

Q.O.D.S
(QR Oriented Data Storage)

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June, 2023

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3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
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8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
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10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
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12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

CO-PO-PSO MAPPING FOR ACADEMIC SESSION 2022-23

Course Name: Project
Semester / Year: VIII/ 4th

AKTU Course Code: KCS851
NBA Code: C411

Course Outcomes:

CO. No.	DESCRIPTION	COGNITIVE LEVEL (BLOOMS TAXONOMY)
C411.1	Analyze and understand the real-life problem and apply their knowledge to get programming solution.	K4, K5
C411.2	Engage in the creative design process through the integration and application of diverse technical knowledge and expertise to meet customer needs and address social issues.	K4 , K5
C411.3	Use the various tools and techniques, coding practices for developing real life solution to the problem.	K5 , K6
C411.4	Find out the errors in software solutions and establishing the process to design maintainable software applications	K4 , K5
C411.5	Write the report about what they are doing in project and learning the team working skills	K5, K6

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
C411.1	3	3	3	3	3	1	1	2	2	3	3	3	3	3
C411.2	3	3	3	3	3	1	1	2	2	3	3	3	3	3
C411.3	3	3	3	3	3	1	1	2	2	3	3	3	3	3
C411.4	3	3	3	3	3	1	1	2	2	3	3	3	3	3
C411.5	3	3	3	3	3	1	1	3	3	3	3	3	3	3
Avg.	3	3	3	3	3	1	1	2.2	2.2	3	3	3	3	3

DECLARATION

I hereby declare that the work, which is being presented in the Project, entitled **“Q.O.D.S. QR ORIENTED DATA STORAGE”** in partial fulfilment for the award of Degree of “Bachelor of Technology” in Department of Computer Science & Engineering, and **submitted to the Department of Computer Science & Engineering**, IMS Engineering College, Ghaziabad, affiliated to **Dr. A.P.J Abdul Kalam Technical University, Lucknow, Uttar Pradesh** is a record of my own investigations carried under the Guidance of **Prof. Dr. Sonali Mathur**, IMS Engineering College, Ghaziabad.

I have not submitted the matter presented in this Project anywhere for the award of any other Degree.

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CERTIFICATE

I hereby certify that the work which is being presented in the project report entitled **“Q.O.D.S. QR ORIENTED DATA STORAGE”** by **“Manav Tyagi”, “Ketan Agarwal”, “Aman Srivastava”, “Mansi Agarwal”, “Manu Chahar”** in partial fulfillment of requirements for the award of degree of B.Tech. (CSE) submitted in the Department of CSE at “IMS Engineering College” under A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW is an authentic record of my own work carried out under the supervision of **Prof. Dr. Sonali Mathur .**

Signature of the SUPERVISOR:

Date:

ACKNOWLEDGEMENT

I would like to place on record my deep sense of gratitude to **Prof. Dr. Sonali Mathur**, Head of Department, Dept. of Computer Science & Engineering, IMSEC, Ghaziabad, India for her generous guidance, help and useful suggestions.

I express my sincere gratitude to **Prof. Dr. Sonali Mathur**, HoD in Department of Computer Science & Engineering, IMSEC, Ghaziabad, for his stimulating guidance, continuous encouragement and supervision throughout the course of present work.

I am extremely thankful to Prof. Vikram Bali, Director, IMSEC, Ghaziabad, for providing me infrastructural facilities to work in, without which this work would not have been possible.

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LIST OF ABBREVIATIONS

QR	:	Quick Response
URL	:	Uniform Resource Locator
DBaaS	:	Data Base as A Service
CAGR	:	Compound Annual Growth Rate
BP Algorithm	:	Back Propagation Algorithm
T-SQL	:	Transact-SQL
JVM	:	Java Virtual Machine
CLR	:	Common Language Runtime
FCL	:	Framework Class Library
AWS	:	Amazon Web Services

ABSTRACT

Q.O.D.S. is a file management system that stores users' files and documents and links them to QR codes for easy retrieval of data. It helps the user manage data and place appropriate links to it at physical locations through QR codes so that when users need information about that particular position, they can just scan that QR code, and they will receive a soft copy of the data that was attached to that QR code.

Quick Response (QR) codes have increased in popularity over the years. Today, the use of QR codes ranges from menus at a restaurant to digital payments, etc. However, the biggest drawback of QR codes is that they are printed after data has been added to them. If there was a way to have QR codes always printed and ready to use, then the QR codes could be used to attach personal data to them on a daily basis and place physical links where that data might be needed.

The above-mentioned problem is exactly what this project aims at solving. The development of this project is aimed at providing a system of pre-printed QR codes that the user can buy, attach data like files, images, etc. to, and place on places where that might be physically linked. This technology can be used by students to attach lecture PDF files to their physical notes so that later retrieval of information is easier.

We plan to solve the mismanagement of data files on modern memory-heavy devices by introducing an efficient and quick system to search, store, and redeem data. We all have been facing issues regarding the management of data on our devices; data stored is usually problematic to retrieve, and supplying physical information and updating it timely is laborious.

CHAPTER 1

INTRODUCTION

A QR code, also known as a matrix code, is a two-dimensional encoding of information. It is a machine-readable matrix code that consists of black and white squares. Information can be stored in the form of URL (Uniform Resource Locator), contact information, links to videos or photos, plain text, and much more

The problem statement attempted in this study may be divided into the following specific objectives-

- Creating an efficient system of data storage and retrieval using QR codes.
- Providing an efficient and secure cloud database to all users.

QR codes have seen an increase in popularity with the advent of the digital age, commonly used to store information of various kinds. Similarly, there has been a rise in the usage of cloud-based storage systems by users. Both cloud databases and QR codes are increasing in popularity because they are quick and efficient. However, both of these technologies also have similar challenges, such as data security and a lack of accessibility. In this project, we have attempted to solve problems related to the availability of QR codes by rethinking them as dynamic physical data locations. At the same time, we have also tried to form a new method of data storage and management where users can have physical links to their data along with digital data. This project serves as a form of "Database as a Service," where data on the cloud can be directly linked to pre-printed QR codes, and the codes can be placed in physical locations.

We all have been in the situation when we took a picture of an important piece of note in our heavy memory devices and then forgot about it only to need it on an important day like before the exams, now we find ourselves scrolling through those thousand photos to find that important picture. As a student, you also might want the link to detailed notes, and references related to your handwritten notes to be available to you. Placing QODS-based QR codes at the start of your notes and attaching all the related

data to that QR code will give you the ability for quick data retrieval from the database. Also, it will help the users link their digital data to physical addresses. The use cases for this technology are widespread.

All these advantages can be reaped only if the technology is implemented properly. The biggest concerns that were faced included the quick and efficient readability of QR codes and the data security of cloud storage systems. Thorough research and development have helped us in extracting and developing algorithms and methods that solve the highlighted issues.

1.1 CURRENT MARKET SURVEY

The scopes and markets that the project covers include the survey on the usage of QR codes, Post-its, and DBaaS (Database as a Service). The below surveys have been referenced by various agencies that are capable of concluding detailed market surveys on each of the markets referenced below.

1.1.1 SURVEY ON THE USAGE OF POST-ITS

Referenced from the preview provided by [1]. Due to the increased demand for both conventional and erasable surface notes as well as the expanding trend of personalization, these companies are anticipated to have considerable growth in the post-it and sticky note markets throughout the forecast period. Post-It and sticky notes are two types of self-adhesive paper that can be used to make notes or set reminders on virtually any surface. The majority of the time, these notes are compact and portable. There are several colors, sizes, and shapes of post-it and sticky notes. Additionally, they can be customized based on the needs of the user. Due to its many benefits, the market for post-it notes and sticky notes is necessary. Their portability, low cost, simplicity of usage, and capacity to adhere to any surface are a few advantages. Sticky notes and Post-it notes are frequently used in homes, companies, and classrooms to leave messages or reminders. Many organizations also utilize them to promote themselves.

The post-it and sticky note market is projected to reach a value of \$2423.01 million by 2029, expanding at a CAGR of 1.9% over the forecast period of 2019–2029. The rise in demand for conventional surface notes, the increased emphasis on ergonomics, and

the expanding trend of personalization are just a few of the factors that have contributed to the expansion of this industry.

The most significant players coated in Global Post It and Sticky Notes Market report-

- Scorto
- Calyx Software
- VSC
- Juris Technologies
- Tavant
- Pegasystems
- Fiserv
- ISGN Corp
- Access Consulting
- Ellie Mae
- Wipro
- Byte Software
- Black Knight

Main Product Type coated in Post It and Sticky Notes sector -

- Small
- Medium
- Large
- Others

Application coated in Post It and Sticky Notes sector -

- Commercial
- Household
- Educational Institutes
- Others

Post-It and sticky notes have several benefits, including portability, affordability, ease of use, and the capacity to stick to virtually any surface. For leaving messages or reminders, Post-It & sticky notes are commonly used in offices, classrooms, and homes.

They are additionally employed by numerous organizations for marketing functions.

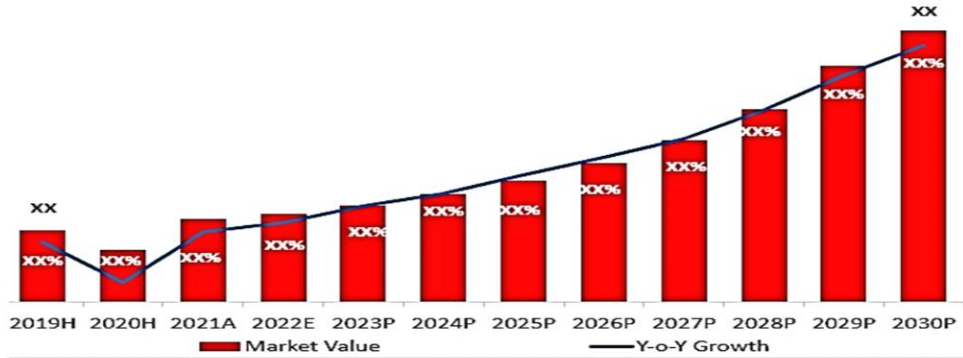
A greater CAGR is anticipated for the Traditional Surface Notes sector during the forecast period. This expansion can be linked to the broad selection of hues, dimensions, and shapes offered in this kind of note, as well as to its affordable price. It is anticipated that throughout the projection period, the Erasable Surface Notes segment will expand at a moderate CAGR. The increased attention being paid to ergonomics and the expanding trend of customization can be credited with this expansion.

During the projected period, a greater CAGR is anticipated for the office application segment. Sticky notes are being used more frequently in offices to leave messages, reminders, and promotional messages, which can be the cause of this development. Also, due to the strong consumption of these notes in offices and homes, North America is anticipated to be the region with the highest market for post-it & sticky notes throughout the projected period. Due to the growing customization trend and the increased emphasis on ergonomics, the Asia Pacific region is anticipated to develop at the greatest CAGR throughout the forecast period.

Even in Figure 1.1, we can clearly see the increased usage of the Sticky Notes and Post-It in different sectors like Office, House-Hold, School stationery, etc. Over this time period, growth has been increasing exponentially. Figure 1.1 is showing the growth of sticky notes from the year 2018- 2030(expected growth).

Post-it Extreme Notes were introduced by 3M in 2019 and are made for use in settings that are too hot or cold, humid, or exposed to direct sunlight. These notes can attach to practically any surface and are simple to remove without leaving any residue.

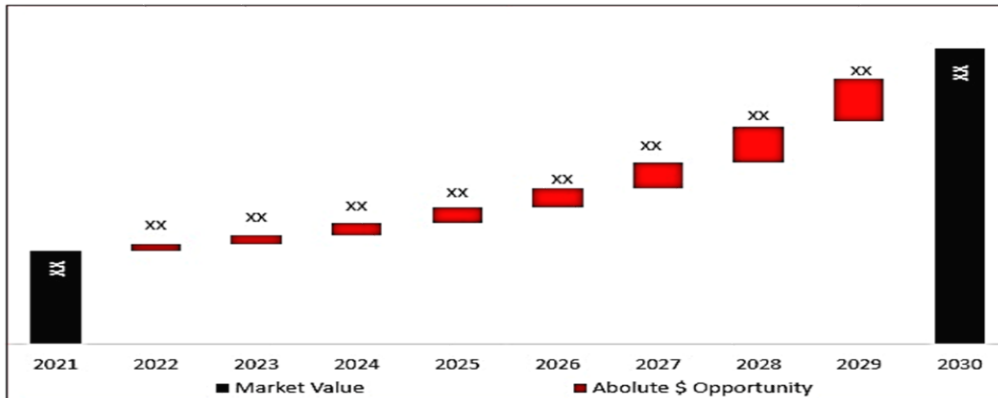
Global Post-It & Sticky Notes Market
Market Size (USD Million), Forecast and Yo-Y Growth, 2019-2030



Segments By Type

- 3" x 3"
- 3" x 6"
- 4" x 4"

Global Post-It & Sticky Notes Market
Market Absolute \$ Opportunity, in USD Million, 2021-2030



Segments By Application

- Office
- Household
- School
- Application 4

Figure 1.1 Survey of Post-It & Sticky Note

1.1.2 SURVEY ON THE USAGE OF QR CODES

Referenced from the market survey by [2]. The QR landscape in the year 2022 looks-like around 45% of the shoppers in the US had used marketing-related QR codes within the 3 months of the survey. The Qr codes were mostly used by people in the age group between 18-30. Approximately 47% of the people in the US agree that QR usage will definitely increase in the upcoming years. After the QR codes have been used there is a 97% increase in the interaction between the consumer and the company and a 98% increase in the interaction about the object. In conclusion, we can say that there is about 96% growth in QR reach over the sametime period that is 2018-2020. Around 1 billion smartphones will access the QR codes by the start of 2023.

Even consumer behavior has changed after the QR has been reached. High-speed internet access has increased from 48% in 2014 to around 62% in 2018 and still increasing in 2022. Internet users have also grown by around 8% from Jan 2020 to Jan 2021. The consumer has a lot of appreciation for the Coupon codes provided by various companies to have an offer, and it is estimated that by the end of 2022, 5.3 billion Coupon codes will be redeemed via QR Codes. The user scans QR codes in multiple places and some most secure places to scan a QR are restaurants, and bars, and some users find it useful even in Gyms, Pools, or any fitness center. 57% of the users scan a QR of a food item to get specific information about it. 75% of the users believed that QR has made their life easier.

The user not only uses the QR code but has a major concern about using the QR too. 22% of the users are aware that a QR code could give away their physical location and 37% were aware that QR codes could download an application. Almost half of the users also stated they either have or don't know if they have security installed on their mobile devices and they felt confident that they could identify a malicious URL, but only 39% stated they could identify a malicious QR code. Still, about 48% of the users use QR codes anyway even having concerns about it.

Figure 1.2 shows how rapidly Smartphones are scanning the QR Codes available. There are multiple reasons that users are using QR Codes in such a rapid way even after having so many concerns about it like, Google Chrome is developing a QR Code-enabled page-

sharing feature for its Chrome Canary. Apple has an in-built QR Code scanner with the latest iOS 13 has a low-light QR Code scanning feature. Multiple Tech companies like 4ORT have launched “Fraud-Free” Dynamic QR Codes. The globally patented algorithm ensures that the users’ unique identities are securely stored within the code, making it impossible for fraudsters to duplicate it. Not only in the US, in all over the world, half of the restaurants now offer their menus in the QR code form as well. Galleries and Museums are interested in providing QR codes for more information about their museums. Mostly the users using the QR codes are predominantly between 24 to 54 years of age. 16% of male respondents used their smartphones to scan QR codes to obtain information, while 10% of female respondents stated they had done the same.

