Technology in Geography

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Technology has been at the forefront of geographical change over the last millennium. What started as old world cartography tables evolved into the vast world of Google Maps in everyone’s pockets, omnipresent and immensely powerful. Navigation apps, however, are only the tip of the iceberg when it comes to geography technology.

Humanity has been fundamentally transformed by technological advancements in the 20th century. Maps, once a static artform, are digitized tools in the pockets of nearly every person on Earth today. From cave art to naval navigation to Google Maps, GPS navigation and Geographic Information Systems (GIS) that empower us today.

**History**

*Preindustrial*

“It may sound hyperbolic, but history proves that when maps change, so does humanity’s perception of itself.

Just as Cold War-era maps by the Soviet Union reflect certain ideas about that society’s worldview, so do maps left by ancient civilizations. A clay tablet from around 600 BCE called the “Babylonian Map of the World,” is thought to be among the first-ever known maps. It features Babylon in the center of the known world surrounded by water and eight triangular regions. This arrangement is thought to be a symbolic, rather than literal, representation of the world. Older maps from Greece are organized similarly” (Bergum).

The earliest known maps were to navigate short distances; the path between trade routes, or a simplification the city. Rather than congregating vast information together, like a map used to navigate a sea route, they aimed to visualize small geographic spaces. This mapping technique dates back to thousands of years before the modern era, with notable examples coming from Babylonian civilization and Greece.

The first revolution in mapmaking came by way of Grecian Claudius Ptolemaeus, better known as Ptolemy, in 150 AD when he published the scientific treatise *Geographia*. In contrast to the past maps, which are categorized in modern day as art, Ptolemy took a mathematical approach. By congregating thousands of historical datasets and maps from all around the world and creating a system of latitude and longitude, this mathematical approach became the prototype of the modern map (“The evolution of maps: From paper to soar.”).

In the Middle Ages, conversely, development stalled. European society stagnated in religious fervor, and maps reflected this change. They were decorated with angels and mythological creatures. They also reflected a sense of geocentrism that pervades to modern day— the source of the map will, almost without fail, be the center of it, too. These maps are not for navigation, but to demonstrate the concept of a vast world.

The Islamic world filled the gap in this timeline while Europe faltered. Following Ptolemy’s mathematical maps publicized in *Geographia*, maps became more calculated. This time period saw the development of more precise measurements as map making forged itself into a science instead of a creative endeavor (“The evolution of maps: From paper to soar.”).

Cartography tools grew and developed, and cartographers became highly esteemed and valued in the early-modern society. Maps were essential to an expanding world as the Americas, Eurasia, and Africa converged into coinciding societies. Much like art, mapmaking became secularized and increasingly divided from religious institutions. Maps were essential to the demands of colonization, as well as the shifting ideas of the 1400s: circumnavigation proved the Earth as one contiguous entity, and maps are startlingly similar to known images of Earth despite lacking the satellite reference of the modern day. In 1569, Gerardus Mercator developed the Mercator projection, which distorted size at the poles to fit a spherical Earth onto a flat plane. This projection is still dominant in modern day (“The evolution of maps: From paper to soar.”).

*Post-Industrial*

In the late 18th century, cartography became mechanized. The ability to travel drove the need for accurate, affordable, and compact maps among a large demographic of middle class and businesspeople who were now free to travel in ways historically restricted to the upper class. This led to the primitive form of remote sensing (to be discussed later) through early arial photography using kites, balloons, and birds. The photos themselves were not good maps but provided useful information to cartographers, and methods eventually shifted to airplanes (“The evolution of maps: From paper to soar.”).

It became more efficient to make digital maps: they were easy to correct, expand, and manipulate in ways paper was not. Though this was initially just the digitalization of paper maps, it quickly formed into entire new digital cartography methods.

The Cold War oversaw the development of the first Global Positioning Systems (GPS), the most pivotal invention in modern day geography. Initially a military venture, it was released to the public as a navigation system in the 1980s that is essential to modern day society. The internet provides vast access to GPS, remote sensing, and satellite data, pushing cartography into the hands of the public instead of just a select few group of specialists (“The evolution of maps: From paper to soar.”).

**GIS**

Geographic Information System, GIS, is the backbone of modern cartography. It is designed for “capturing, storing, checking, and displaying data related to positions on Earth's surface” (“GIS (Geographic Information System)”). Geographic Information Systems uses location data to assess and isolate relevant data, combining them with layers. An example of an effective use of GIS technology is to create a map that overlays pollution levels with population density.

In Geographic Information Systems, vector data is essentially geometric spatial data (points, lines, polygons) and their respective descriptive units. Raster data, on the other hand, is unquantifiable. Satellite photos, aerial photography, and any other electronic images are all considered raster data.

