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INTERNET OF THINGS (IOT), ITS APPLICATION AREA AND COMBINATION WITH GPS

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ABSTRACT

In this paper, we look up to highlight the concept of Internet of Things (IOT) in general, and its application areas in our life. The expression “Internet of Things” (IOT), coined back in 1999 by Kevin Ashton, the British technology pioneer who cofounded the Auto-ID Center at the Massachusetts Institute of Technology. The Internet of Things (IOT) has gained significant momentum as a technology to connect physical objects to the Internet and to facilitate machine-to-human and machine-to-machine communications. We seek to describe the importance and application areas of Global Positioning system (GPS) in our life. GPS has its usefulness in military, weather conditions, vehicle location, farms, mapping and many other areas. By the coordination of internet of things (IOT) and global positioning system (GPS) technologies we can make our life easier and these two technologies save the time and money in our business.

Keywords: IOT, GPS, Satellite and traditional network

INTRODUCTION

Today, we are living in the era of smart technologies which represents a "ubiquitous computing" Internet of Things (IOT) has emerged strongly as a more prosperous area to express this kind of a new technology. It is not the first technology in this field, but also the cloud computing technology has been used to represent the ubiquitous computing world. The Internet of Things (IOT) was originally coined as a phrase by Kevin Ashton in 1990 (Ashton, K.2009).

According to TomTom (2015), The Global Positioning System (GPS) is a satellite-based radio navigation system developed and operated by the U.S. Department of Defense. The GPS satellites can be used free of charge by anyone.

GPS provides accurate position, velocity, and time (PVT) information to an unlimited number of suitably equipped ground, sea, air and space users. As one of the first methods to track and catalogue digital data of the physical world, GPS has had an essential influence on Internet of Things technologies. IOT can collect and quantify large amounts of data for everything from personal health to vehicles; GPS tracking is needed to provide location information for these objects (Abulude & Akinnusotu, 2015).

Objectives of the Research:
1. To introduce the importance of IOT.
2. To discuss the application areas of IOT.
3. To study the communication between IOT and GPS technology.

MATERIALS AND METHOD

The research entitled "Internet of Things (IOT), Its Application Area and Combination with GPS" is a review paper which is based on secondary data. the research was conducted in Helmand Province, Afghanistan in 2021. The source of data used in this paper is from Textbooks, academic websites and databases, International Journals and etc. the utilization of data and its implication in this paper was carried out systematically and consistently. However, this is a descriptive and qualitative research.

RESULTS AND DISCUSSION

Definitions and History:
In 1991, Mark Weiser has described the vision of the future Internet under the name of "Ubiquitous Computing". Through this vision he was focused on how to turn on the smart livable environment in the presence of mobile phone technology this provide a powerful multimedia system. Kevin Ashton is a one of the pioneers talk about IOT. According to Atzori A. lera et al, classified IOT to three paradigms namely, internet oriented (Middleware), things oriented (Sensors), and semantic oriented (Knowledge). In 1999 Neil Gershenfeld was speaking about similar things from the Massachusetts Institute of Technology, MIT Media Lab in his book "When Things Start to think". In 1999 Auto- ID labs and MIT sought to develop Electronic Product Code EPC, and use RFID to identify things on the network. In 2003-2004 the emergence of projects serving IOT idea such as Cool town, Internet0, and the Disappearing Computer initiative, also IOT start to appear in book titles for the first time. RFID is deployed was published on a massive scale by the US Department of Defense. In 2005 IOT entered a new level when published its first report by International Telecommunication Union ITU. In 2008 a group of companies such as Cisco, Intel, SAP and over (50) other members of companies met to create IPSO Alliance, to promote the use of Internet protocol (IP) and to activate IOT concept. In 2008-2009 IOT was "Born" by Cisco Internet Business Solutions Group (IBSG) [8]. From the previous perspectives can be defined IOT as a set of smart things/objects such as home devices, mobile, laptop, etc., addressed by a unique addressing scheme and connected to the Internet through a unified framework this framework may be cloud computing (Ali et al., 2015).

Architecture and Design:
The best design of the architecture is a foundation stone to build a privileged IOT system; this architecture helped to address a lot of issues in the IOT environment such as scalability, routing, networking, etc... Typically, the IOT architecture approach based on three main