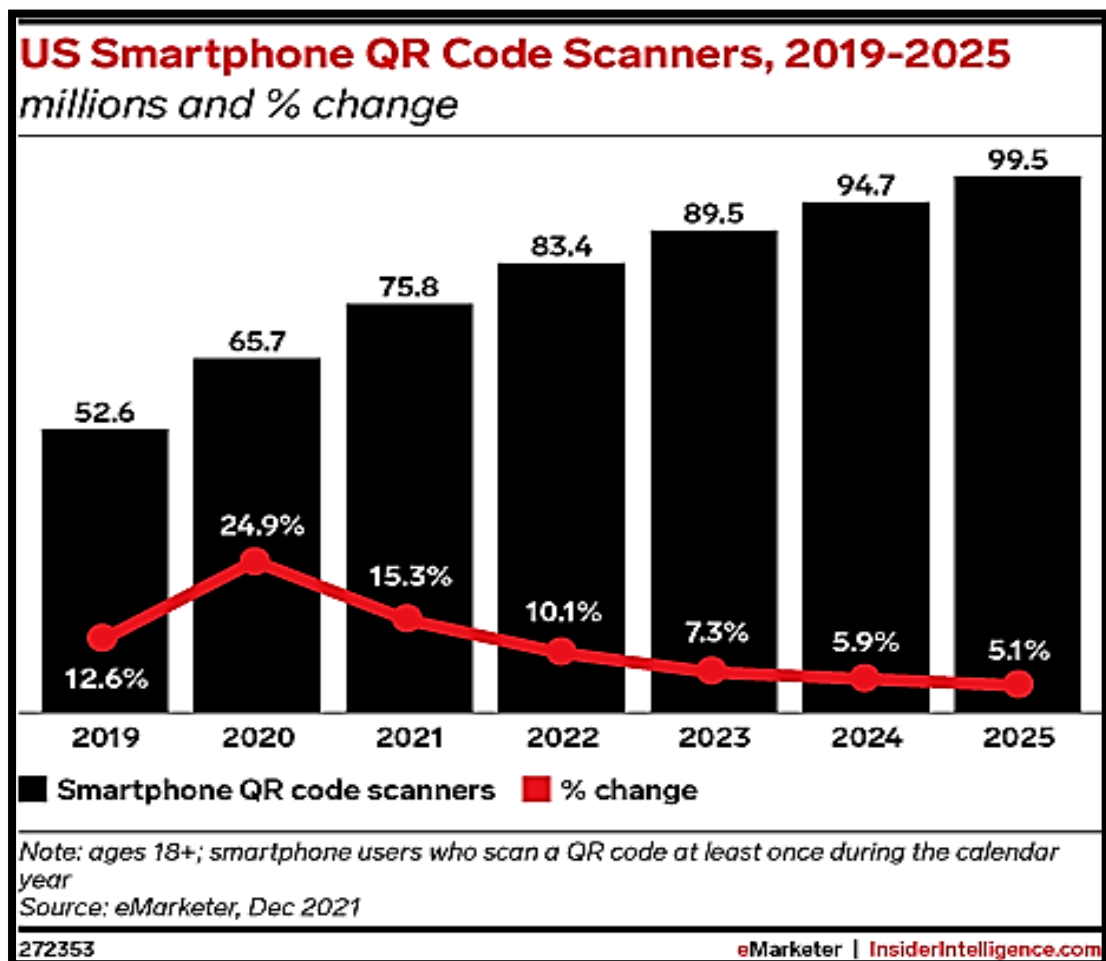


Figure 1.2 QR Code Scanners Survey

1.1.3 SURVEY ON THE USAGE OF DBAAS

The DBaaS option is gaining popularity particularly. The use of DBaaS has increased from 40% in 2019 to 50% in 2020. The DBaaS delivers a level of convenience that IT Teams are looking for while setting up, deploying, and maintaining the databases, especially for companies without skilled labor and proper DBAs.

Referenced from the market survey by [3], 93% of the users agreed that data storage across their organization, in a single database helps with standardizing security protocols, notable since 80% of respondents use two or more databases.

Around 88% of the people have agreed that DBaaS would help their organization save money, and approximately, 88% of the people agreed that using DBaaS would help to bridge the cloud skills gap.

Figure 1.3, displays how the market of Database as a Storage is growing in some of the previous years and how it is expected to grow in the upcoming years.

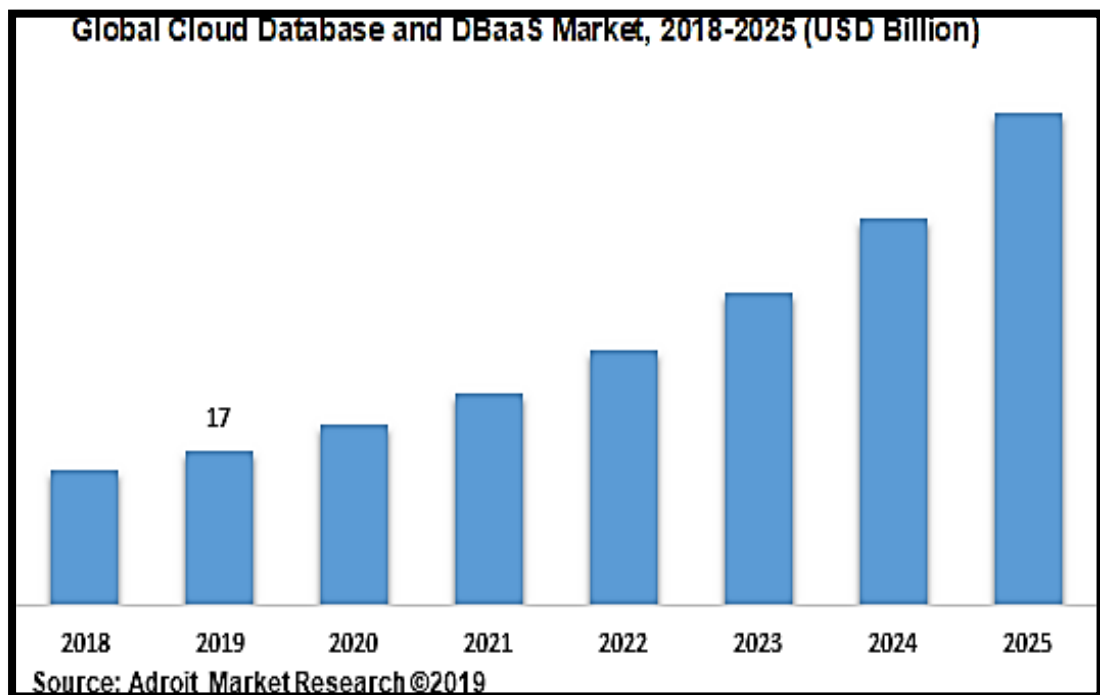


Figure 1.3 Market of DBaaS

1.2 ADVANTAGES OF QR-ORIENTED DATA STORAGE

QR-oriented data storage is a project that rethinks the data storage and retrieval systems. The purpose of the project is to enable a process where access to data is easier. The project aims to create a system where the data can be placed with physical markers using QR codes that would enable the user to retrieve files from the addresses where they need them. The project also aims to enable users to create a better online repository of their files, by different types of files in different QR packets.

Benefits of Q.O.D.S. (QR Oriented Data Storage)

1. Cost Efficient

By using the cloud storage service, the business or individual can outsource the data storage problem. By using Data Base as a Service, enterprises, and individuals reduce the expenses of internal storage systems. With this technology, the need for internal professional support to manage and store data is eliminated; it is handled by us.

Using cloud storage options we can provide cloud storage for a lifetime at an affordable price, which can prove to be highly beneficial for small businesses and individual users.

2. Availability and accessibility

This application will be accessible to every age group as the QR codes will be available to all the local stores and the applications can be downloaded by anyone without any restrictions, by which they can keep their documents and notes precisely.

3. Multiple users

One of the benefits of using a cloud environment is that we can have more than one user associated with it. Using cloud storage technology, multiple users will be able to collaborate with a common file. For instance, multiple users can be allowed to access and edit your files. The files can be accessed in real time from any part of the world by an authorized person.

4. Convenient

The need for a hard disk or flash drive to access or view your data is eliminated when

using cloud storage systems. Unless you want to download any file or data and generate an offline copy, you will not require a storage device or internal storage space on your device. Viewing files online would not occupy any space on your device. Any changes to the data will reflect on every device when it is synced with the storage service. Using cloud storage services does not require any expert or technical knowledge.

5. Environment-Friendly

By using this application, we don't ever need to write all our notes on a piece of paper they can be simply stored and shared from our application.

6. Students and Professionals

Through this application, we can make data storage and extraction easier for students and professionals, as now instead of spending hours on finding one pdf or image, they can just save those docs to the database using QR codes and access them later just by scanning the QR code.

CHAPTER 2

LITERATURE SURVEY

The following research papers provide detailed research on QR image recognition, use cases, and a detailed overview of increasing security in cloud computing. The available data can be cited for better implementation of connecting QR codes to cloud computing databases.

Based on the literature review, we are going to discuss the implementation of storing data in cloud-based storage systems while providing a physical address to the data points using pre-printed QR codes.

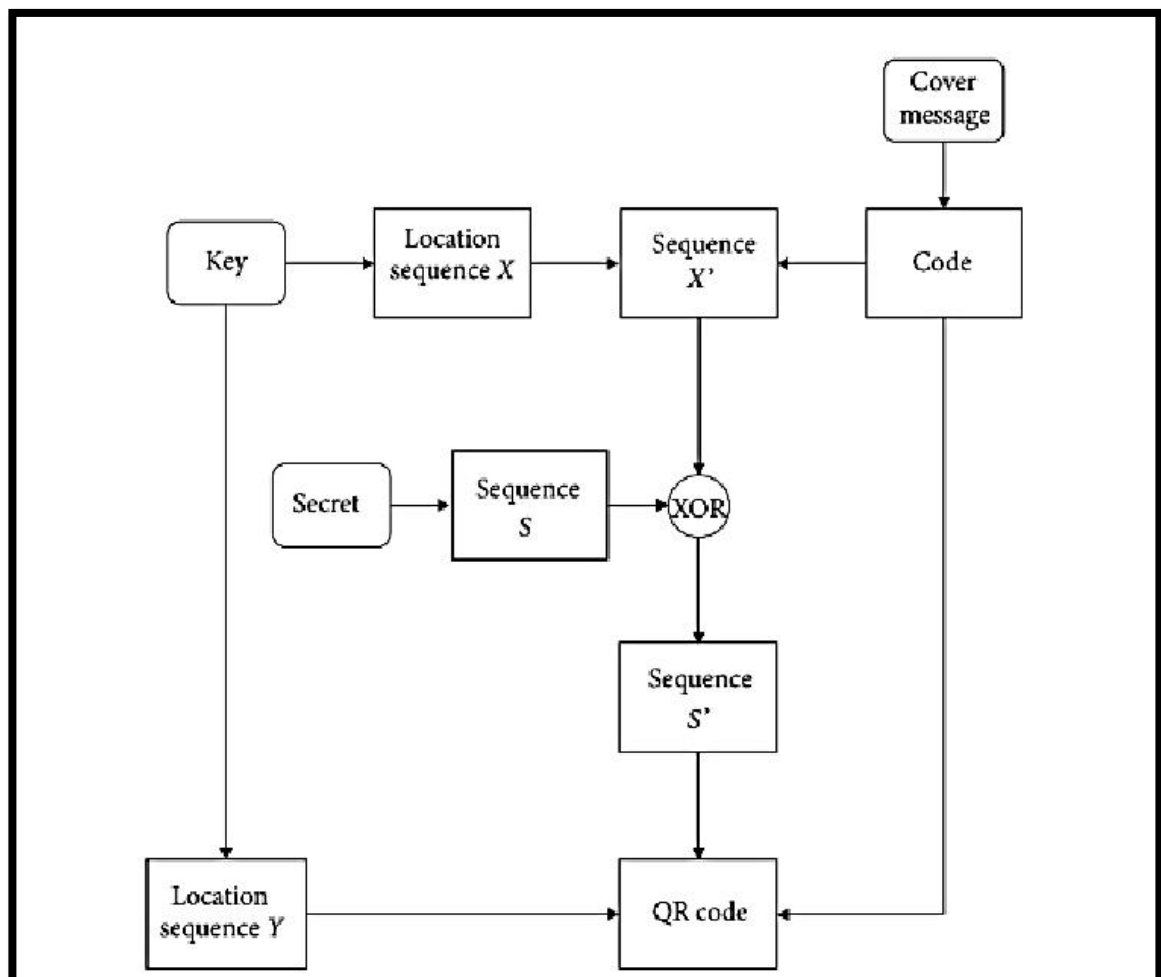


Figure 2.1 Secret Hiding Process

The proposed model in [1] provides a detailed review of the scheme to hide data in the QR code. It discusses a method of hiding information using a secret hiding and extraction process. Figure 2.1 and Figure 2.2 show how the data hiding and extraction process works in the proposed model.

The authors of [2] state that the use cases of QR codes are widespread, and any study on this technology has far-reaching significance.

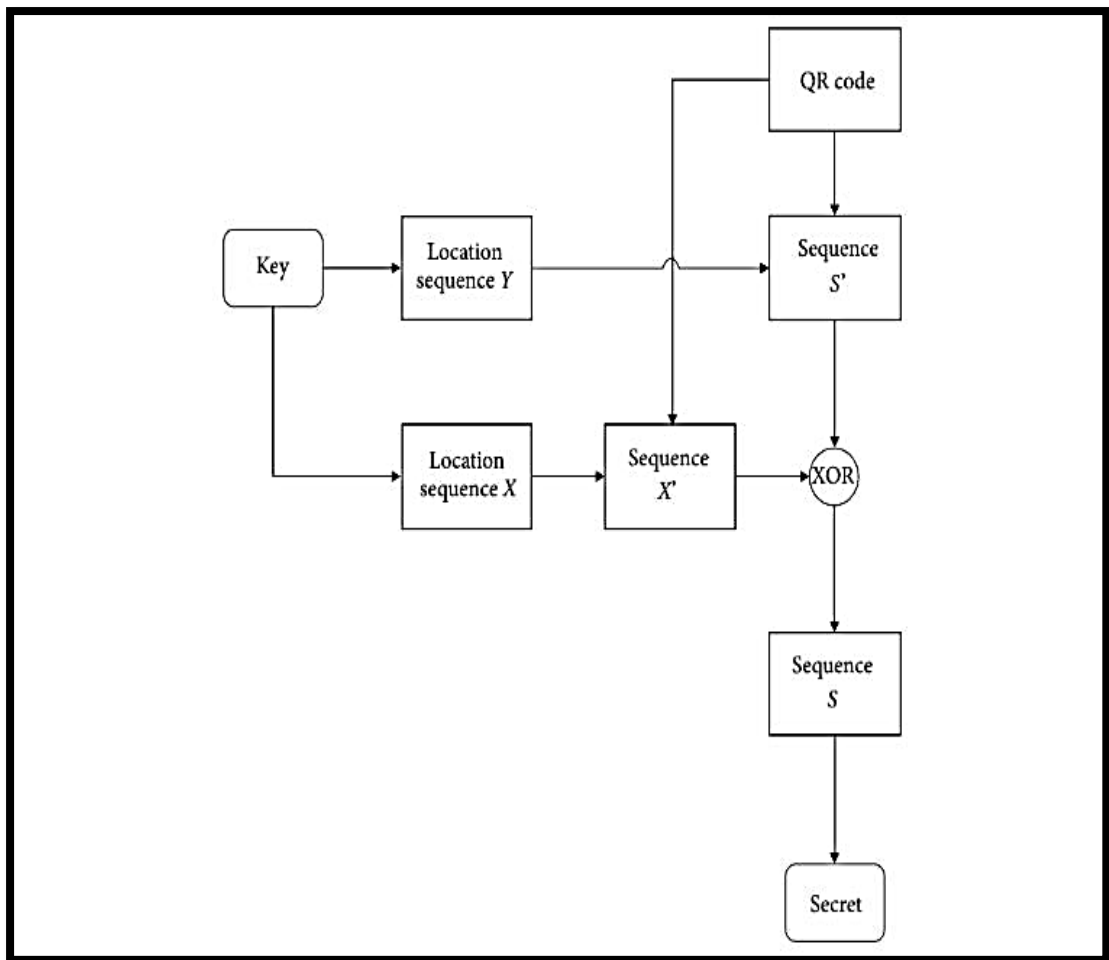


Figure 2.2 Secret Extraction Process

The authors propose an improved adaptive median filter algorithm and a QR code distortion correction method based on backpropagation neural networks. The research highlights the usage of the self-learning ability of the BP neural network to find the polynomial relationship between pixel coordinates. Figure 2.3 shows the proposed BP algorithm flow.

