



Evolution of Timekeeping Devices

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Why in News?

Recently, researchers have made significant developments in [nuclear clocks](#) by developing a laser for **thorium-229** nuclei stimulation and linking it with an optical clock.

- The world has evolved from keeping time with the **Sun** and the **moon** to **atoms** and their nuclei.

How Timekeeping Devices Evolved Over History?

▪ Historical Timekeeping Devices:

- **Sundials:** Ancient devices that indicated time by [casting shadows](#) from **sunlight**.
- **Water Clocks:** Measured time through the gradual **filling** of a vessel with water.
- **Hourglasses:** Used sand instead of water to measure time.

▪ Development of Mechanical Clocks:

- **Early Mechanical Clocks:** Improved water clocks included additional tanks, **gears**, and **pulleys**.
- **Astrarium (Medieval Astronomical Clock):** A sophisticated instrument to track **celestial movements**.
- **Pendulum Clock:** Spring-driven clocks replaced weights with **coiled springs**.

▪ Modern Clocks:

- **Electric Clocks:** Emerged in the 19th century, using **batteries** or electric motors instead of springs or weights.
- **Quartz Clocks:** Use a quartz crystal that **oscillates** when electrically charged. These clocks are affordable and widespread, leading to the popularity of quartz watches and wall clocks.

▪ Atomic Clocks:

- **Operation:** Use **lasers** and **atoms** of the same **isotope** to measure time. The frequency of radiation emitted when atoms transition between energy states defines the time.
 - India is setting up **atomic clocks nationwide** to make sure that the time on **digital devices** matches [Indian Standard Time \(IST\)](#), as part of the [One-Nation, One-Time initiative](#).
- **Caesium Atomic Clocks:** Utilize **caesium-133** atoms and are highly accurate, maintaining the IST.
 - IST is a cesium atomic clock used at the National Physical Laboratory (NPL), New Delhi.
 - Council Of Scientific And Industrial Research-National Physical Laboratory (CSIR-NPL) maintains the IST.
- **Next-Generation Optical Clocks:** Use atoms like [strontium or ytterbium](#) to achieve even greater precision of time.

▪ Future Developments in Timekeeping:

- **Nuclear Clocks:** Focus on the nuclei of atoms for even higher precision. The emission frequency of these [nuclear clocks](#) is around 2,020 terahertz, indicating ultra-high precision.

How Clocks Evolved Over History In India?

- The development of clocks in Indian history reflects a rich blend of **indigenous ingenuity** and **external influences**.
- **Ancient India** utilised various timekeeping methods, such as **water clocks (known as ghatika yantra)** and **sundials**, which were used in temples and for daily activities.
 - Ancient Indians tracked time using the stars and **planetary positions (Nakshatras)** to accurately record significant events.
 - Timekeeping linked to planetary positions led to the development of **astrology** and exploring the **influence of planets** on human life.
 - Despite the advanced system, daily time was often measured in **hours** or **pahars**, and **simple clock** towers were sufficient for general public use.
- With the arrival of **Islamic rulers**, more **advanced water clocks** and astronomical instruments were introduced, blending with local traditions.
- The **colonial period** saw the introduction of **mechanical clocks** and **pocket watches**.

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