World's Smallest QR Code

Prelims: *Current events of national and international importance | Science & Technology*

Why in News?

Recently, researchers from TU Wien and start-up Cerabyte created the world's smallest QR code, earning a Guinness World Records title

- **QR code –** A quick response (QR) code is a type of barcode that can be scanned by a digital device and ***stores information as a series of pixels in a square-shaped grid.***
- **Types of QR Codes – Micro QR Code –** Smaller than normal QR codes; used where space is limited (e.g., small products).
- Smallest size – 11 × 11 modules that store up to 21 characters.
- **Model 1 QR Code –** Early version (prototype) of QR codes.Stores up to 1,167 numbers.
- **Model 2 QR Code –** Improved and most commonly used version today.
- Has better alignment and higher data capacity.
- Can store up to 7,089 numbers (Version 40).
- **iQR Code –** Can be square or rectangular.
- Useful when shape or space is a constraint.
- **SQRC (Secure QR Code) –** Has a restricted access feature.
- Used for storing private or confidential information.
- **Frame QR Code –** Comes with a customizable frame.
- Can include images, logos, or illustrations along with data.
- **Uses –** In various applications, from supply chain management to digital payments to cryptocurrency wallet addresses.

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- **Size –** Around ***2 square micrometres (smaller than a bacterium).***
  - Nearly **one-third the size** of the previous record holder.
- **Objective –** To tackle "Data Rot" as the present storage devices (hard drives, magnetic tapes) last only 10–30 years.

- Require continuous power, cooling, and data transfer to new systems.
- Risk of long-term digital data loss.
- **Features – Grid size –** 29 × 29 pixels.
- **Each pixel –** 49 nanometres, which is *smaller than the wavelength of visible light.*
- **Material used –** 15 nm chromium nitride (ceramic coating).
- **Technique –** Focused Ion Beam (FIB) milling (atom-level carving).
- **Verification –** Using a Scanning Electron Microscope.
- **Ceramic-Based Data Storage –** Highly durable, heat-resistant, corrosion-resistant, and chemically inert.
- ***One A4-sized ceramic sheet can store over 2 TB of data.***
- **Information density –** *130 bits per square micrometre.*
- Data is etched physically; hence no power is needed for preservation and can potentially last for millennia.

Reference

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