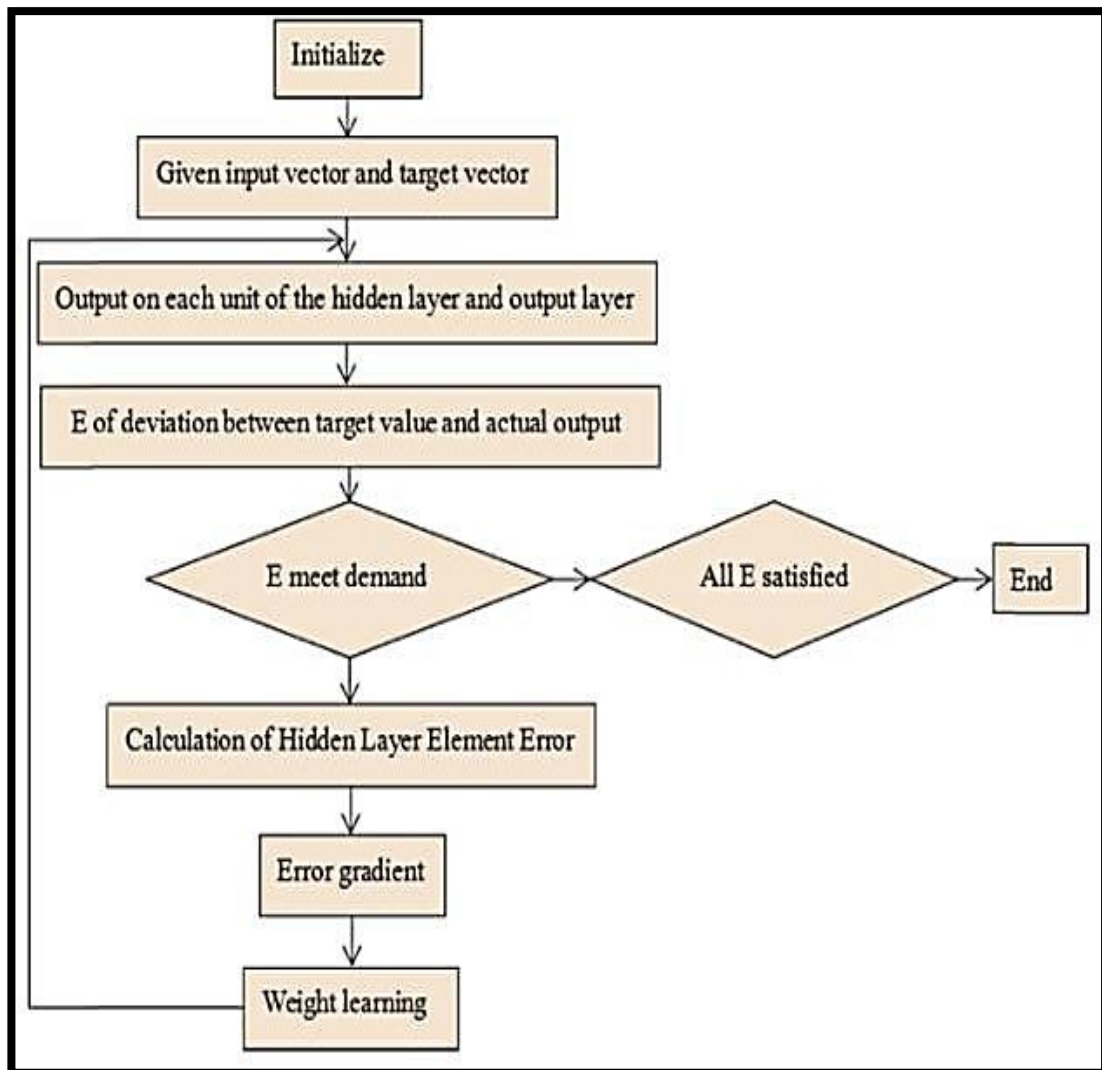


Figure 2.3 BP Algorithm Flow

The authors from [7-8] provide a detailed overview of providing Database as a Service (DBaaS). The papers discuss the capabilities and drawbacks of using cloud databases. The authors in [8] highlight that in their survey they found that government organizations and big corporations refrain from using cloud services. The authors in [8] also conclude that the biggest challenges of DBaaS are unavailability, interoperability, and data confidentiality.

The papers from [9-11] talk about encryption technologies that can be used to hide data in QR codes. Authors from [9] present an effective method for encrypting data inside a

QR code using AES. Authors from [10] list various encryption methodologies that have been used and implemented since the start of encryption technologies. The author from [11] briefly describes encryption in QR codes using Stenography and the need for secure QR codes.

The papers [12-17] shed light on different use cases of QR codes and their impact on various industries. Authors from [12] conduct a study on constructing an authentication system for cloud computing using QR codes, the paper presents a method for creating QR codes from user data and using it for authentication while accessing cloud computing environments. The authors from [13] talk about the usage of QR codes in museum-like spaces, highlighting how QR codes can be useful to convey information by placing it at relevant locations, especially with younger audiences. Similarly, in [14] the authors have highlighted the usage of QR codes in the teaching and learning process, the research displays positive feedback from tutors and students, indicating that QR codes can be utilized in learning environments. The authors in [15] talk about the usage of QR codes in AR applications, the authors utilize the high data storage capacity of a QR code to overcome the limitations of a traditional AR maker. The authors in [16] present a study on the user experience perspective on using QR codes and the psychology behind it, the studies highlight the reasons behind the growing popularity of QR codes and the user concerns attached to them. The authors in [17] develop a traceability system using QR codes that is used for the safety of fishery products, the research shows how QR codes can be used to store digital signatures and information encoding.

The papers [18-19] review and compare various data compression technologies. The authors from [18] discuss compression techniques on various forms of data like text, video, image, etc. The authors also discuss the methodologies of various data compression technologies while also providing a detailed review of these techniques. Similar to the authors from [18], the authors from [19] also discuss the methodologies and evaluate the performance of different compression algorithms, the difference being that the authors from [19] focus on only modern lossless data compression algorithms.

The papers [4] [5] [6] [20] [21] [22] [23] [24] [25] [26] are focused on data storage in databases and cloud computing environments, the security of data in those

environments, the user experience perspective, their advantages, drawbacks, and efficient methods of data storage. The authors from [4] propose a model for increasing the security of Data in cloud computing. The model presented in the research offers different scenarios based on the sensitivity of the data. A similar model was proposed in [5], [6], where the authors propose controlling security in cloud data based on the ITSS of an organization and different algorithms to select security options.

The authors from [20] discussed a questionnaire and presented a review of security threats to the existing database. The paper described the various strands and their forms that have been known to date. The article also highlighted various methods of extending the authentication chains of the database and the techniques that have been able to deal with the methods. In [21], the authors propose a model to solve cloud storage issues using cryptography and steganography techniques. The authors compare the efficiency of the proposed model to AES, Blowfish, and a hybrid algorithm. The authors of [22] have discussed some of the threats like confidentiality and integrity of sharing data over the cloud. As mentioned by writers of [22], a CSP's Service-Level Agreement (SLA) with its clients should include provisions for confidentiality, integrity, and availability that address these concerns.

Effective auditing mechanisms also can be used for providing data integrity. Using the techniques for data deduplication, the author of [23] have studied the data partitioning technologies, contrasted the fixed long block algorithm and variable length block algorithm's benefits and drawbacks, and employed the slider algorithm to optimize storage space utilization, reduce data backup time, and enhance distributed data storage performance based on the cloud computing environment.

The content of [24] is based on studies that can be utilized for modelling systems and clearly identify data storage demands. Utilizing the hardware and software infrastructure to its full potential is a benefit of this study. Also, in systems where performance issues already exist, this model can help to identify bottlenecks and find a way to improve them. The author of [25] aims at the problem of data detection and data availability and also proposed the corresponding solutions which use a POR system based on a trusted log and is based on the DSBT scheme, DSBT adopts more efficient and reliable erasure codes as the core model whereas, the POR system based on the

trusted log is based on the traditional POR system, trusted the log, and combined with DSBT scheme.

The studies of [25] also introduce the implementation of the DSBT system based on trusted log and POR system as the core of the cloud storage prototype system. The author of [26] states the uses, types, and impact of the database used in workplaces. The authors also shared the benefits businesses achieve by using databases. They have also discussed the safety and moderate issues regarding the databases used in businesses. They also state the importance of reports and forms for a business. The report collects data and enters specific workflows.

The authors from [27] determine the features of dynamic and static QR codes. The authors also provide a comparison of dynamic and static QR coding and determine that dynamic QR codes are more flexible compared to static QR codes, since it is possible to change the concept or content of a dynamic QR code even after its creation. Authors from [28] present many algorithms for recognizing QR codes in an image. Each method presented in [28] gives robust results for a specified set of images. Authors use the following method of pattern extraction: image pre-processing, Tilt Correction, Geometric Correction, Image Normalization, Segmentation and localization, feature Extraction, and classification. Authors from [29], propose a practical image pre-processing method for QR barcode recognition. The authors do not utilize traditional methods such as edge detection and line detection, using this the authors were able to minimize the influence of background noise and inhomogeneous light, and geometric distortion. In addition, the authors used alignment patterns to adaptively sample the barcode in terms of regions, which greatly improved the recognition rate.

The authors from [30] conclude a study that takes high vocational students' class exercise score management system as a research case, the study discusses the design and implementation of the server-side application based on a mobile client, it also included the overall function of the server, page design, its implementation and the data interaction with the mobile client. The study showed that this system can greatly improve students' interest in learning, ensure better teaching results, and promote the efficiency of high vocational teaching.

The authors of [31] have stated that the human brain is abstracted, simplified, and emulated by artificial neural networks (ANN), often referred to as neural networks (NN), which are made up of several processing units called neurons connected by extensive networks. It reflects the basic characteristics of the human brain. The multi-layer feedforward network, also known as a BP (Backpropagation) neural network, is used for learning and training and is in line with the error back-propagation method; it does not need a prior understanding of the expression mapping mathematical equation, will be able to store and train a large amount of input data.

The author of [32] presents a study on the usage of sticky notes, the study shows that sticky notes can be incorporated as tools for teaching and learning in many ways.

The authors state that with sticky notes, it is possible to adapt the three activities the first being to paste your learning goals on walls using sticky notes, the second activity is to paste common mistakes, errors, and issues on a digital sticky note board, the third activity is to use sticky notes as a back channeling device by allowing students to paste their doubts using sticky notes on a dedicated wall in the classroom.

From the research above, we have learned to use some algorithms and formats to implement data security features and efficient QR image code recognition. We also learned about the challenges and advantages of using QR codes and cloud services. Building on this information, we can go forward with forming a QR-based data storage and management application that improves and implements the most efficient image recognition systems and a secure cloud-based data storage system.

CHAPTER 3

WORKING OF Q.O.D.S

QR codes, short for Quick Response codes, are two-dimensional matrix-based barcodes that can store a significant amount of data. They were originally created in the automotive industry for tracking purposes but have since gained widespread use across various applications.

The working of a QR code involves several key steps:

Encoding Data: The first step is to encode the desired data into the QR code. This data can be in the form of text, numbers, URLs, contact information, or any other type of information that can be represented digitally.

Generating the QR Code: Once the data is encoded, a QR code generator software or tool is used to create the actual QR code image. The generator applies specific algorithms and encoding techniques to convert the data into a visually readable barcode.

Scanning the QR Code: To read the data stored in a QR code, a QR code scanner or reader is required. This can be a dedicated hardware device or a smartphone application. The scanner captures the QR code's image using a camera and decodes the information embedded within it.

Decoding the Data: The QR code scanner analyses the patterns and structure of the QR code to extract the encoded data. It interprets the barcode information and converts it back into its original format, such as text, URLs, or contact details.

Performing Actions: Once the data is decoded, the QR code reader can perform various actions based on the type of information encoded in the QR code. For example, if the QR code contains a URL, the reader can open the corresponding website or link. If it contains contact information, the reader may prompt to save the contact details or initiate a phone call.

3.1 GENERATING QR CODES

QR Codes in the project are generated as a series of QR codes, each with an id that can be later assigned to locate data in the database. The id of a QR code is a 12-letter series of generated characters and numbers, the first eight letters of this series identify the packet to which these QR codes belong. Generating QR codes in packets helps in producing and selling QR codes to end users. Moreover, these packets also help in improving data management, users can assign different packets for different purposes and view these packets and assigned QR codes inside the application.

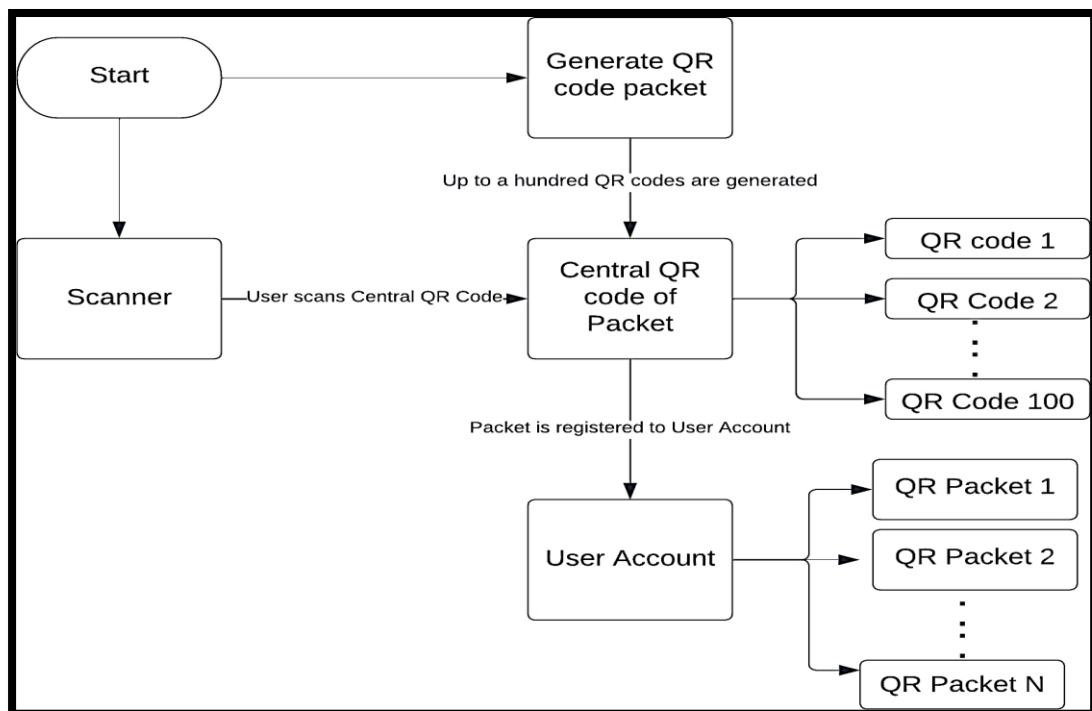


Figure 3.1 Flowchart of generating QR code

Figure 3.1, shows how the system generate QR codes, how multiple QR codes are linked to a single packet, and how these packets are assigned to the user's account.

3.2 SCANNING QR CODE

Application's QR code scanning is supported by the ZXing library. The library is capable of efficient and quick data extraction from QR images. Once the QR code has been scanned and the id of the QR code has been extracted, the packet id is extracted from the QR code id. After the extraction of the packet id, the user's access to that particular packet is checked.

