QR Code Overview
• Quick response, or QR, Code is a two-dimensional version of the Barcode
• Developed in 1994 by Masahiro Hara when he was working for DENSO WAVE technologies.
• QR Code system originated from requests from DENSO manufacturing sites due to problems with Barcodes in terms of capacity and reliability and use 2D barcodes.
• One problem for Hara was figuring out a way to make 2D codes to be read fast, while preventing false recognition once the shape of the position detection pattern was added (black and white dots)
  • The shape needed to be unique
  • Tests showed ideal ratio as 1:1:3:1:1
    • Enabled the Code to be detected regardless of the scanning angle
      • You can scan it from up, down, left or right.
• When a QR Code is scanned, it conveys a wide multitude of information
QR Codes vs Barcodes

- QR Codes contain more information than barcodes because they have the ability to hold information both horizontally and vertically
  - Barcodes only use horizontal information
    - Ideal for supermarket use
- QR Codes have higher capacity for transferring information
  - Thus making them more popular
History of QR Codes

• QR Codes found their first use in Japan’s Kanban, which is a type of electronic communication tool used in the automotive industry.
• Hara decided not to keep patent rights, QR Codes were widely adopted.
• In 2000, QR Codes were added to ISO international standards see (https://www.iso.org/standard/62021.html), “ISO/IEC 18004:2015 Information technology — Automatic identification and data capture techniques — QR Code bar code symbology specification”
QR Codes Models

• Model 1:
  • Original Model of QR code: he original QR Code, a code capable of coding 1,167 numerals with its maximum version being 14 (73 x 73 modules)

• Model 2
  • QR Code created by improving Model 1 so that this code can be read smoothly even if it is distorted in some way
  • This code can encode up to 7,089 numerals with its maximum version being 40 (177 x 177 modules)
QR Codes types

• Micro QR Codes
  • Smaller than QR code
  • Less Information
  • Less area
QR Codes types

• SQRC (registered trade mark by DENSO)
  • A single code carries two types of data: public and private
• A single QR Code can carry public data and Secure data
  • Secure data can be read only with a reader with access to the corresponding private key
• SQRC looks the same as the QR Code

FrameQR®
A next-generation QR Code with both design flexibility and security
Information Capacity

- QR Code range from Version 1 to 40
- Each version has a module configuration
  - refers to the number of modules contained in a symbol, commencing with Version 1 (21 × 21 modules) up to Version 40 (177 × 177 modules).
  - Each higher version number comprises 4 additional modules per side
- Each QR Code symbol version has maximum data capacity according to the amount of data, character type and error correction level
- As the amount of data increases, more modules are required to comprise QR Code, resulting in larger QR Code symbols
The anatomy of a QR Code

The anatomy of a QR Code


### Positioning detection markers

Located at three corners of each code, it allows a scanner to accurately recognize the Code and read it at high speed, while indicating the direction in which the Code is printed. They essentially help quickly identify the presence of a QR Code in an image and its orientation.
The anatomy of a QR Code


**Alignment markings**

Smaller than the position detection markers, they help straighten out QR Codes drawn on a curved surface. And, the more information a Code stores, the larger it is and the more alignment patterns it requires.
The anatomy of a QR Code

See https://www.qr-code-generator.com/qr-code-marketing/qr-codes-basics/

**Timing pattern**

Alternating black/white modules on the QR Code with the idea of accurately helping configure the data grid. Using these lines, the scanner determines how large the data matrix is.
The anatomy of a QR Code


**Version information**

With currently 40 different QR Code versions, these markers specify the one that is being used. The most common ones are versions 1 to 7.
The anatomy of a QR Code


**Format information**

The format patterns contain information about the error tolerance and the data mask pattern and make it easier to scan the Code.
The anatomy of a QR Code

See https://www.qr-code-generator.com/qr-code-marketing/qr-codes-basics/

Data and error correction keys

The error correction mechanism inherent in the QR Code structure is where all your data is contained, also sharing the space with the error correction blocks that allow up to 30% of the Code to be damaged.
The anatomy of a QR Code

