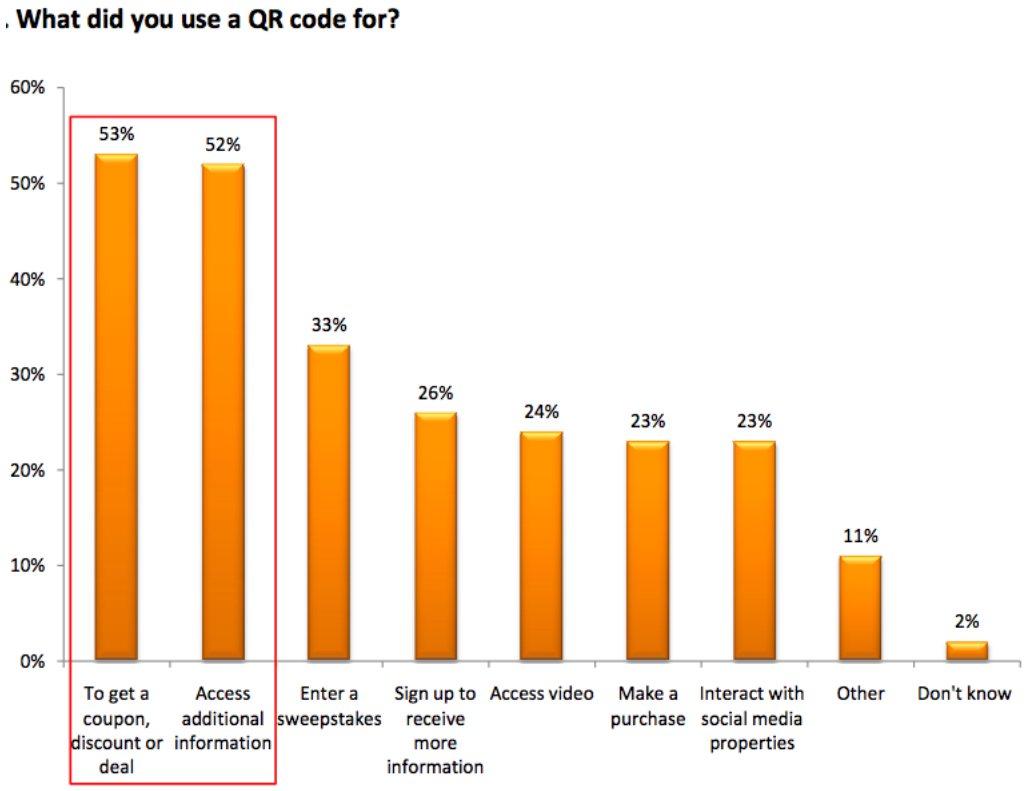

Figure 3.1 – Scan Usage

3.1.2 SCANS

The most important thing to be taken into the account was how many times would a person go ahead to scan and re-scan if the QR Code does not work. Many users have said to scan around 2-5 times in case of a failed scan.

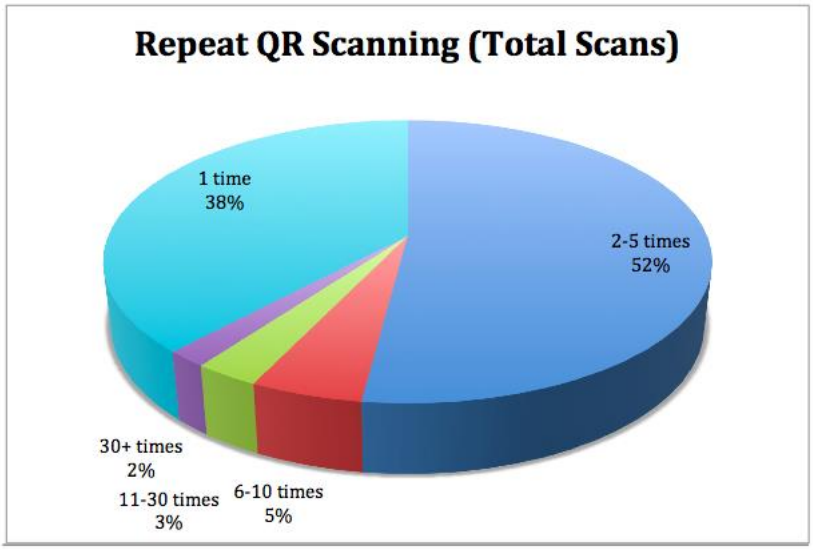

Figure 3.2 – Repeat Scans

3.1.3 MODEL WEBSITE

- ✓ The model website for this project is - digimus.wordpress.com which overtime WAS edited to make that of a museum.
- ✓ The museum is called Archaic – The New Generation Museum
- ✓ Figure 3.3 is the QR code linked to the Home Page of that website

