Evolution of GPS & How It Changed Our Life

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Abstract*— Global Positioning System (GPS) has revolutionized the world and this technology has become an indispensable tool of our modern world and lifestyle. We use it in almost every field whether it be agriculture or defence, navigation or disaster management. This paper provides an overview on the evolution, functioning principles, applications, impact and future trends and advancements. Starting with learning a little history of GPS we make our way to understand some technical aspects, clearing HOWs and WHYs of GPS in depth. By now we would be able to get why the GPS have so many applications, and what a big impact it has on our life. At last, we would wonder how can we make any further improvements in this technology, while discussing the ongoing evolution of this beautiful technology.

Index Terms- Global Positioning System, navigation, satellite constellation, receiver, mapping, wildlife tracking, future trends, impact.

I. INTRODUCTION

GPS is short for the Global Positioning System, which is a technology that changed our life on a whole different scale. Developed by USA this is a satellite-based navigation system. Since the birth of GPS, it has undergone various advancements and now has become an inseparable part of our life. In this paper we will deeply and thoroughly review the evolution and impact of GPS along with studying the functioning principles and applications of GPS.

II. EVOLUTION OF GPS

With the launch of Sputnik, the humans have already opened the gates to so many new possibilities, and one of them was satellite-based navigation system. The development of ground-based navigation systems such as LORAN, laid the footing for GPS. In 1978 the first GPS satellite was launched, which was exclusively for the use of US Army and by 1994 a full group of 24 GPS satellites were orbiting Earth. The very first non-military, civilian GPS was not so accurate and would only locate a GPS receiver within about 300 meters. We have come a long way from that and now have a free GPS for anyone having a smartphone with an astonishing accuracy, with some of them being able to tell the location of a GPS receiver with an accuracy of 1 cm.

III. FUNCTIONING PRINCIPLES OF GPS

The way GPS works is really simple yet so fascinating. There is a network of 24 satellites that orbits Earth and provide accurate positioning information. Each of these satellites completes one revolution around Earth in about 12 hours. Not only GPS tells us about our position, it tells us the accurate time too. Now for the question that how does this whole thing performs, the answer lies in the radio waves. The satellites produce radio waves, these waves travel at a constant speed and our receiver picks them up. If only a single satellite is used to tell our position on Earth it would be a very rough data of a vast area and to pinpoint the exact location of the receiver would be very tough. In the actual process a signal (radio wave) is generated by multiple satellites that our receiver picks and with the help of simple math calculating the speed (of radio waves) and time taken (by signal to reach receiver) the system tells us our position on Earth and the accurate time. The idea of processing multiple signals is that we can get way more accurate position of the receiver this way. Imagine in a dark room you're holding a torch and aiming it straight; In this way the torch is the satellite and the beam is the signal and the place it enlightened is the area it covered. Now the receiver could be anywhere there. Now instead of one torch there are multiple torches generating multiple beams and the lines are intersecting in the wall where they land. It now greatly reduces the area the receiver can be in. That is a rough example to get an idea how the receiver is located by calculating the data received by the satellites (time taken by the signal to reach receiver).

Distance = Speed * Time, by multiplying the values receiver gets from the satellites it tells its respective distance from the satellites and this way it tells its own position in the maps.

IV. APPLICATION OF GPS

You all know how GPS is used in our day to day lives, what if I tell you, it gets more and more things done than just keeping you from getting lost. For starters we all know the basic things we use GPS for, like, finding route to a destination, tracking something or someone in real time. Some of the complex applications of GPS consist of surveying land hard to step foot on, it can precisely position something, with some devices powerful enough to pinpoint the location with an accuracy of 1 cm. We use GPS in mapping of land, infrastructure, natural resources. We also use GPS in agriculture in some parts of world. Other than that emergency response, wildlife tracking, and atmospheric monitoring are some of the prime examples of how GPS helps in various field of work.

V. IMPACT OF GPS

The impact GPS has on our life is humongous. Imagine one day you wake up and get to know there is no such thing as GPS. See how weird it was without GPS most of the things we do are going to become difficult to such an extent that this generation of human beings would be so weirded out by that. Not only does GPS makes our life easy, it has significantly improved safety on road, enabled precise agriculture, facilitated disaster response and recovery efforts, and most importantly enhanced military capabilities (the main reason it was designed for).

VI. FUTURE TRENDS AND ADVANCEMENTS

The fact that once we were nothing but hairless monkeys and now, we have GPS, we human beings have evolved so much. Even the growth we have made in this technology is unrealistic. One might think we can't make further advancement in this field but I guess not. GPS technology is poised to undergo further advancements and innovations. Some of the ideas are,

1. To integrate GPS with AI or IOT. Although work has been started on it there is a huge room to improve on.
2. Inside and outside exploration with the concept of exploring a building floor by floor. This would revolutionize everything.
3. Self-driving vehicles and space exploration can surely be benefitted as the GPS technology improves.

CONCLUSION

As we have seen how the GPS works and impacts our day-to-day life, we can clearly see the need of this technology in so many various fields. From starting as a tech for military to navigate through the way to having been used daily even from our smartphones GPS has come a long way. GPS has become an indispensable tool for modern life. Though being the boon, all that glitters is not gold. It questions our reliance on technology while seriously challenging our privacy and security. The very thing making our lives easy might become the reason life gets hard. It is for you to decide how you perceive things, because there's always two sides of the coin.

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