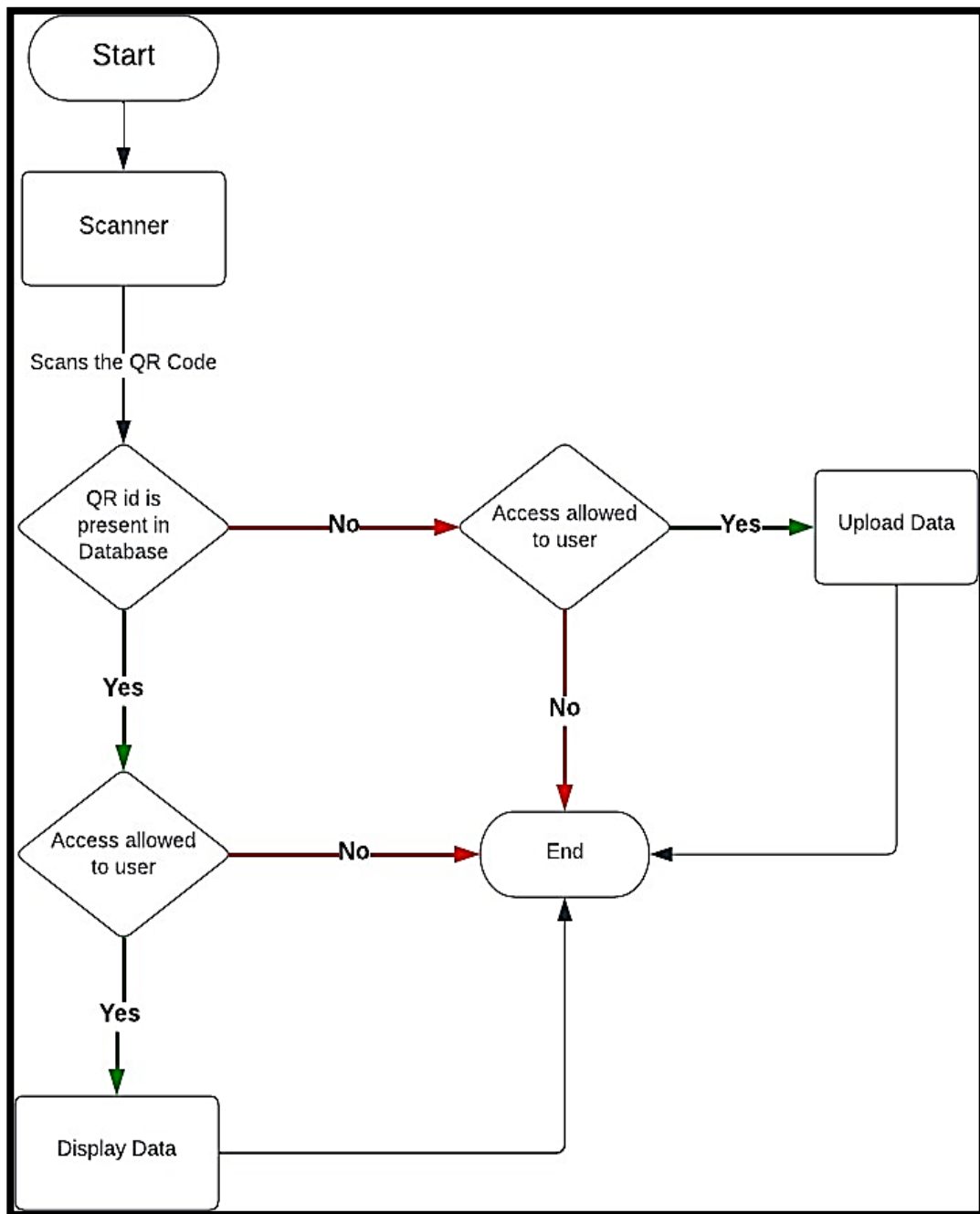


Figure 3.2 Flowchart for scanning the QR code

Figure 3.2 shows the flowchart for scanning the QR code and displaying the data attached to it or attaching data to the QR code. When a user has access to a packet, the application performs a series of steps to handle the QR code and associated data. Let's break down the process:

Checking the Database: The application first checks the database to see if the QR code's ID is present there. The ID extracted from the QR code is used as a reference for this search operation.

Data Display: If the ID is found in the database, it indicates that data is already attached to the QR code. In this case, the application retrieves the associated data from the database and displays it to the user. The specific type of data, such as text, images, or documents, will depend on the nature of the application.

Data Attachment: If the ID is not present in the database, it means that no data is currently linked to the QR code. In this scenario, the user is given the opportunity to attach data to the QR code. The application provides functionality for the user to upload files, enter text, or add any other relevant information.

Saving Data in the Database: Once the user attaches the desired data to the QR code, the application saves this data in the database. The ID of the QR code is used as the identifier or key for the associated data entry. By using the same ID, the application establishes a connection between the QR code and the newly attached data.

Assignment to Respective Packet: After the data is saved in the database, the application assigns the QR code to its respective packet. This ensures that the QR code and its associated data are associated with and can be viewed from the specific packet to which they belong. This assignment allows for organized management and retrieval of data within the application.

3.3 IMPLEMENTATION OF SECURITY FEATURES

The main concern with providing physical addresses of sensitive user data on the cloud is ensuring that data is not accessible by any unauthorized user. During the implementation of the project model, it was important to us that the project support a structure in which the security of user data could be ensured. To ensure the security of user data and secure accessibility, we put forward the following structures:

1. One of the first challenges we had to solve was that the data linked to the QR code should only be accessed by authorized users. To ensure this, we made sure that no directlink for the data or cloud service is present on the QR code. The QR code consists only of an id that can be later linked to a data point.
2. Further, the project model divides the access of each QR code into three levels, namely “Public”, “Private”, and “Limited”.
3. Since the initial access of the QR code lies with the owner of the packet to which this QR code belongs. Naturally, the owner has read and write access on all three levels. Theowner can set a QR code on any of the three levels, and each level follows a different data extraction pattern, as discussed below:
 - **[PUBLIC]:** When a user sets a QR code as public, the application follows a process to determine access privileges. After extracting the QR code ID and packet ID, the app checks if the current user is the owner of the QR code. If they are the owner, read and write access is granted, allowing them to view and modify the associated data. For users who are not the owners, read-only access is provided, enabling them to view the data but not make any changes. This approach ensures that only authorized individuals have the ability to modify the data, maintaining data integrity and security. By allowing public access to some QR codes while restricting modification rights, the system strikes a balance between convenience and data protection. If a QR code is set as public by the user, then after the extraction of QR code id, the app extracts the packet id and checks if the current user is also the owner of the QR. If the current user is the owner, then read and write access is provided. Otherwise, only read access is provided to the user.
 - **[PRIVATE]:** If a QR code is set as private by the user, then after the extraction of the QR code id, the app extracts the packet id and checks if the current user is also the owner of the QR. If the current user is the owner, then read and write access is provided. Otherwise, no access is provided to the user.
 - **[LIMITED]:** If a QR code is set as limited by the user, then after the extraction of the QR code id, the app extracts the packet id and checks if the current user is

also the owner of the QR. If the current user is the owner, he or she has read and write access. Otherwise, the user's authorization and its level are checked from a linked list containing the authorized account ids and their access levels. If the user is authorized, then they are provided read or write access as per their access level. If the user is not authorized, then no access is provided

4. Another major challenge is the security of user data inside the cloud database. To tackle this issue, promising algorithms have been laid out in [5]. Moving forward, we plan to implement and build upon these algorithms and models to increase the security of user data in the cloud database.

Type of User	Public	Private	Limited
Owner	Read/Write	Read/Write	Read/Write
Guest	Read	No Access	Access depends on the authorization of the guest provided by the owner.

Table 3.1 Access levels of the QR

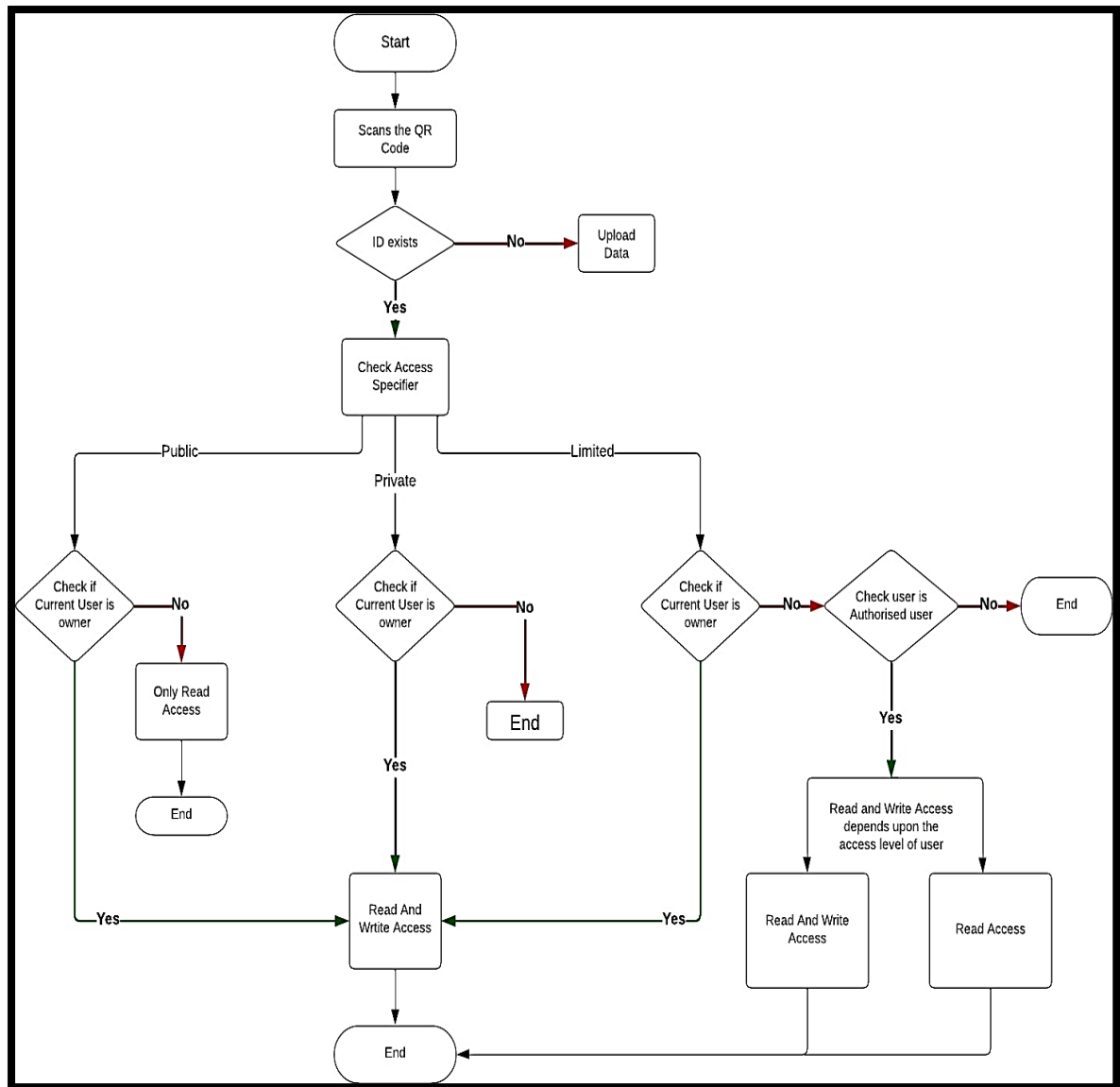


Figure 3.3 Flowchart for implementing security features

Figure 3.3 shows how access to the QR code is provided based on the access level of the user and the QR code.

CHAPTER 4

TECHNOLOGY USED

4.1 SERVER SIDE

HARDWARE AND SOFTWARE REQUIREMENTS

- Database server: SQL server 2005.
- IntelliJ Idea Ultimate (Version: 2022.2.1)
- Visual Studio 2008(.Net Framework 3.5).
- VS Code
- Core Java
- Flutter
- Postman
- Amazon AWS

Database server: SQL Server 2005

Microsoft SQL Server 2005 Compact Edition (SQL Server 2005 Compact Edition) is designed for developers who need a lightweight, in-process relational database solution for their applications that can be developed and deployed on desktop, tablet PC and mobile devices. Figure 4.1 shows a basic display of the Database Server 2005. SQL Server is a relational database management system (RDBMS) developed by Microsoft. It is primarily designed and developed to compete with MySQL and Oracle database. SQL Server supports ANSI SQL, which is the standard SQL (Structured Query Language) language. However, SQL Server comes with its own implementation of the SQL language, T-SQL (Transact-SQL).

T-SQL is a Microsoft propriety Language known as Transact-SQL. It provides further capabilities of declaring variable, exception handling, stored procedure, etc. SQL Server Management Studio (SSMS) is the main interface tool for SQL Server, and it supports both 32-bit and 64-bit environments.

Microsoft SQL Server or MS SQL Server for short is the query language provided for data definition and manipulation. SQL Server is a Relational Database Management Systems which was developed and marketed by the Microsoft company. SQL and SQL servers are built as two layers where the SQL server is on the top for interacting with the relational databases.

MS SQL Server also has T-SQL or Transact-SQL and the main focus of T-SQL is to handle the transactions. As it is a Microsoft's developed system, it worked only on Microsoft's environment until it was made available on Linux platforms in the year 2016.

SQL Server can access data from other management systems without moving or copying the data. It is able to do this through something called data virtualization. SQL Server supports the UTF-8 data encoding system. Data is encoded during storage and retrieval to reduce demands that are placed on the computer's memory and storage. This is important because relational database management often involves big data analytics or data analysis of extremely large amounts of data. Data is also encoded as a way to secure sensitive information, such as financial data.

SQL Server allows users to stop and resume work at any time with something called the resumable online index create. This prevents the need to start all over in case something happens and the user has to stop work. Also, there are various operations in databases that can cause the data to become fragmented and to operate less efficiently. The resumable online index creates feature allows users to rebuild operations easily.