Figure 3.3 – Archaic

CHAPTER 4

DESIGNING

4.1 THE WEBSITE

The website was designed using the WordPress domain since this was a crucial part of the project. ARCHAIC was the name given to the model museum, and the site was designed to resemble that of a real museum. If the project is put for use, the museum can fund this project and have a site personally customized for them.
The important parameters that were added to this model site are mentioned below:

- The Home Page
- Contact Information so the users could give the feedback
- The list of all the exhibits that would be present in the museum
- A model souvenir shop where people can purchase gifts for their loved ones

Website design was done in two phases, first being the selection of domain and the name followed by adding each parameter to the site to make it more user friendly. Research was done through multiple preexisting museum sites for getting a perfect result.
Figure 4.1 is a snapshot of the desktop version for the model website that can be accessed by the QR code mentioned earlier. There is also the mobile version for this website.

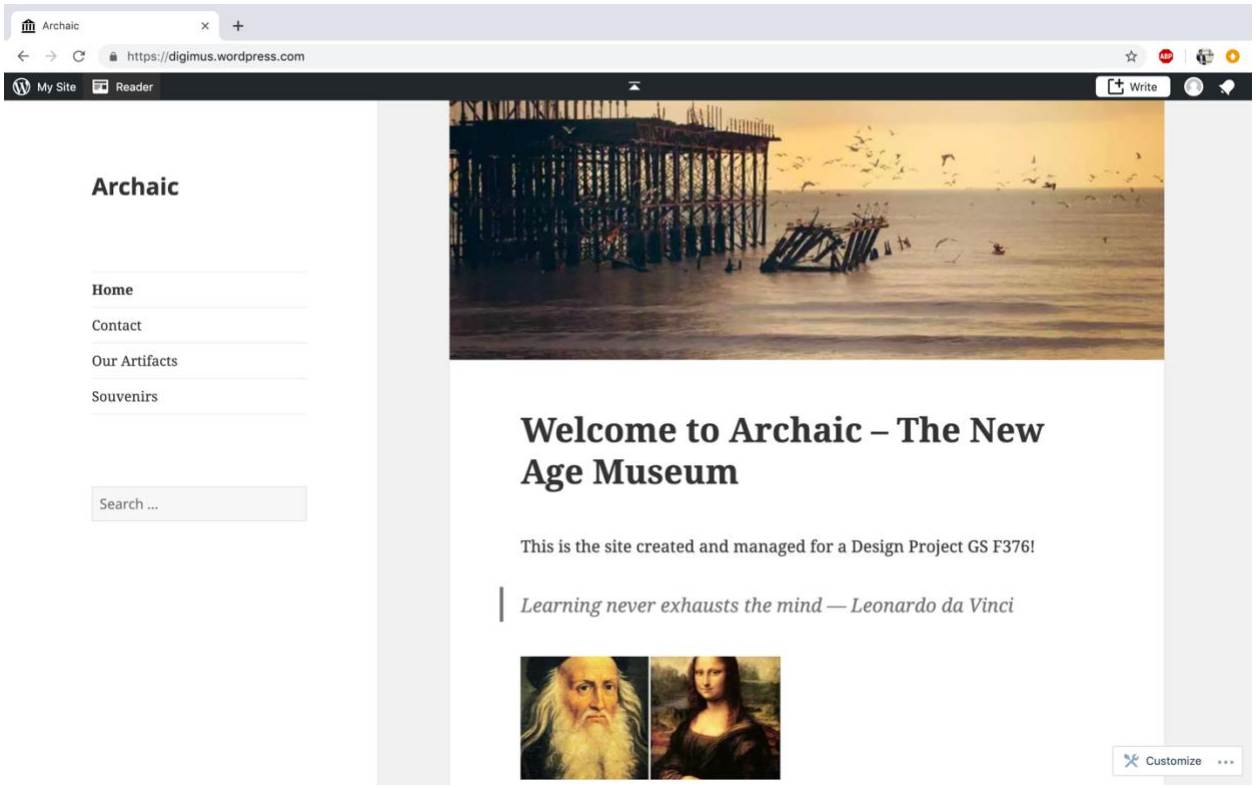

Figure 4.1 – Model Website for the Museum

4.2 DESIGNING THE QR CODES

The QR codes were generated for the following as shown in Figure 4.2:

Exhibits: The following exhibits from Table 4.1 were added to the museum site and later incorporated in the museum blueprint.