dimensions are: Information items: it includes all items connected to IOT environment may be sensing items, identifying items and control items, Independent network: which includes several features such as self-configuration, self-protection, self-adaptation, and self-optimization; and Intelligent applications: which have intelligent behavior over the Internet generally; the intelligent behavior may be intelligent control, exchange data methods through network items, data processing, all the applications which are related to the IOT can be classified according to these dimensions. The intersection between these dimensions creates a new space named "infrastructure of IOT", which provides support systems to serve the special things, which can provide various services such as goods identification, location identification and data protection. In this end, there are several approaches to build an architecture of IOT, to create an application on IOT, the architectural approach favored which based on an open architecture the EPC global network. The system designed by AutoID center for conveying the dynamic information about objects/things to provide a history of the product movement for the authorized users, the RFID technology plays a key role to differentiate between these mobile objects, this system is called "the EPC global network". The IOT uses the EPC global network as a principle to design the architecture framework. The future architecture of IOT seeks to achieve connection between real-world, cyber-world and social world. Unite and ubiquitous IOTs or U2IOTs is considered as a different kind of IOT architecture, it's used to integrate the physical world with the cyber world. The U2IOTs consists of a set of heterogeneous systems, including unit of IOT to resemble human neural network that provides solutions to specific applications; U2IOTs includes the industrial IOT, local youth, national IOT, and global IOT which integration of multiple Unit IOTs with ubiquitous features, and it is similar to the social organization framework. The main characteristics of U2IOT model are cyber, physical, social co-existence, connectivity and interactivity, space-time consistency and multi-identity status (Ali et al., 2015).

Differences between IOT and Traditional network:

In the beginning, the IOT technology has broken a lot of the traditional ideas of network and started a new era of telecommunication technology. Can be considered IOT as an extension and expansion network based on the Internet; but it is different from either traditional network or the so-called Internet of people and WSN although considered as backbone to build any IOT block. The major equation to represent the IOT environment is "IOT environment= Internet + WSN", it is a common statement that uses to express the IOT environment. To analyze and judge the correctness of this statement, must be determined the similarities and differences between IOT, Internet, and WSN according to table 1. From the previous knowledge about the IOT environment can be judged on this view, it's a wrong; because there are two basic reasons for rejecting this view. First; IOT may not necessarily use IP in all cases for addressing things, because nature of IOT needs lightweight communication protocols, the complexity of the TCP/IP protocol is not suitable in particular, when works with the smart little things. Second, the IOT environment is mainly based on the connected smart objects unlike traditional network. That's what makes them move from only a mere extension of the Internet, also the behavior of IOT depends on the creation of the interoperable systems, based on these arguments, can be corrected the previous statement:

IOT= Internet + WSN+ Smart Items surrounded by Intelligent environment.

Finally, IOT supports a set of useful features such as interoperability, self- configuration, self-adaptive and self-protection. The intelligent environment is a way to ensure the existence of a minimum level of the previously mentioned elements within the network (Ali et al., 2015).

Table 1. The Similarities and Differences between IOT, Internet, and WSN.

Characteristics	IOT	Internet	WSN
Comm. Protocol	Lightweight Comm. protocols.	(TCP/IP)	Lightweight Comm. Protocols.
Scale degree of Area	Cover Wide Area	Cover Wide Area	Cover Local Area
Networking Approach	Determine backbone	Determine backbone	Self-organization
Identify objects	Must	Can not	Can
Type of nodes	Active and passive	Active	Active
Network design	WSN+ dynamic smart things+ Internet surrounded by intelligent environment	Set of networks contains set of fixed objects	Dynamic smart objects
Behavior	dynamically	Fixed	dynamically
Networking Time	Timing synchronization	Unlimited	Unlimited

GPS Development:

GPS was designed by the U. S. military. The development started in the 1960s and the first satellite was launched in February 1978. The first hand-held GPS receiver was introduced in 1989 by the Magellan Corp. In 1996, President Ronald Reagan allowed the free use of GPS by civilian users (America.gov, 2006). The US Federal Government is committed to providing GPS technology for peaceful uses on a worldwide basis, free of charge. Since its deployment, the U.S. has implemented several improvements to the GPS service including new signals for civil use and increased accuracy and integrity for all users, all the while maintaining compatibility with existing GPS equipment. Modernization of the satellite system has been an ongoing initiative by the U.S. Department of Defense through a series of satellite acquisitions to meet the growing needs of the military, civilians, and the commercial market. As of early 2015, high-quality, FAA grade, Standard Positioning Service (SPS) GPS receivers provide horizontal accuracy of better than 3.5 meters (GPS Accuracy, 2015), although many factors such as receiver quality and atmospheric issues can affect this accuracy. GPS is owned and operated by the United States Government as a national resource (Abulude and Akinnusotu, 2015).

System Description:

According to Hoffman-Wellenhof, Lichtenberger and Collins (2001). GPS has three 'segments': 1. The space segment now consists of 28 satellites, each in its own orbit about 11,000 nautical miles above the Earth. 2. The user segment consists of receivers, which you can hold in your hand or mount in your car. 3. The control segment consists of ground stations (five of them, located around the world) that make sure the satellites are working properly (Abulude and Akinnusotu, 2015).