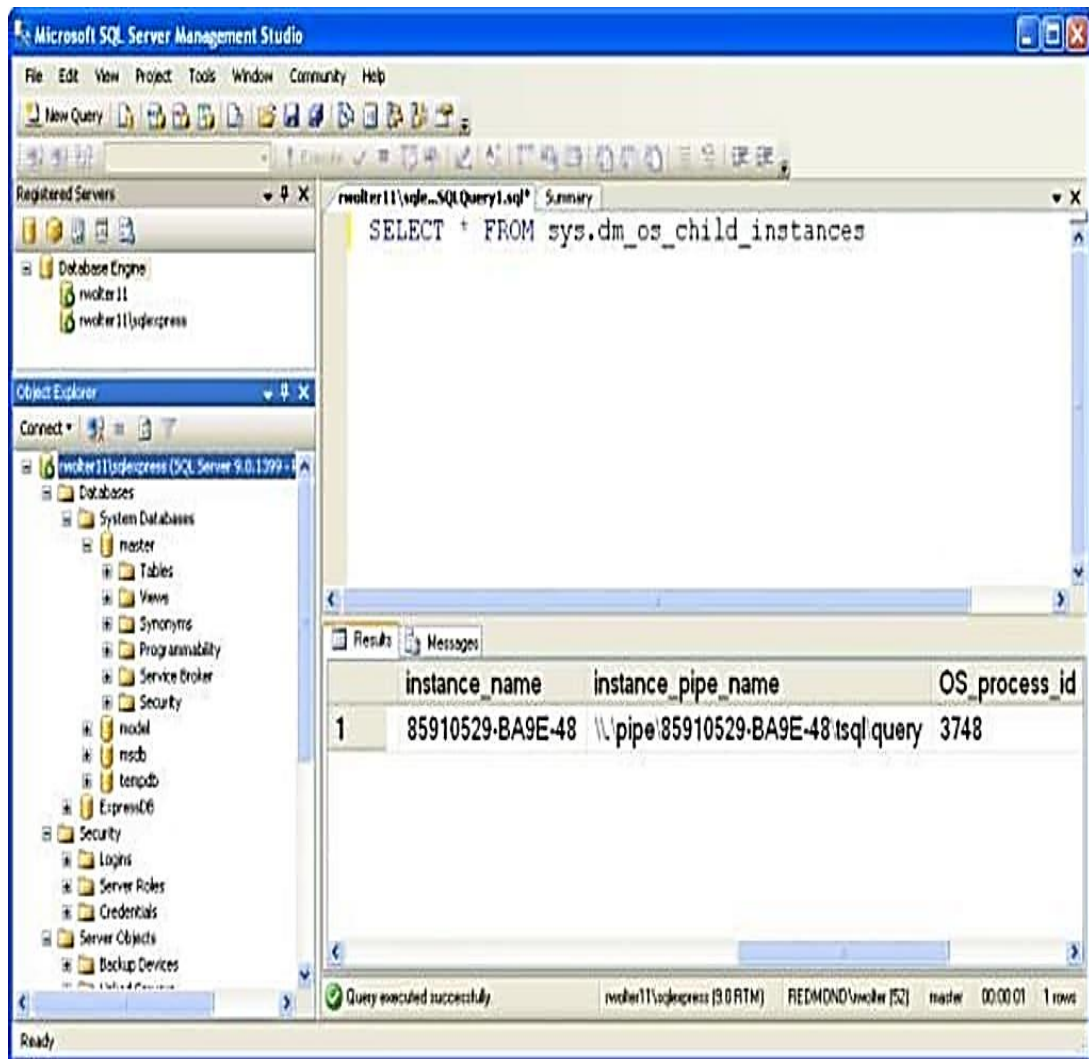


Figure 4.1 SQL Server 2005

IntelliJ Idea Ultimate (Version: 2022.2.1)

IntelliJ IDEA is an integrated development environment (IDE) written in Java for developing computer software written in Java, Kotlin, Groovy, and other JVM-based languages. It is developed by JetBrains (formerly known as IntelliJ) and is available as an Apache 2 Licensed community edition and in a proprietary commercial edition. Both can be used for commercial development. IntelliJ Idea is shown in Fig 4.2.

The first version of IntelliJ IDEA (logo is in figure 4.3) was released in January 2001 and was one of the first available Java IDEs with advanced code navigation and code refactoring capabilities integrated.

In 2009, JetBrains released the source code for IntelliJ IDEA under the open-source Apache License 2.0.^{[7][8]} JetBrains also began distributing a limited version of IntelliJ IDEA consisting of open-source features under the moniker Community Edition. The commercial Ultimate Edition provides additional features and remains available for a fee.

In a 2010 InfoWorld report, IntelliJ received the highest test center score out of the four top Java programming tools: Eclipse, IntelliJ IDEA, NetBeans and JDeveloper.

Some features of IntelliJ IDEA Ultimate:

Coding assistance -

The IDE provides certain features like code completion by analyzing the context, code navigation which allows jumping to a class or declaration in the code directly, code refactoring, code debugging, linting and options to fix inconsistencies via suggestions.

Built in tools and integration -

The IDE provides integration with build/packaging tools like Grunt, bower, Gradle. It supports version control systems like Git, Mercurial, Perforce, and Subversion. Databases like Microsoft SQL Server Oracle, PostgreSQL, SQLite, and MySQL can be accessed directly from the IDE in the Ultimate edition. through an embedded version of Data Grip, another IDE developed by JetBrains.

Plugin ecosystem -

IntelliJ supports plugins through which one can add additional functionality to the IDE. Plugins can be downloaded and installed either from IntelliJ's plugin repository website or through the IDE's inbuilt plugin search and install feature. Each edition has separate plugin repositories, with both the Community and Ultimate editions totaling over 3000 plugins each as of 2019.

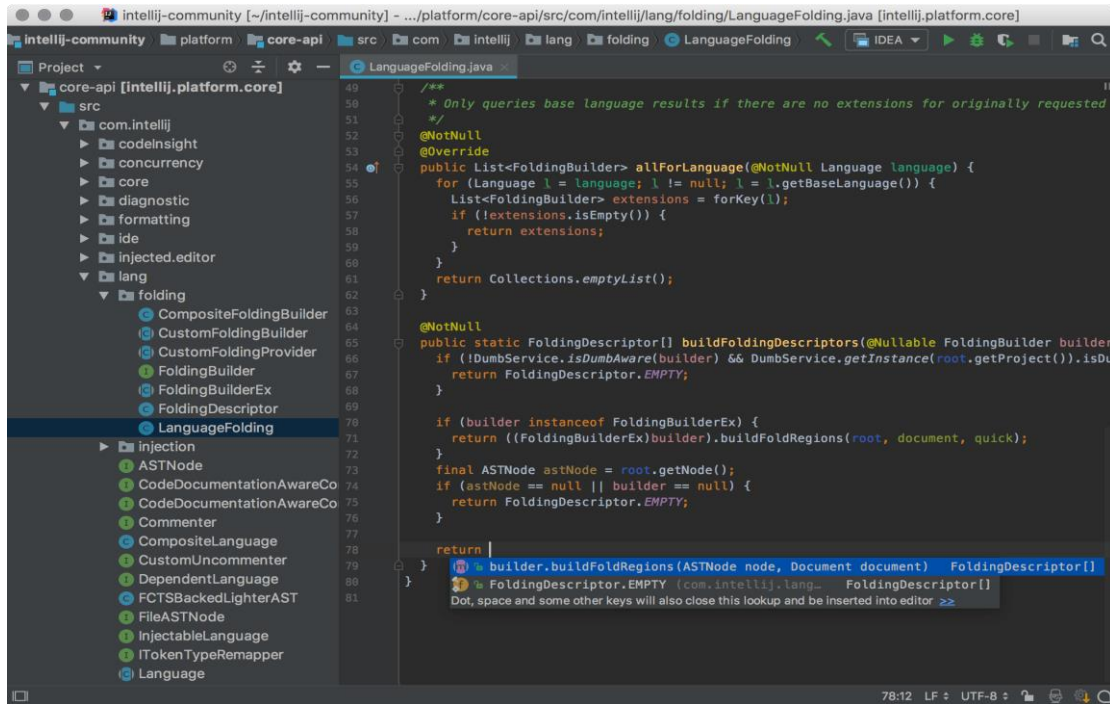


Figure 4.2 IntelliJ Idea Ultimate

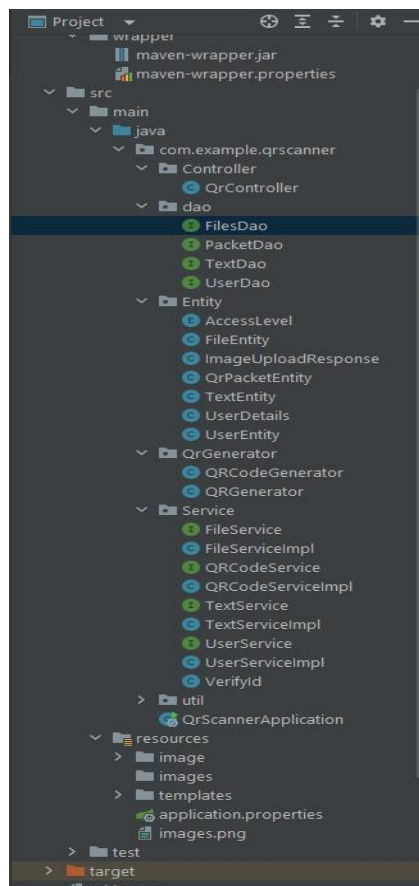


Figure 4.3 – Project Structure Of QODS

Visual Studio 2008(.Net Framework 3.5)

.NET is a free and open-source, managed computer software framework for Windows, Linux, and macOS operating systems. It is a cross-platform successor to .NET Framework. The project is primarily developed by Microsoft employees by way of the .NET Foundation, and released under the MIT License.

The .NET Framework (pronounced as "*dot net*") is a proprietary software framework developed by Microsoft that runs primarily on Microsoft Windows. It was the predominant implementation of the Common Language Infrastructure (CLI) until being superseded by the cross-platform .NET project. It includes a large class library called Framework Class Library (FCL) and provides language interoperability (each language can use code written in other languages) across several programming languages. Programs written for .NET Framework execute in a software environment (in contrast to a hardware environment) named the Common Language Runtime (CLR).

The CLR is an application virtual machine that provides services such as security, memory management, and exception handling. As such, computer code written using .NET Framework is called "managed code". FCL and CLR together constitute the .NET Framework.

FCL provides the user interface, data access, database connectivity, cryptography, web application development, numeric algorithms, and network communications. Programmers produce software by combining their source code with .NET Framework and other libraries. The framework is intended to be used by most new applications created for the Windows platform. Microsoft also produces an integrated development environment for .NET software called Visual Studio.

.NET Framework began as proprietary software, although the firm worked to standardize the software stack almost immediately, even before its first release. Despite the standardization efforts, developers, mainly those in the free and open-source software communities, expressed their unease with the selected terms and the prospects of any free and open-source implementation, especially regarding software patents. Since then, Microsoft has changed .NET development to more closely follow a contemporary model of a community-developed software project, including issuing an update to its patent promising to address the concerns.

VS Code

Visual Studio Code, Fig 4.3 also commonly referred to as VS Code, is a source-code editor made by Microsoft with the Electron Framework, for Windows, Linux and macOS. Features include support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded Git. Users can change the theme, keyboard shortcuts, preferences, and install extensions that add functionality.

In the Stack Overflow 2022 Developer Survey, Visual Studio Code was ranked the most popular developer environment tool among 71,010 respondents, with 74.48% reporting that they use it.

Visual Studio Code is a source-code editor that can be used with a variety of programming languages which C, C#, C++, Fortran, Go, Java, JavaScript, Node.js, Python, Rust. It is based on the Electron framework, which is used to develop Node.js web applications that run on the Blink layout engine. Visual Studio Code employs the same editor component (codenamed "Monaco") used in Azure DevOps (formerly called Visual Studio Online and Visual Studio Team Services). Out of the box, Visual Studio Code includes basic support for most common programming languages. This basic support includes syntax highlighting, bracket matching, code folding, and configurable snippets. Visual Studio Code also ships with IntelliSense for JavaScript, TypeScript, JSON, CSS, and HTML, as well as debugging support for Node.js. Support for additional languages can be provided by freely available extensions on the VS Code Marketplace.

Instead of a project system, it allows users to open one or more directories, which can then be saved in workspaces for future reuse. This allows it to operate as a language-agnostic code editor for any language. It supports many programming languages and a set of features that differs per language. Unwanted files and folders can be excluded from the project tree via the settings. Many Visual Studio Code features are not exposed through menus or the user interface but can be accessed via the command palette.

The CLR is an application virtual machine that provides services such as security, memory management, and exception handling. As such, computer code written using .NET Framework is called "managed code". FCL and CLR together constitute the .NET Framework.

Visual Studio Code can be extended via extensions, available through a central repository. This includes additions to the editor and language support. A notable feature is the ability to create extensions that add support for new languages, themes, debuggers, time travel debuggers, perform static code analysis, and add code linters using the Language Server Protocol. Source control is a built-in feature of Visual Studio Code. It has a dedicated tab inside of the menu bar where users can access version control settings and view changes made to the current project. To use the feature, Visual Studio Code must be linked to any supported version control system (Git, Apache Subversion, Perforce, etc.). This allows users to create repositories as well as to make push and pull requests directly from the Visual Studio Code program. Visual Studio Code includes multiple extensions for FTP, allowing the software to be used as a free alternative for web development. Code can be synced between the editor and the server, without downloading any extra software. VS Code logo is shown in figure 4.4

Visual Studio Code allows users to set the code page in which the active document is saved, the newline character, and the programming language of the active document. This allows it to be used on any platform, in any locale, and for any given programming language. Visual Studio Code collects usage data and sends it to Microsoft, although this can be disabled. Due to the open-source nature of the application, the telemetry code is accessible to the public, who can see exactly what is collected.

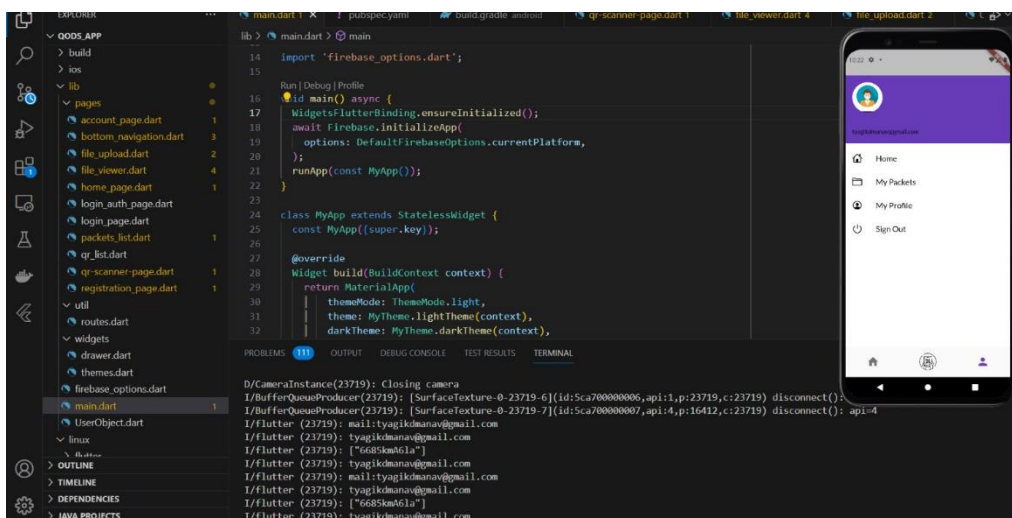


Figure 4.4 VS Code with simulator of QODS

Core Java

Java is a high-level, class-based, object-oriented programming language that is designed to have as few implementation dependencies as possible. It is a general-purpose programming language intended to let programmers write once, and run anywhere (WORA), meaning that compiled Java code can run on all platforms that support Java without the need to recompile. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of the underlying computer architecture. The syntax of Java is similar to C and C++ but has fewer low-level facilities than either of them.

The Java runtime provides dynamic capabilities (such as reflection and runtime code modification) that are typically not available in traditional compiled languages. As of 2019, Java was one of the most popular programming languages in use according to GitHub, particularly for client–server web applications, with a reported 9 million developers.

Java was originally developed by James Gosling at Sun Microsystems. It was released in May 1995 as a core component of Sun Microsystems' Java platform. The original and reference implementation Java compilers, virtual machines, and class libraries were originally released by Sun under proprietary licenses. As of May 2007, in compliance with the specifications of the Java Community Process, Sun had relicensed most of its Java technologies under the GPL-2.0-only license. Oracle offers its own HotSpot Java Virtual Machine, however the official reference implementation is the OpenJDK JVM which is free open-source software and used by most developers and is the default JVM for almost all Linux distributions. As of March 2023, Java 20 is the latest version, while Java 17, 11 and 8 are the current long-term support (LTS) versions.

James Gosling, Mike Sheridan, and Patrick Naughton initiated the Java language project in June 1991. Java was originally designed for interactive television, but it was too advanced for the digital cable television industry at the time. The language was initially called *Oak* after an oak tree that stood outside Gosling's office. Later the project went by the name *Green* and was finally renamed *Java*, from Java coffee, a type of coffee from Indonesia. Gosling designed Java with a C/C++-style syntax that system and application programmers would find familiar. Sun Microsystems released the first

public implementation as Java 1.0 in 1996. It promised Write Once, Run Anywhere (WORA) functionality, providing no-cost run-times on popular platforms. Fairly secure and featuring configurable security, it allowed network- and file-access restrictions.