See https://www.qr-code-generator.com/qr-code-marketing/qr-codes-basics/

**Quiet zone**

This is similar to the importance of white space in design, that is it offers structure and improves comprehension. For whom or what you may ask? For the scanning program. In order to distinguish the QR Code from its surroundings, the quiet zone is vital.
# The Specification QR Code


<table>
<thead>
<tr>
<th>Symbol size</th>
<th>Min. 21x21 cell - Max. 177x177 cell (with 4-cells interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information type and volume</td>
<td>Numerical characters</td>
</tr>
<tr>
<td></td>
<td>Alphabets, signs</td>
</tr>
<tr>
<td></td>
<td>Binary (8 bit)</td>
</tr>
<tr>
<td></td>
<td>Kanji characters</td>
</tr>
<tr>
<td>Conversion efficiency</td>
<td>Numerical characters mode</td>
</tr>
<tr>
<td></td>
<td>Alphanumeric/signs mode</td>
</tr>
<tr>
<td></td>
<td>Binary (8 bit) mode</td>
</tr>
<tr>
<td></td>
<td>Kanji character mode (13 bit)</td>
</tr>
<tr>
<td>Error correction functionality</td>
<td>Level L</td>
</tr>
<tr>
<td></td>
<td>Level M</td>
</tr>
<tr>
<td></td>
<td>Level Q</td>
</tr>
<tr>
<td></td>
<td>Level H</td>
</tr>
<tr>
<td>Linking functionality</td>
<td>Possible to be divided into 16 symbols at maximum</td>
</tr>
</tbody>
</table>
Tutorial (must Read)

See https://www.thonky.com/qr-code-tutorial/introduction

Remember to go through the link

Also please read Reed–Solomon error correction
See https://en.wikipedia.org/wiki/Reed%E2%80%93Solomon_error_correction
Dynamic QR Code


- Hard to change the QR after printing (Static QR Codes)
- Dynamic QR Codes allow developer to update, edit and change the type of the QR Code on the fly
- Also the more information is stored into Static QR Code, the more complex the code becomes.
- Solution is by using a Dynamic Code
- Content provided in the code is a redirection URL assigned to real content
# Dynamic QR Code

<table>
<thead>
<tr>
<th>Dynamic QR Code Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>🔄 <strong>App Store</strong></td>
<td>Linking to multiple app stores with just one scan, it makes the promotion and download of your mobile apps much more efficient by reaching a wider target audience, regardless of the scanner's cellular operating system.</td>
</tr>
<tr>
<td>📄 <strong>PDF</strong></td>
<td>Digital magazines, brochures, eBooks, with this Code you can simultaneously boost your marketing, save on printing costs, and offer customers the chance to save and share documents all from the palm of their hand.</td>
</tr>
<tr>
<td>🌐 <strong>Social Media</strong></td>
<td>Share all of your social media platforms on a mobile-friendly landing page. Whether it’s Twitter, Snapchat, YouTube or Instagram, your audience can choose which platform to follow you on.</td>
</tr>
<tr>
<td>💳 <strong>Coupon</strong></td>
<td>Remove the hassle of couponing for your customers with this Code. With one scan, they can save your promotion to their mobile devices, share it on social media or by email, and redeem it with ease at your nearest location or online store.</td>
</tr>
<tr>
<td>📞 <strong>Business Page</strong></td>
<td>Let your audience get to know you a little better at their own convenience. If you don’t have a website, then this QR Code is the perfect, mobile-friendly platform to let customers know your mission statement, how to reach you, your physical store locations, opening hours and how to find you with Google Maps.</td>
</tr>
</tbody>
</table>

References

5. https://www2.slideshare.net/mrudula14/qr-code-ppt?next_slideshow=1
8. https://www.youtube.com/watch?v=kHTWTyV7VJQ&t=483s