Geographic Information Systems use standard computer hardware. It requires a large amount of memory due to vast file sizes and amounts of data stored. Though both MacOS and Windows can have the hardware to run GIS, the software is optimized for Windows. The most used software is ArcGIS and QGIS (“What Is GIS?”).

Remote sensing is imagery and data collected through overhead aerial means: these are often satellites, balloons, or drones, but have historically also been means such as carrier pigeons, kites, and the early airplanes.

Geographic Information Systems are used to “display spatial relationships and linear networks” (“GIS (Geographic Information System)”). These can be topography, or land-use patterns, among other things. Linear networks are information stored as a single line; this could be roads, highways, or it could be the boundaries of an area. GIS aligns all this information into one cohesive scale, where a given unit of space on the represents a corresponding unit on Earth.

Geographic Information Systems are revolutionizing modern development. Archaeologists can use GIS to map ancient settlements and uncover migration patterns. public health officials can identify areas with high disease rates and target interventions, and businesses can analyze customer demographics and optimize marketing strategies. With its ability to integrate vast amounts of data and reveal hidden patterns, GIS is poised to play an even greater role in shaping our future.

**Usage**

One of the most pressing issues in modern America are how to measure, process, and mitigate the effects of climate change driven by human impact. Worldwide, GIS is essential in visualizing and communicating environmental data and tracking trends. In fact, GIS can be used to discover trends that weren’t apparent to the naked eye; “This helps organizations in preserving and restoring ecosystems, promoting biodiversity, and protecting natural resources while planning and operating their networks” (René).

Similarly, developing sustainable, future forward cities is essential to a growing population and the urbanization trend. GIS makes these tasks much easier: with GIS technology, urban planners can better visualize the needs of a city through remote sensing, as well as contextualizing a greater perspective on land and infrastructure. GIS is quickly editable, meaning it can adapt quickly to a growing city and its needs. The tools can also be used on a much smaller scale, planning streets and rural communities with just as much accuracy.

“GIS technology empowers urban planners with enhanced visibility into data. They monitor fluctuations over time, evaluate the feasibility of proposed projects and predict their effects on the environment. GIS software can also show all relevant stakeholders exactly what the changes on the ground will look like to help them make better decisions. For example, GIS planning software may generate visualizations of an area’s current environmental conditions and allow users to draw comparisons between the anticipated results of proposed development plans” (René).

**In Popular Culture**

“When the mobile game debuted in July 2016, it became an instant phenomenon. Apple reported that “Pokémon Go” was downloaded more times in its first week of release than any other app to date. Since then, the free-to-play game has shown impressive staying power, reaching a total of 800 million downloads by May 2018 and inspiring the next generation of AR-based toys and games” (Freeman).

It’s not the first that comes to everyone’s minds when thinking about geographical tech, but one of the most prolific examples after navigation technology is the mobile gaming application *Pokémon Go.*

The premise is simple: the user can travel their real-world environment and collect virtual ‘Pokémon,’ a fictional monster species. Travelling to local landmarks, such as a church or a statue, can give user rewards such as upgraded ‘Pokéballs’ to capture Pokémon more efficiently or upgrade them to higher levels. Water type Pokémon will cluster around bodies of water, and some Pokémon can only be captured in certain regions like Mr. Mime, who can only be found in Europe. The interface is a digital map, similar to Google Maps, optimized to track slow walking movement.

Niantic, the startup company behind the viral sensation, started in Google. It’s CEO, John Hanke, is an expert in geospatial data and technology who had worked on Google Earth and Google Maps in the past. As Niantic grew bigger, it became fully independent and was able to begin work on *Pokémon Go.* In late 2017, they switched from a Google Maps base to the crowdsourced OpenStreetMap, which “makes it possible for user edits to add more details about specific areas and adapt more quickly to changes like road closings” (Geospatial Data Is Super Effective! The Use of GIS and Cartography in Pokémon Go).

**Conclusion**

In the brief history of human civilization, technology has transformed geography into a dynamic and interactive science critical to modern life. From the antiquated maps of the past to the digital marvels of today like Google Maps and GIS, this geographic revolution has impacted every facet of human life. GIS empowers researchers to uncover historical trends and predict environmental changes. Urban planners leverage its power to design sustainable cities, while everyday people use navigation apps to explore their world with unprecedented ease. The impact of technology on geography extends even to popular culture, with games like Pokémon Go blurring the lines between the real and virtual worlds. As technology continues to evolve, so will humanity’s relationship with planet Earth. Thus, intertwined with it is the future of geography, which promises to be a future of constant discovery, driven by ever-more sophisticated tools that allow people to see our world in entirely new ways.

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