Major web browsers soon incorporated the ability to run Java applets within web pages, and Java quickly became popular. The Java 1.0 compiler was re-written in Java by Arthur van Hoff to comply strictly with the Java 1.0 language specification

```

61  public static void main(String[] args) {
62      try {
63          // Задаем начальные значения
64          int a = 10, b = 20;
65          double c = 1.5, d = 2.5;
66          String s = "Java";
67          // Выводим меню
68          System.out.println("Меню:");
69          System.out.println("1. Сложение");
70          System.out.println("2. Вычитание");
71          System.out.println("3. Умножение");
72          System.out.println("4. Деление");
73          System.out.println("5. Выход");
74          // Вводим номер операции
75          int n = 0;
76          while (n < 1 || n > 5) {
77              System.out.print("Введите номер операции: ");
78              n = Integer.parseInt(System.in.nextLine());
79          }
80          // Выполняем операцию
81          switch (n) {
82              case 1:
83                  System.out.println("Сложение: " + a + b);
84                  break;
85              case 2:
86                  System.out.println("Вычитание: " + a - b);
87                  break;
88              case 3:
89                  System.out.println("Умножение: " + a * b);
90                  break;
91              case 4:
92                  System.out.println("Деление: " + a / b);
93                  break;
94              case 5:
95                  System.out.println("Выход");
96                  return;
97          }
98          // Выходим меню
99          System.out.println("Меню:");
100         System.out.println("1. Сложение");
101         System.out.println("2. Вычитание");
102         System.out.println("3. Умножение");
103         System.out.println("4. Деление");
104         System.out.println("5. Выход");
105         // Вводим номер операции
106         int n = 0;
107         while (n < 1 || n > 5) {
108             System.out.print("Введите номер операции: ");
109             n = Integer.parseInt(System.in.nextLine());
110         }
111         // Выполняем операцию
112         switch (n) {
113             case 1:
114                 System.out.println("Сложение: " + a + b);
115                 break;
116             case 2:
117                 System.out.println("Вычитание: " + a - b);
118                 break;
119             case 3:
120                 System.out.println("Умножение: " + a * b);
121                 break;
122             case 4:
123                 System.out.println("Деление: " + a / b);
124                 break;
125             case 5:
126                 System.out.println("Выход");
127                 return;
128         }
129     } catch (Exception e) {
130         System.out.println("Ошибка: " + e.getMessage());
131     }
132 }

```

Figure 4.5 JAVA

The Java (Figure 4.5) platform refers to a group of software products from Sun Microsystems. The platform is used to develop and run Java programs. The platform includes the execution engine (called a Java Virtual Machine) that allows Java programs to do the same thing on different computer systems. This capability of being able to develop software on one platform and running it on other platforms is called "cross-platform capability". There are many resources available for learning Java programming, including books, tutorials, and online courses.

Flutter

Flutter is an open-source UI software development kit created by Google. It is used to develop cross-platform-applications for Android, iOS, Linux, macOS, Windows, Google Fuchsia, and the web from a single codebase.

The major components of Flutter include –

- Dart platform
- Flutter engine
- Foundation library
- Design-specific widgets

The first version of Flutter was known as "Sky" and ran on the Android operating system. It was unveiled at the 2015 Dart developer summit with the stated intent of being able to render consistently at 120 frames per second. During the keynote of Google Developer Days in Shanghai in September 2018, Google announced Flutter Release Preview 2, the last major release before Flutter 1.0. On December 4th of that year, Flutter 1.0 was released at the Flutter Live event, denoting the first stable version of the framework. On December 11, 2019, Flutter 1.12 was released at the Flutter Interactive event. On May 6, 2020, the Dart software development kit (SDK) version 2.8 and Flutter 1.17.0 were released, adding support for the Metal API which improves performance on iOS devices by approximately 50%, as well as new Material widgets and network tracking development tools.

On March 3, 2021, Google released Flutter 2 during an online Flutter Engage event. This major update brought official support for web-based applications with a new Canvas Kit renderer and web specific widgets, early-access desktop application support for Windows, macOS, and Linux and improved Add-to-App APIs. This release also utilized Dart 2.0 that featured sound null-safety, which caused many breaking changes and issues with many external packages; however, the Flutter team included instructions and tools to mitigate these issues.

Framework Architecture of Flutter –

The major components of Flutter include:

Dart platform - Flutter apps are written in the Dart language and make use of many of the language's more advanced features. For better performance, release versions of Flutter apps on all platforms use ahead-of-time (AOT) compilation, except for on the Web where code is trans-compiled to JavaScript. Flutter inherits Dart's Pub package manager and software repository, which allows users to publish and use custom packages as well as Flutter-specific plugins. (Figure 4.6)

```
class _MyHomePageState extends State<MyHomePage> {
  int _counter = 0;

  void _incrementCounter() {
    setState(() {
      _counter++;
    });
  }

  @override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(
        title: Text(widget.title),
      ), // AppBar
      body: Center(
        child: Column(
          mainAxisAlignment: MainAxisAlignment.center,
          children: <Widget>[
            Text(
              'You have pushed the button this many times:',
            ), // Text
            Text(
              '$_counter',
              style: Theme.of(context).textTheme.display1,
            ), // Text
          ], // <Widget>[]
        ), // Column
      ), // Center
      floatingActionButton: FloatingActionButton(
        onPressed: _incrementCounter,
        tooltip: 'Increment',
        child: Icon(Icons.add),
      ), // FloatingActionButton
    ); // Scaffold
  }
}
```

Figure 4.6 Flutter application of QODS

Flutter engine - Flutter's engine, written primarily in C++, provides low-level rendering support using either Google's Skia graphics library or the custom "Impeller" graphics layer.¹ Additionally, it interfaces with platform-specific SDKs such as those provided by Android and iOS to implement accessibility, file and network I/O, native plugin support, and more.

Foundation library - The Foundation library, written in Dart, provides basic classes and functions that are used to construct applications using Flutter, such as APIs to communicate with the engine.

Design-specific widgets - The Flutter framework contains two sets of widgets that conform to specific design languages: Material Design widgets implement Google's design language of the same name, and *Cupertino* widgets implement Apple's iOS Human interface guidelines. Flutter allows the developer to use either set of widgets on either platform, i.e. even Cupertino widgets on Android. Third party packages can be used to automatically adjust the app's design to the current operating system. Figure 4.7 is the display of the Flutter code in VS Code IDE.

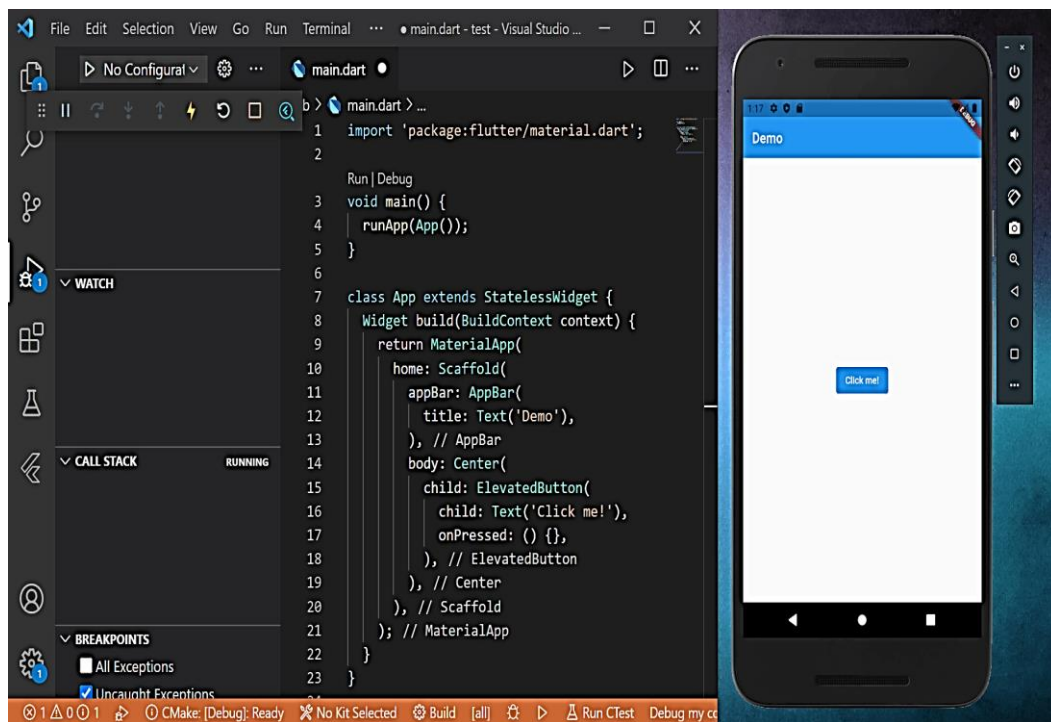


Figure 4.7 – Flutter

Postman

Postman is an API platform for developers to design, build, test, and iterate their APIs. As of April 2022, Postman reports having more than 20 million registered users and 75,000 open APIs, which it says constitutes the world's largest public API hub. The compa

ny is headquartered in San Francisco and maintains an office in Bangalore, where it was founded. Postman started in 2012 as a side project of software engineer Abhinav Asthana, who wanted to simplify API testing while working at Yahoo Bangalore. He launched Postman as a free app in the Chrome Web Store. As the app's usage grew, Abhinav recruited former colleagues Ankit Sobti and Abhijit Kane to help create Postman Inc. The three co-founders lead the company today, with Abhinav serving as CEO and Sobti as CTO. Figure 4.3 shows a snapshot of coding parts done in the Postman Tool.

Postman is the only complete API development environment. The comprehensive set of built-in tools support every stage of the API lifecycle so individuals and teams can easily maintain a single source of truth. You can design and mock, debug, test, document, monitor, and publish your APIs from the Postman UI. Postman allows you to manage your APIs on the Postman native apps for MacOS, Windows, and Linux, with Newman, Postman's command line tool, and via the cloud using Postman Monitoring.

Postman Collections are the most common API specification format and are at the core of every tool within Postman. This makes it easy to save and reuse your work throughout each stage of the API life-cycle. Collections also allow you to collaborate with team members on Postman. Postman recently added private and team Workspaces to make sharing (and privacy) easier. Team Workspaces are the ideal locale for teams to support ongoing development and collaboration. Admins and team leads get project-specific insights, permissions, and oversight. In an additional effort to encourage collaboration, Postman now accommodates teams of any size. This year Postman added a larger Enterprise plan that includes features like single sign-on, etc.

Features of Postman -

- **Workspaces** - allow team collaboration during software development
- **Collections** - series of HTTP requests organized by purpose
- **Environments** - allow for storage and protection of private information
- **Test Scripts** - write and run tests for each request using JavaScript.
- **Variables** - allow you to reference locally stored data without compromising sensitive information.

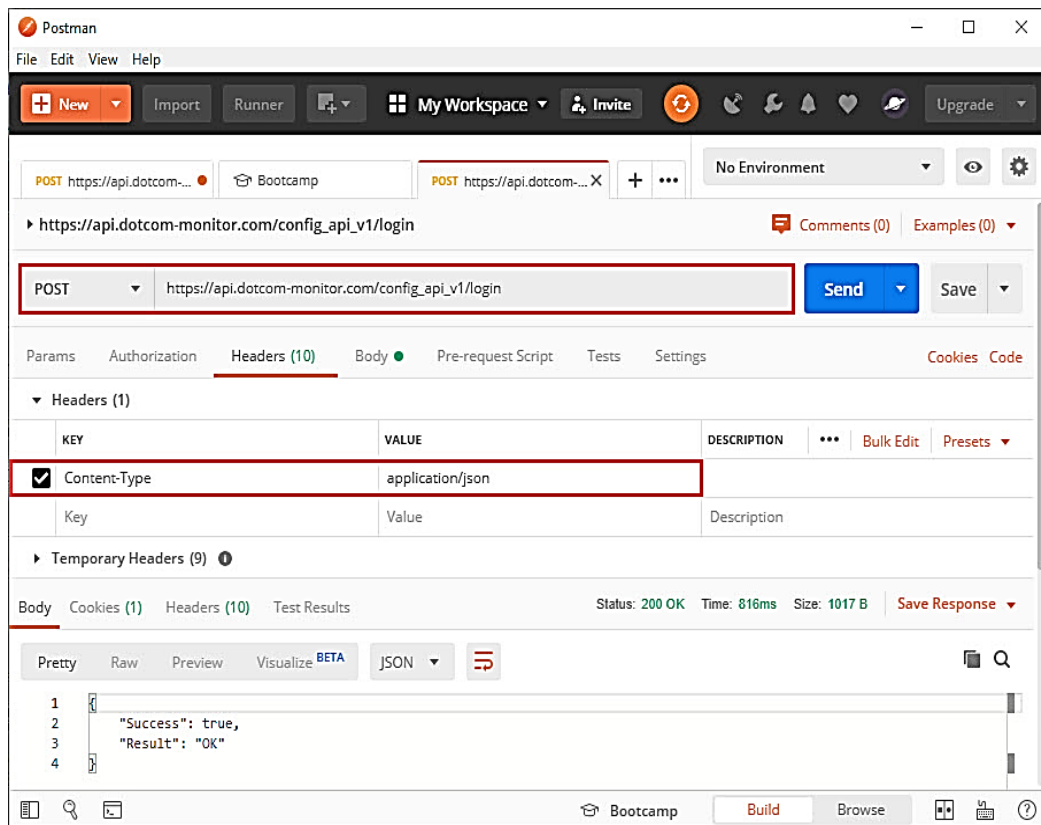


Figure 4.8 Postman API Get/Post Method

Amazon AWS

AWS stands for Amazon Web Services. Amazon Web Services, Inc. (AWS) is a subsidiary of Amazon that provides on-demand cloud computing platforms and APIs to individuals, companies, and governments, on a metered, pay-as-you-go basis. Oftentimes, clients will use this in combination with autoscaling (a process that allows a client to use more compute in times of high application usage, and then scale down to reduce costs when there is less traffic). These cloud computing web services provide various services related to networking, compute, storage, middleware, IoT and other processing capacity, as well as software tools via AWS server farms. This frees clients from managing, scaling, and patching hardware and operating systems. One of the foundational services is Amazon Elastic Compute Cloud (EC2), which allows users to have at their disposal a virtual cluster of computers, with extremely high availability, which can be interacted with over the internet via REST APIs, a CLI or the AWS console. AWS's virtual computers emulate most of the attributes of a real computer, including hardware central processing units (CPUs) and graphics processing

units (GPUs) for processing; local/RAM memory; hard-disk/SSD storage; a choice of operating systems; networking; and pre-loaded application software such as web servers, databases, and customer relationship management (CRM).

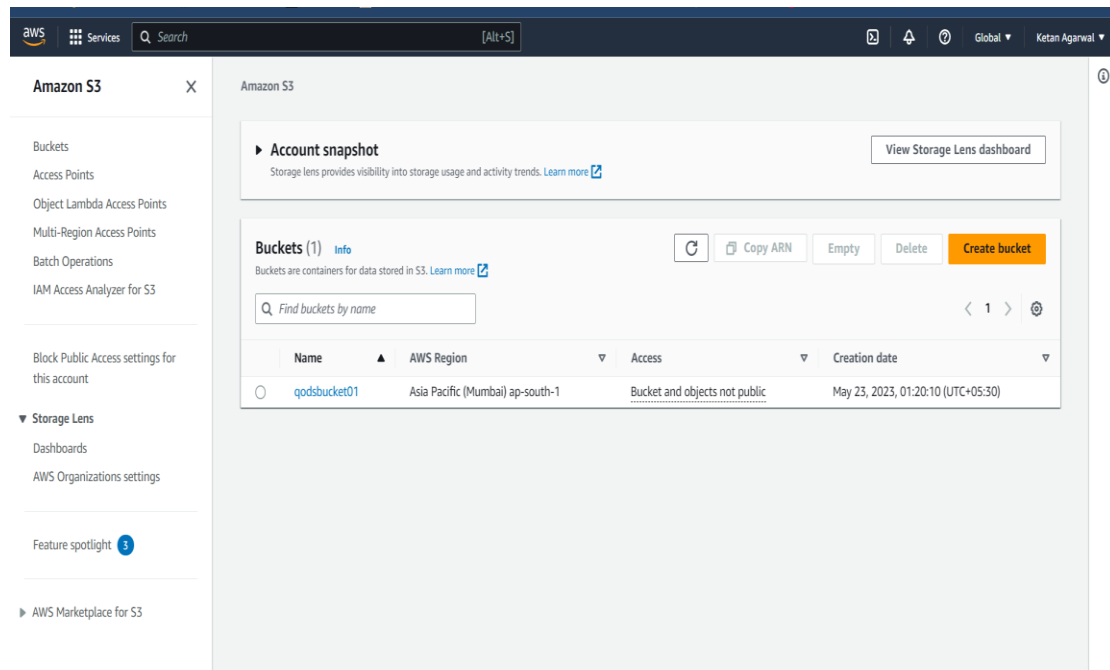


Figure 4.9 Amazon AWS S3

Amazon S3 or Amazon Simple Storage Service is a service offered by Amazon Web Services (AWS) that provides object storage through a web service interface. Amazon S3 uses the same scalable storage infrastructure that Amazon.com uses to run its e-commerce network. Amazon S3 can store any type of object, which allows uses like storage for Internet applications, backups, disaster recovery, data archives, data lakes for analytics, and hybrid cloud storage. AWS launched Amazon S3 in the United States on March 14, 2006, then in Europe in November 2007. Figure 4.9 shows the homepage of Amazon S3.