Name	Quantity of QR Tags
Monalisa	1
Leonardo Da Vinci	1
Chandragupta Maurya	1
Chanakya	1
Akbar, the great	1
Alauddin Khalji	1
Mohenjo Daro	1
Mesopotamian Civilisation	1
Greek Civilisation	1
Julius Caesar	1

Table 4.1 – Exhibits

Contact Information: the contact information plays a vital role in a museum, hence there were QR codes placed in the blueprint for the same**.**

Souvenir Shop: every museum has a souvenir shop and it would be easy for the visitor to know about it. Hence there were QR codes designed for it and placed in the museum.

Archaic: this QR code when scanned would direct the user to the homepage of the model museum's website, where they could find the other options (listed above).

Figure 4.2 – QR Codes for the exhibits

4.3 DESIGNING THE BLUEPRINT

while drafting the Blueprint for Archaic, following parameters were included in the design to make it more realistic. Since every museum needs to have these basic facilities, they were included. Table 4.2 contains the name of each basic parameter that was added, and Figure 4.3 shows the rough design.
The information desk was placed near the entry while the souvenir shop was added close to the exit, so people could purchase things on their way home. A mini seating area was added with a cafeteria, so people could relax there while sipping their favorite coffee.
For the purpose of making it more appealing to the tourist, a mini show fountain were added and as part of the basic amenity – a washroom.

Parameters
Exhibits
Information Desk
Washroom
Cafeteria
Fountain
Seating Area
Entrance/Exit

Table 4.2 – Parameters

The information desk was tagged with the QR code linked to the list of artifacts, QR code with Archaic were tagged all over the museum and so were the tags leading to the souvenir shop.
Along with the above mentioned QR Codes, there were Contact Information tags placed in the important areas of the museums for people to give their feedback and ask queries.
Figure 4.3 is the blueprint of the museum after implementing every factor mentioned in the above discussion.

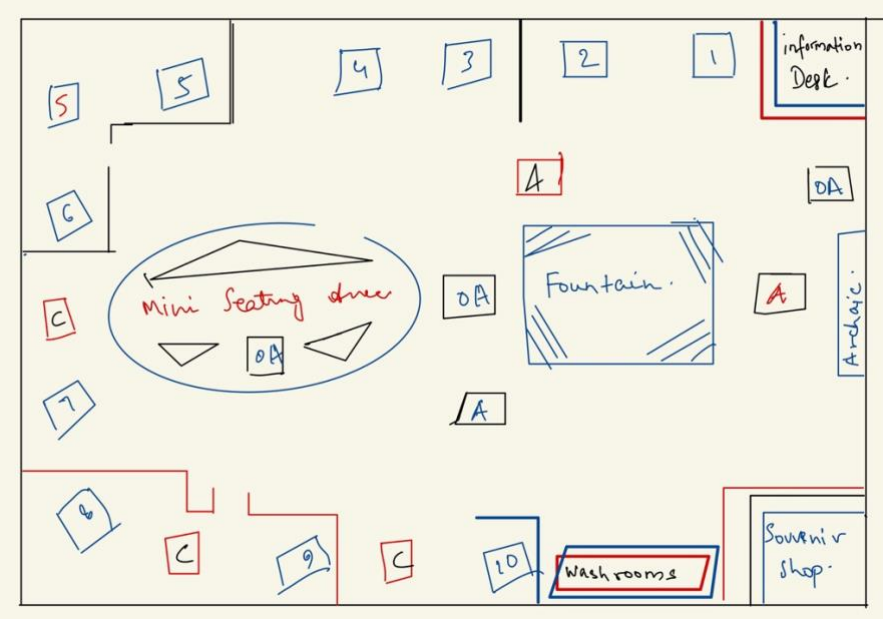

Figure 4.3 – Blueprint of the Model Museum

4.4 THE FINAL DESIGN

The blueprint drafted earlier was followed thoroughly while designing the final model. Figure 4.4 depicts the final design with the tagged QR codes for all the exhibits and parameters discussed above. Each QR code was tested with the smartphone – Android and iPhone camera. For the Android users, appropriate application was downloaded from the Google Play store and for the iPhone users, the inbuilt QR code reader in the camera was tested.

