17/ENG03/021

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CVE310 ASSIGNMENT

ENGINEERING SURVEYING 2

1. **Benefits of GPS over other forms of equipment for measuring**

**What is GPS?**

GPS stands for Global Positioning System. The system uses signals transmitted by orbiting satellites to pinpoint a device's location and determine any movement over time. On its own, GPS has limitations as it only provides basic information such as coordinates and a few other statistics, but when combined with other technology, such as maps, and incorporated into navigational systems, it becomes a powerful tool.

Originally developed by the US Department of Defense for military use, GPS is now widely commercially available to the public, often incorporated into products such as stand alone or built-in navigation devices for road vehicles and boats, as well as apps for smartphones.

**The GPS Benefits over other equipment**

1. Buildings and Earthquakes

I explain each of the main advantage of GPS in more detail below.

**1. Navigation**

Perhaps the most common use for GPS is in navigation systems. Combined with map technology, it becomes a powerful tool for road vehicles and boats. GPS can pinpoint a device's location with accuracy and by comparing coordinates, the statistics can be used to calculate a devices direction of movement and speed. This information can be used to provide step-by-step directions from Point A to Point B in real time.

**2. Low Cost**

The satellites behind GPS are paid for, maintained and upgraded by the US Department of Defense. That means that the system is essentially free, although you may have to pay for a device and software to utilize it. Smartphone apps, such as Google Maps, that use GPS are also usually free.

**3. Crime and Security**

GPS can be used as a valuable tool by law enforcement to track criminals or terrorists, using devices they attach to vehicles, or through tracking the perpetrator's smartphone. GPS tracking devices can also be used to deter theft by employers or ordinary people.

**4. Easy to Use**

Navigation using GPS is generally very easy and requires minimal skill or effort, certainly when compared to traditional methods and technologies, such as map-reading. In most cases, the user just has to input the destination and the device will do the rest. GPS is also an easier and more efficient technology to use for tasks like surveying and the study of the movement of tectonic plates (see below).

*Employers can use GPS tracking to monitor the position of their vehicles, increasing efficiency and improving customer service.* | Source

**5. Employer Monitoring**

Employers can use GPS tracking to make sure that their drivers are behaving responsibly, such as following the quickest route, and not wasting time or fuel by going off track, as well as following speed restrictions. Businesses can also provide better customer service if they know where delivery or service vehicles are at any one time. A fleet of vehicles can be used more efficiently using GPS.

**6. Safety**

GPS tracking can be used by parents to keep tabs on their children. Spouses can also use similar technology to keep track of their partners. Workers and others can also use GPS tracking for personal safety, so that their whereabouts are known if there is an emergency.

**7. Neighborhood Search**

As well as navigation, GPS can also be used to provide information on the local area. For instance, finding out where the nearest hotel or gas station is, or discovering nearby restaurants that are open for business. This is convenient when you are on a long road trip and need to find a place to stop for food, gas, sleep, and so on.

**8. Traffic and Weather Alerts**

One of the nice things about GPS is that it is all happening in real time. That means that you can be notified if there is a traffic accident or other hold-up ahead, or if you are approaching an area where there is a severe weather event occurring. Not only can this shorten your journey time, but also improve safety.

*GPS can help drivers or sailors to avoid severe weather.* | Source

**9. Available Anywhere**

One of the best features of GPS is that because it essentially works through satellite technology, it is available across the entire globe. There is no need to be caught out not knowing your own location, or get lost.

**10. Updated and Maintained**

The GPS system is paid for, updated, and maintained by the US Department of Defense, so that it is always accurate. Most software, apps, and devices that use GPS are also regularly updated, normally for free. So unlike a traditional printed map which goes out of date after a while, GPS and related technology normally stays very accurate.

**11. Exercise Monitoring**

GPS can be used for exercise monitoring and can help amateurs to improve their health and fitness, as well as professional sports men and women. It can be used to calculate speed, distance traveled, and even use the information to estimate calories burned.

**12. Flexible Route Options**

GPS give you route choices in live time, enabling flexibility. You can choose a route according to your particular needs or desires. If you take a wrong turn, a new route can be calculated using GPS. If your route becomes blocked by an incident, GPS can be used to calculate a new pathway.

*The US military use GPS technology to ensure missile accuracy, lowering the level of collateral damage.* | Source

**13. Military Usage**

As well as being useful for navigation and other general uses, the military employs GPS when setting targets for guided missiles. GPS improves accuracy through giving the missile a specific set of coordinates, and reduces collateral damage through increased accuracy.

**14. Surveying**

Land surveying takes place before construction or development. Over time, GPS has gradually replaced traditional land surveying techniques, mainly because it is cheaper, quicker, and usually more accurate. It often takes hours with GPS, rather than days.

**15. Buildings and Earthquakes**

There are many scientific applications of GPS beyond just navigational matters. It can be used to help detect structural problems in roads and buildings, as well as predict natural disasters like earthquakes through the monitoring of tectonic plate movement.

1. **ERRORS ASSOCIATED WITH ABSOLUTE GPS POSITIONING MODE**
2. **Satellite clock**: GPS position calculations, as discussed above, depend on measuring signal transmission time from satellite to receiver; this, in turn, depends on knowing the time on both ends. NAVSTAR satellites use atomic clocks, which are very accurate but can drift up to a millisecond (enough to make an accuracy difference). These errors are minimized by calculating clock corrections (at monitoring stations) and transmitting the corrections along with the GPS signal to appropriately outfitted GPS receivers.
3. **Upper atmosphere (ionosphere)**: As GPS signals pass through the upper atmosphere (the ionosphere 50-1000km above the surface), signals are delayed and deflected. The ionosphere density varies; thus, signals are delayed more in some places than others. The delay also depends on how close the satellite is to being overhead (where distance that the signal travels through the ionosphere is least). By modeling ionosphere characteristics, GPS monitoring stations can calculate and transmit corrections to the satellites, which in turn pass these corrections along to receivers. Only about three-quarters of the bias can be removed, however, leaving the ionosphere as the second largest contributor to the GPS error budget.
4. **Receiver clock**: GPS receivers are equipped with quartz crystal clocks that are less stable than the atomic clocks used in NAVSTAR satellites. Receiver clock error can be eliminated, however, by comparing times of arrival of signals from two satellites (whose transmission times are known exactly).
5. **Satellite orbit**: GPS receivers calculate coordinates relative to the known locations of satellites in space, a complex task that involves knowing the shapes of satellite orbits as well as their velocities, neither of which is constant. The GPS Control Segment monitors satellite locations at all times, calculates orbit eccentricities, and compiles these deviations in documents called ephemerides. An ephemeris is compiled for each satellite and broadcast with the satellite signal. GPS receivers that are able to process ephemerides can compensate for some orbital errors.
6. **Lower atmosphere**: The three lower layers of atmosphere (troposphere, tropopause, and stratosphere) extend from the Earth’s surface to an altitude of about 50 km. The lower atmosphere delays GPS signals, adding slightly to the calculated distances between satellites and receivers. Signals from satellites close to the horizon are delayed the most, since they pass through the most atmosphere.
7. **Multipath**: Ideally, GPS signals travel from satellites through the atmosphere directly to GPS receivers. In reality, GPS receivers must discriminate between signals received directly from satellites and other signals that have been reflected from surrounding objects, such as buildings, trees, and even the ground. Antennas are designed to minimize interference from signals reflected from below, but signals reflected from above are more difficult to eliminate. One technique for minimizing multipath errors is to track only those satellites that are at least 15° above the horizon, a threshold called the "mask angle."