AWS services are delivered to customers via a network of AWS server farms located throughout the world. Fees are based on a combination of usage (known as a "Pay-as-you-go" model), hardware, operating system, software, or networking features chosen by the subscriber required availability, redundancy, security, and service options. Subscribers can pay for a single virtual AWS computer, a dedicated physical computer,

or clusters of either. Amazon provides select portions of security for subscribers (e.g. physical security of the data centers) while other aspects of security are the responsibility of the subscriber (e.g. account management, vulnerability scanning, patching). AWS operates from many global geographical regions including seven in North America. Amazon markets AWS to subscribers as a way of obtaining large-scale computing capacity more quickly and cheaply than building an actual physical server farm. All services are billed based on usage, but each service measures usage in varying ways. As of 2021 Q4, AWS has 33% market share for cloud infrastructure while the next two competitors Microsoft Azure and Google Cloud have 21%, and 10% respectively, according to Synergy Group.

4.2 CLIENT SIDE

HARDWARE AND SOFTWARE REQUIREMENTS

- A reliable internet connection.
- Operating System: Android (Version 5.0 and above) or iOS (10 or above).
- Processor: Dual Core 1.5 GHz or Higher.
- 256MB RAM

CHAPTER 5

DESIGN AND ANALYSIS

5.1 DESIGN

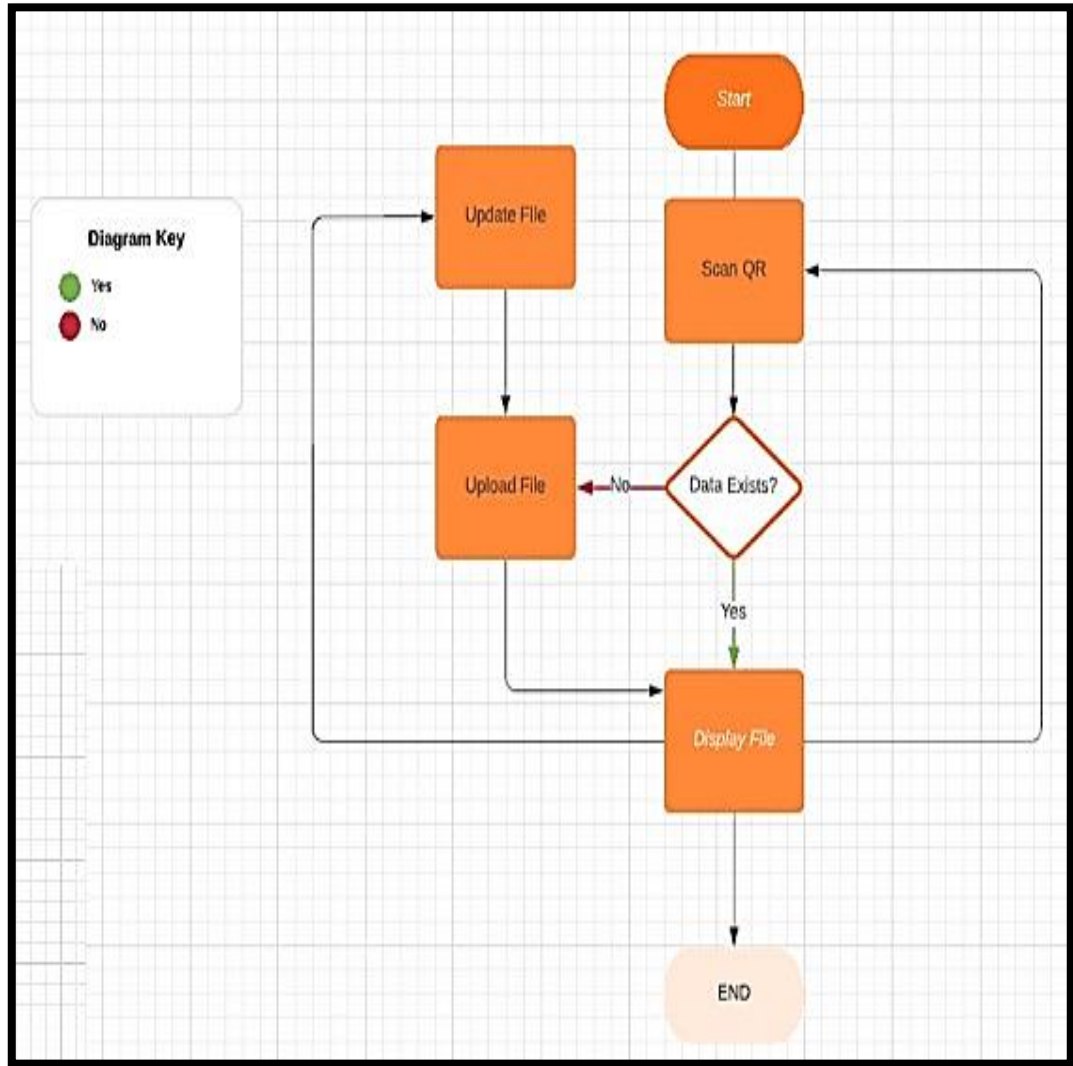


Figure 5.1 Flow Chart of Q.O.D.S.

Figure 5.1 presents the basic flow of the process and information within the system called Q.O.D.S. This flowchart illustrates the sequence of steps involved in the operation of the system and the flow of information between different components. The flowchart typically includes various symbols and connectors to represent different actions, decisions, and data flow within the system. Each symbol or connector in the flowchart has a specific meaning and represents a particular operation or transition. In

this section, the flowchart is explained in more detail, breaking down each step and describing the purpose and functionality of the different components involved.

5.2 IMPLEMENTATION

For the initial testing phase of the design structure, a basic webpage was designed. The webpage was linked to an extensive backend, designed using Springboot and Java. Figure 5.2 shows the basic interface of the prototype application, which consists of an option to choose a QR code to scan. In Chapter 3 of the document, a module was developed to facilitate the generation and reading of QR codes. QR codes are two-dimensional barcodes that can store various types of information, such as text, URLs, or IDs. In this case, the generated QR code contains an ID.

The purpose of generating QR codes in this context is to associate them with specific files and store them in a database. By attaching the ID represented in the QR code to a file, the application can easily retrieve and reference that file later using the ID.

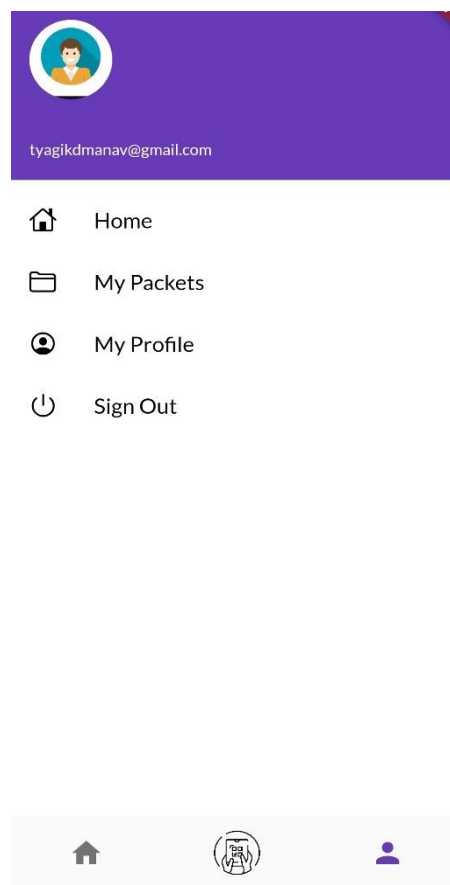


Figure 5.2 Application Accounts page

Figure 5.2 illustrates the interface of the application. One of the options available on this interface is the ability to choose a QR code to scan. This means that the application allows users to use their device's camera or a QR code reader to capture a QR code's image. Once the QR code is scanned, the application can extract the ID embedded within it and perform the necessary actions, such as retrieving the associated file from the database.

The application provides a user-friendly interface with a functionality to scan QR codes. This enables users to associate files with unique IDs by generating QR codes, and subsequently retrieve those files by scanning the QR codes.

In Chapter 3 of the document, a module was developed to facilitate the generation and reading of QR codes. QR codes are two-dimensional barcodes that can store various types of information, such as text, URLs, or IDs. In this case, the generated QR code contains an ID.

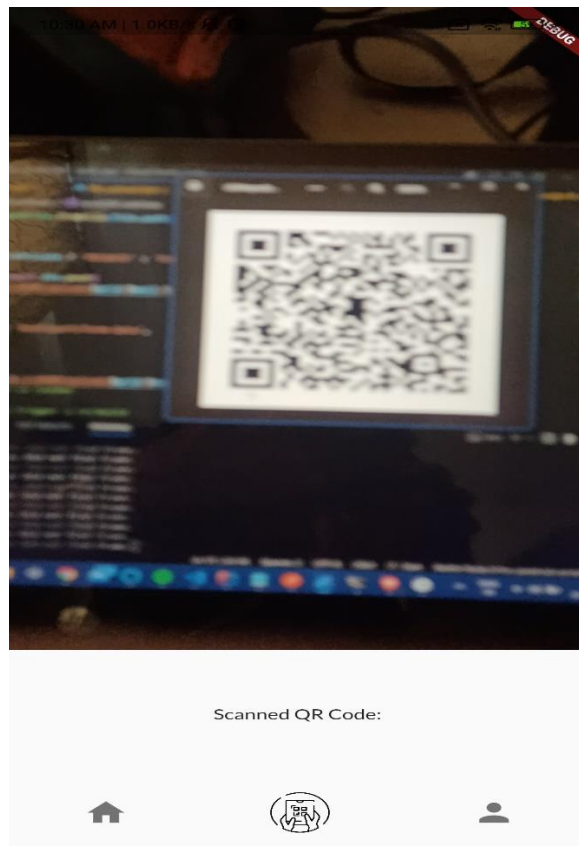


Figure 5.3 QR code scanner module

Figure 5.3 illustrates the process when a user selects the option to upload a QR code. The user interface likely provides a functionality for the user to choose a QR code from their device or a designated location.

Let's consider an example where the user selects a QR code containing the ID "12346". Once the user selects the QR code, the system retrieves the ID embedded within it. This ID is then sent to the backend of the system for further processing

The backend of the system is responsible for handling data operations and interactions with the database. Upon receiving the ID from the frontend, the backend initiates a search operation within the database. It looks for any records or files associated with the provided ID "12346".

The search process involves querying the database using the ID as a reference. The backend checks if there are any matching records or files linked to the ID "12346". This search operation allows the system to locate the specific file or information associated with the scanned QR code.

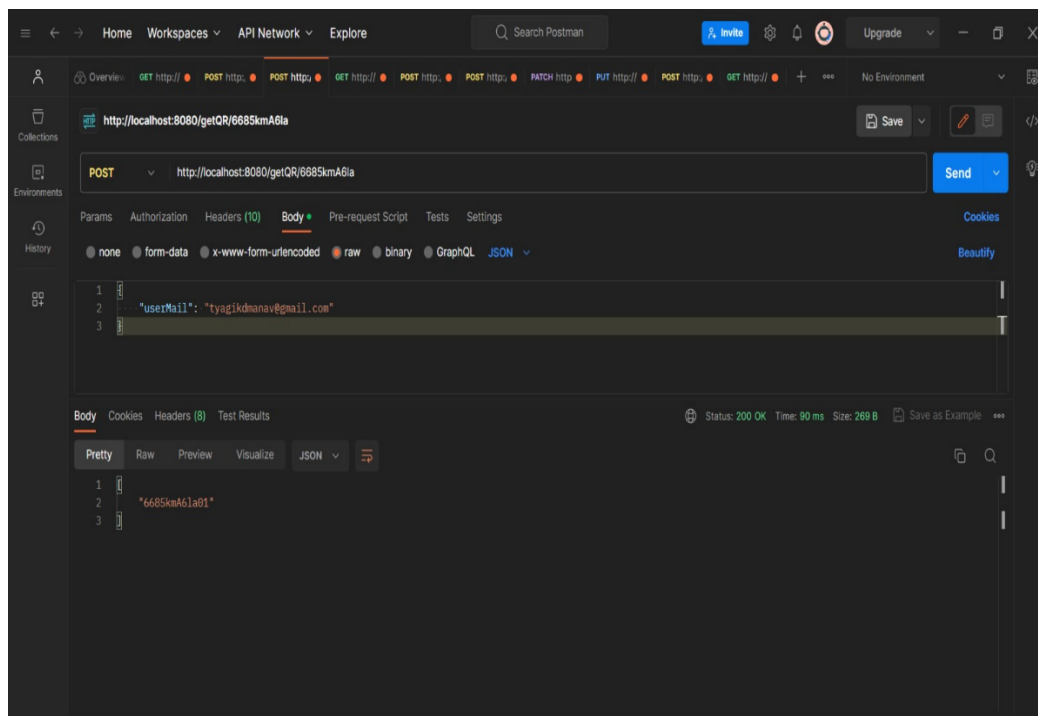


Figure 5.4 Endpoint to retrieve QR Packets linked to an account

In Figure 5.4 of the document, the focus is on the QR codes linked to the accounts, and the corresponding data attached to those entries. The database serves as a repository for storing information linked to specific IDs.

Each entry in the database represents a unique ID, and associated with that ID is a set of data or information. This data can vary depending on the system's purpose, but it could include text, images, files, or any other relevant content.

Authorized users of the system can utilize the same IDs to retrieve the corresponding data from the database. This means that if a user has the appropriate authorization, they can input a specific ID into the system, and the system will fetch and present the corresponding data associated with that ID.

The retrieval process involves querying the database using the provided ID. The system searches for the entry in the database that matches the given ID and retrieves the associated data.

← **File Display**



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PROFILE
An aspiring software engineer with knowledge in software engineering practices such as coding, testing, code reviews, code comments, etc. Strong ability to communicate with clients and ability to express ideas clearly and concisely.

SKILLS

Java

Docker

C/C++

REST API

Spring Boot

Jenkins

Kubernetes

MySQL

MS Excel

English (Written & Spoken)

WORK EXPERIENCE

BACK-END DEVELOPER
SoftNerve Technologies Jan 2021 - Aug 2021

- Held the responsibility of developing robust REST-APIs using the *spring-boot* framework.
- Worked with high-end tools and technologies including Jenkins, Heroku, Redis, MongoDB, MySQL, etc.
- Played a key role in deploying the DevOps pipeline using Jenkins and Kubernetes.

OPERATIONS INTERN
Glider.ai Jan 2022 - Apr 2022

- Held the responsibility for reviewing assessments for various technical and non-technical roles.
- Proofread question statements and checked for errors in code blocks.
- Functioned closely with the Head of Operations to design workflow sheets and excel trackers.