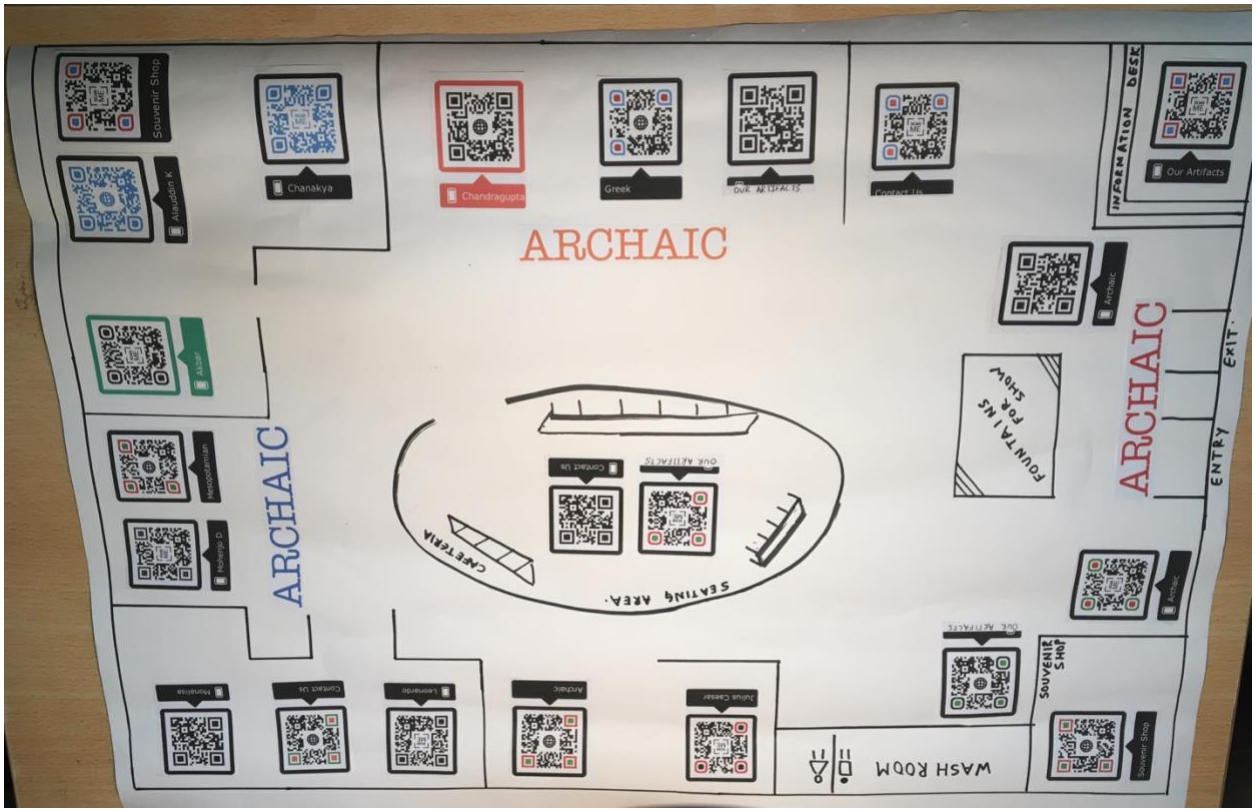

Figure 4.4 – Final Design of the Model Museum

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

Digitization of Museums with QR Code is an effective way for both data preservation and enhancement of user interaction. Cost Optimization and Space optimization are also two key factors to this project. In this digital era, while everybody has access to the smartphones and the internet, using Quick Response Code would prove to be beneficial for the museums.

With Internet of Things (IoT) being the latest trend today and Virtual Reality being an important aspect to this, museum interaction can be improved to a higher scale while ticket prices being pocket friendly to the tourists.

5.2 FUTURE SCOPE

With proper funding and interest, this design project can be implemented in museums around the world and in the Middle East. This will not only help preserve information but also in generating revenue through increase in number of tourist's visits.

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