CONTENT WRITER
ADON Men, London Jun 2021 - Aug 2021

- Was responsible for developing blogs and other content.
- Handled the responsibility of building a content strategy for the website and social media platforms.

CONTENT AND APP DEVELOPMENT MENTOR
Fsalon Academy Mar 2020 - Apr 2020

- Worked on developing various franchise documents, blogs, and portfolios as a content writing intern at F. Salon Academy.
- Later worked as a mentor of the content and app development team of interns at the same organization.

EDUCATION HISTORY

Bachelor of Technology (B.Tech), Computer Science & Engineering
IMS Engineering College 2019 - 2023

Complete Core Java Course
E & ICT Academy (IIT Kanpur) 2021

Senior Secondary (XII), Science
St. Mary's School (CBSE board) 2018

Figure 5.5 Displayed data after scanning QR

In Figure 5.5 of the document, the system demonstrates the functionality of displaying the attached information on the screen upon scanning a QR code. The information attached to the QR code can take various forms, including images, text, Word documents, PDFs, or any other supported file types.

When a QR code is scanned using the system, the backend processes the scanned data and retrieves the associated information from the database. This information can be in the form of different file types, as mentioned earlier.

The system then presents the retrieved information on the screen, allowing the user to view and interact with it. Depending on the nature of the attached data, the system may employ suitable rendering techniques to display the information appropriately.

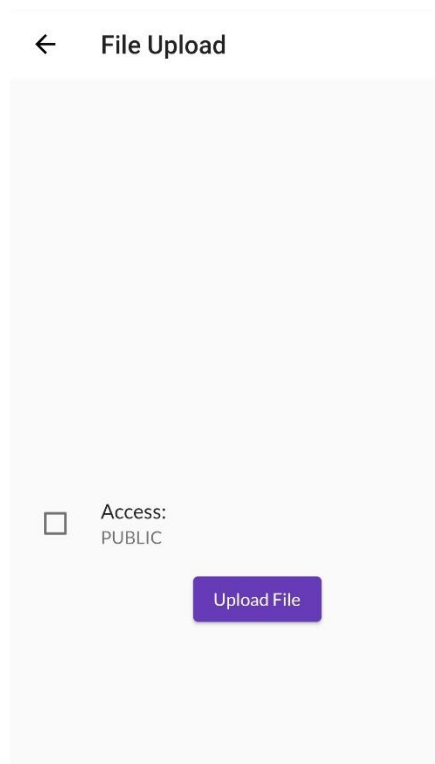


Figure 5.6 Upload Data to the QR

In the scenario depicted in Figure 5.6 of the document, when a QR code with an ID, such as "12345," is scanned, and no data is found attached to that ID in the database, the prototype system displays a message stating "upload file."

This situation occurs when the scanned QR code does not have any associated data or information linked to it in the system's database. In other words, the ID "12347" does not have any existing records or files associated with it.

To address this scenario, the system prompts the user to upload files or attach any relevant data to the scanned QR code. This message serves as a notification to the user that the system does not currently have any data associated with the scanned QR code and provides guidance on how to rectify it

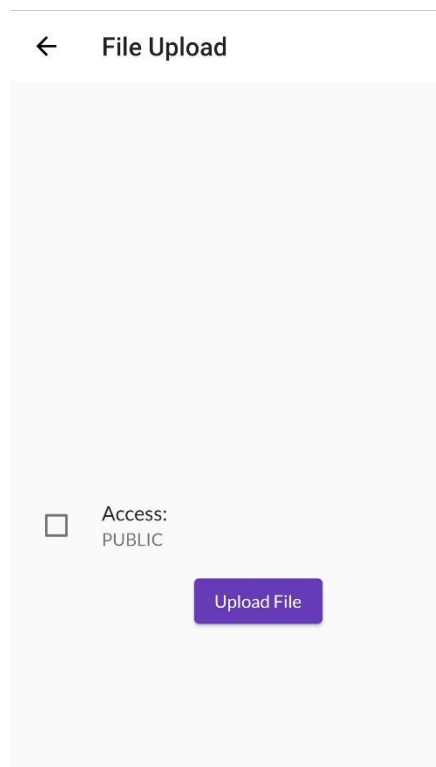


Figure 5.7 Setting up access level for file

A model is shown in figure 5.7 in which the owner of a particular packet can establish there authority over the a particular QR of the packet as Private or Public, and then according to which another user can see the QR data.

5.3 ENTITES AND SERVICES

"File Entity" is an entity or data structure used in a system to store information about files. The File Entity contains several attributes or properties that describe the file and its characteristics.

The attributes typically associated with a File Entity include:

1. **File Name:** This attribute stores the name of the file, which is the identifier or label used to distinguish it from other files.
2. **String ID:** The String ID attribute represents a unique identifier or key assigned to the file entity. It helps in uniquely identifying and retrieving the file when needed.
3. **File Type:** The File Type attribute indicates the type or format of the file, such as .jpg, .pdf, .txt, etc. It specifies the file's extension, which provides information on how the file can be processed or interpreted.
4. **Access Level:** The Access Level attribute determines the level of accessibility or security associated with the file. It specifies whether the file is private, public, or protected. Private files are typically restricted to specific users, public files are accessible to anyone, and protected files may have additional access restrictions or permissions set by the user.

By storing this information in the File Entity, the system can effectively manage and organize files, understand their types, and enforce appropriate access controls based on the security levels specified by the user. The File Entity Code is given in Figure 5.8.


```

1  import lombok.AllArgsConstructor;
2  import lombok.Builder;
3  import lombok.Data;
4  import lombok.NoArgsConstructor;
5
6  import javax.persistence.*;
7
8  18 usages
9  @Entity
10 @Table(name = "file")
11 @Data
12 @Builder
13 @NoArgsConstructor
14 @AllArgsConstructor
15 public class FileEntity {
16     @Id
17     @Column(name = "id")
18     // @GeneratedValue(strategy = GenerationType.IDENTITY)
19     private String id;
20
21     @Column(name = "name")
22     private String name;
23
24     @Column(name = "type")
25     private String type;
26
27     @Column(name = "accessLevel")
28     @Enumerated(EnumType.STRING)
29     private AccessLevel accessLevel;
30
31     @Column(name = "image", unique = false, nullable = false, length = 1000000000)
32     private byte[] data;
33 }
34
35

```

Figure 5.8 – File Entity

There are additional entities in the QODS system besides the File Entity. These entities are the QR Packet Entity and User Entities, which serve specific purposes within the system.

QR Packet Entity: The QR Packet Entity is an entity designed to store information related to QR packets. It is likely used to generate QR codes associated with a specific packet ID. The QR codes generated can be used for various purposes, such as tracking, identification, or retrieval of information related to a particular packet. This entity helps in managing and organizing QR packets efficiently.

User Entities: The User Entities represent individual users within the system. They are used to store user-specific information, such as name, email, or any other relevant details. These entities enable users to register and associate multiple packets with their account or name. This functionality allows users to manage and keep track of their registered packets conveniently. Additionally, it may facilitate collections or grouping of packets based on user preferences or requirements.

User Entity and QR Packet Entity codes are shown in Figure 5.9 and 5.10 respectively.

```

1 package com.example.qrscanner.Entity;
2
3 import lombok.AllArgsConstructor;
4 import lombok.Builder;
5 import lombok.Data;
6 import lombok.NoArgsConstructor;
7
8 import javax.persistence.ElementCollection;
9 import javax.persistence.Entity;
10 import javax.persistence.Id;
11 import java.util.HashMap;
12 import java.util.List;
13
14 23 usages
15 @Entity
16 @Data
17 @Builder
18 @AllArgsConstructor
19 @NoArgsConstructor
20 public class UserEntity {
21     @Id
22     private String userMail;
23     @ElementCollection
24     private List<String> qrPacket;
25 }

```

Figure 5.9 User Entity

```

1 package com.example.qrscanner.Entity;
2
3 import lombok.AllArgsConstructor;
4 import lombok.Builder;
5 import lombok.Data;
6 import lombok.NoArgsConstructor;
7
8 import javax.persistence.ElementCollection;
9 import javax.persistence.Entity;
10 import javax.persistence.Id;
11 import java.util.HashMap;
12 import java.util.List;
13
14 5 usages
15 @Entity
16 @Data
17 @Builder
18 @AllArgsConstructor
19 @NoArgsConstructor
20 public class QrPacketEntity {
21     @Id
22     private String packetID;
23     @ElementCollection
24     private List<String> qrCodes;
25 }

```

Figure 5.10 QR Packet Entity

By incorporating the QR Packet Entity and User Entities into the system, it becomes possible to generate multiple QR codes for a single packet ID, enhancing the system's flexibility and functionality. Users can register multiple packets under their name or email, enabling them to conveniently manage and track their packets or perform actions such as packet collections with multiple imports.

In addition to the entities mentioned, there are also services implemented in the system to handle specific functionalities and operations.

File Service: The File Service (Figure 5.11) retrieves files for users who have scanned the QR code in order to extract the file data. It accomplishes this by using the packet ID associated with the QR. The File Service maintains a list or database of files stored in the system, and when a user scans a QR code, the File Service is called upon. It searches the list using the file ID from the QR code and returns the corresponding file to the user, allowing them to access the file's data.

```
13
14 @Service
15 public class FileServiceImpl implements FileService{
16
17     4 usages
18     private final FilesDao filesDao;
19
20     @Autowired
21     public FileServiceImpl(FilesDao filesDao) { this.filesDao = filesDao; }
22
23
24     1 usage
25     @Override
26     public void storeFile(MultipartFile file, String id, AccessLevel access) throws IOException {
27         FileEntity fileEntity = new FileEntity();
28         fileEntity.setId(id);
29         fileEntity.setName(file.getOriginalFilename());
30         fileEntity.setData(file.getBytes());
31         fileEntity.setType(file.getContentType());
32         fileEntity.setAccessLevel(access);
33         filesDao.save(fileEntity);
34     }
35
36     1 usage
37     @Override
38     public List<FileEntity> getAllFiles() { return filesDao.findAll(); }
39
40     2 usages
41     @Override
42     public Optional<FileEntity> getFileById(String id) { return filesDao.findById(id); }
43
44 }
45
```

Figure 5.11 File Services

Text Service: The Text Service (Figure 5.12) handles operations related to text entities. It provides functionalities such as adding, putting, and patching data using a text entity or ID as a parameter. This service allows users to manipulate and manage text-based data within the system. For example, users can add new text entities, update existing entities, or modify specific fields within a text entity by providing the respective ID. The Text Service enables efficient handling and manipulation of textual data.

```
22 | 1 usage
23 | @Override
24 | public List<TextEntity> get texts() { return repository.findAll(); }
25 |
26 |
27 | 1 usage
28 | @Override
29 | public TextEntity getText(Long id) {
30 |     //TextEntity entity = repository.getReferenceById(id);
31 |     return repository.getReferenceById(id);
32 | }
33 |
34 | 1 usage
35 | @Override
36 | public TextEntity addText(TextEntity text) {
37 |     repository.save(text);
38 |     return text;
39 | }
40 |
41 | 3 usages
42 | @Override
43 | public String getDesc(Long id) {
44 |     TextEntity entity = repository.getReferenceById(id);
45 |     return entity.getDescription();
46 | }
47 |
48 | 1 usage
49 | @Override
50 | public TextEntity patchData(Long id, TextEntity text) {
51 |     TextEntity entity = repository.getReferenceById(id);
52 |     entity.setDescription(text.getDescription());
53 |     return text;
54 | }
55 |
56 | 1 usage
57 | @Override
58 | public TextEntity putData(TextEntity text) {
59 |     repository.save(text);
60 |     return text;
61 | }
```

Figure 5.12 – Text Services

User Service: The User Service focuses on storing QR packets associated with a specific user who has an account registered in the system. When a user scans a QR code, the User Service checks if the user is registered in the system. If the user is found, the QR packet is stored under their account. However, if the user is not registered, the system displays a message indicating that the user is not found. In such cases, the system proceeds to display the data stored within the particular QR code without associating it with a specific user account.

5.4 ANALYSIS

The project introduces a wide array of use cases and future scopes. In the traditional sense, QR codes have been a physical address that is generated after uploading a link to a QR code generator on the web. With this application, we will be able to provide users with ready-made QR codes that can be later attached to any data of their choice. The access to ready-made QR codes will allow users to use QR codes for everyday uses. Some of the use cases and future scopes of the project have been discussed below

In terms of scope:

The technology can be used in various fields and professions, for ex-

- By students to store notes on specific pages.
- By institutes to provide digital notice boards and to easily update them.
- To place important and lengthy instructions.
- In offices to provide authorized access to interactive data sheets, graphs, etc. on team boards and management software.

In terms of Resources:

The technology can be used for various resources such as pictures, documents, notices, assignments, office files, class notes, important links, lengthy instructions, and guidebooks.

In terms of Time:

In current scenarios where we have been receiving most of our assignments and related documents online, managing them and finding them is havoc. Since the world is moving towards remote workspaces, it is only useful to have a better file management system.

5.5 MARKET POTENTIAL

The market potential and future scope of the application include the addition of several features and use cases that make the application useful to as many users as possible.

Some of the future scopes that we can be looking forward are mentioned below:

- **In the field of education**

As students, we have always found it difficult to locate pdf and important documents. A lot of times after completing our notes, we lose access to source documents, these documents are often required when reviewing notes later. If we have the ability to link source documents to handwritten notes, then we can easily review the sources to cover up any knowledge gaps. QODS can also be used by teachers to distribute weekly notes and other documents. These documents can directly be linked to other QR codes by students when provided with write access.

- **Scope of use in offices**

The need of connecting physical files to digital data is required nowhere more than in the offices. In the future implementation of the application, integration can be provided to applications like MS Teams or Jira by Atlassian. Integration with this application will allow teams to provide physical addresses to excel sheets, open tickets, tableau data, etc. on office boards, with access to only limited team members and admins.

- **Interactive Web Pages**

Interactive web pages can be included as a premium feature for business and commercial use cases, where the user can use QR codes for the management of stores, providing interactive menus at restaurants, etc. This subscription-based model can help them in scaling their business and automating the processes without buying costly tools or designing web pages. Web pages and store management templates can be provided to users as per the requirement of their business and the scale of operation.

- **Combining Teams**

In the future, we can add more features like Creating teams or organizational accounts within apps for flawless transfer of data between teams.

- **Readers Confirmation**

We can include a feature that whenever a user scans your QR code you receive a notification with the details of the user, which can help workplaces and offices

confirm that the instructions have reached every individual in their team and organization.

- **Cloud Storage of Important Files**

When a user attaches a file to the QR it is uploaded to the cloud, the user can access That file from any device by logging in to his account which will keep his documents safe and make it easy for them to classify between useful and untuned information.

CHAPTER 6

CONCLUSION

6.1 CONCLUSION

In conclusion, this project implements a model that helps us in rethinking the QR codes as physical connectors to the digital world. Most projects and research that have been done so far focus on generating QR codes after receiving printable information. The model discussed in the report highlights a method through which QR codes can be supplied to users without attaching any information to them. The readymade set of QR codes will allow users and organizations to discover widespread use cases of this technology as per their requirements.

The absence of a system through which digital data can be linked to physical locations securely was the motivation behind the creation of the project.

The model discussed in the report allows the user to buy a set of stickable QR codes as a packet. This packet can then be linked to the user's account by scanning a QR code present on the inside of the packet. Scanning this packet will allow the user to become the owner of all the QR codes inside the packet. The user can then attach any file or document to the QR code and place it as per their requirement. This will allow the user to access the data later by either scanning the QR code or visiting the application.

Security models implemented in the project allow the user to set the access level to QR codes, namely "public", "private", or "limited". These access levels will allow the QR code owner to select who can read or edit the data present inside the QR code.

This application has widespread uses ranging from schools, colleges, and offices to shops and restaurants.

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