Accuracy:

From the information provided by GPS.Gov (2015), the accuracy of the GPS signal in space is actually the same for both the civilian GPS service (SPS) and the military GPS service (PPS). However, SPS broadcasts on one frequency, while PPS uses two. This means military user can perform ionospheric correction, a technique that reduces radio degradation caused by the Earth's atmosphere. With less degradation, PPS provides better accuracy than the basic SPS (Abulude and Akinnusotu, 2015).

Satellite Selection:

Navstar (1996) noted that a typical satellite tracking sequence begins with the receiver determining which satellites are visible for it to track. If the receiver can immediately determine satellite visibility, the receiver will target a satellite to track and begin the acquisition process. Satellite visibility is determined based on the GPS satellite almanac and the initial receiver estimate (or user input) of time and position. If the receiver does not have the almanac and position information stored, the receiver enters a "search the sky" operation that systematically searches the PRN codes until lock is obtained on one of the satellites in view. Once one satellite is successfully tracked, the receiver can demodulate the navigation message data stream and acquire the current almanac as well as the health status of all the other satellites in the constellation. Depending on its architecture, a receiver selects either a "best" subset of the visible satellites to track or uses all healthy satellites in view to determine an "all-in-view" PVT solution. The all-in-view solution is usually more accurate than a four satellite solution although it requires a1-11 more complex receiver and receiver processing. The all-in-view solution is also more robust, since the temporary loss of a satellite signal (for example due to a physical obstruction near the receiver) does not disrupt the flow of PVT data while the receiver attempts to reacquire the lost signal. Many receivers will track more than four satellites, but less than all-in-view, as a compromise between complexity, accuracy, and robustness. Receivers that select a "best" subset do so based on geometry, estimated accuracy, or integrity (Navstar, 1996).

Application:

GPS has become a widely deployed and useful tool for commerce, scientific uses, tracking, and surveillance. It facilitates everyday activities such as banking, mobile phone operations, and even the control of power grids by allowing well synchronized hand-off switching. This technology also has its usefulness in studying the movements and feeding habits of deer, measurement in buildings, assists in settling property disputes between land owners, used by Marine archaeologists in researches and other areas of applications (GPS data revealed that Mt. Everest is getting taller) (Kaplan, 2011).

GPS has many applications for both the military and civilians. Civilians applications include (Navigation, astronomy, cartography, mapping, cellular telephony, disaster relief, radio occultation, clock synchronization, geotagging, geofencing, fleet tracking, air tracking, mining, tours, recreation, robotics, surveying, sports, tectonics, telematics and other uses), while in the military it has found its usefulness in the following areas: navigation, target tracking, missile and projectile guidance, search and rescue, reconnaissance, as nuclear detonation detectors) (US Air force, 2013).

Agriculture:
GPS equipment manufacturers have developed several tools to help farmers and agribusinesses become more productive and efficient in their precision farming activities. The various benefits are:
• Precision soil sampling, data collection, and data analysis, enable localized variation of chemical applications and planting density to suit specific areas of the field.
• Accurate field navigation minimizes redundant applications and skipped areas, and enables maximum ground coverage in the shortest possible time.
• Ability to work through low visibility field conditions such as rain, dust, fog and darkness increases productivity.
• Accurately monitored yield data enables future site-specific field preparation.
• Elimination of the need for human "flaggers" increases spray efficiency and minimizes over-spray.

Aviation:
GPS is used to increase the safety and efficiency of flight. With its accurate, continuous, and global capabilities, GPS offers seamless satellite navigation services that satisfy many of the requirements for aviation users. The advantages to aviation are:
• Continuous, reliable, and accurate positioning information for all phases of flight on a global basis, freely available to all.
• Safe, flexible, and fuel-efficient routes for airspace service providers and airspace users.
• Potential decommissioning and reduction of expensive ground based navigation facilities, systems, and services.
• Increased safety for surface movement operations made possible by situational awareness.
• Reduced aircraft delays due to increased capacity made possible through reduced separation minimums and more efficient air traffic management, particularly during inclement weather.
• Increased safety-of-life capabilities such as EGPWS

Environment:
• GPS data collection systems complemented with GIS packages provides a means for comprehensive analysis of environmental concerns.
• Environmental patterns and trends can be efficiently recognized with GPS/GIS data collection systems, and thematic maps can be easily created.

•GPS data can be quickly analyzed without the preliminary requirement for field data transcription into a digitized form.
•Accurate tracking of environmental disasters such as fires and oil spills can be conducted more efficiently.
• Precise positional data from GPS can assist scientists in crustal and seismic monitoring.
• Monitoring and preservation of endangered species can be facilitated through GPS tracking and mapping.

Marine:
GPS is playing an increasingly important role in the management of maritime port facilities.
GPS
•Allows access to fast and accurate position, course, and speed information, saving navigators time and fuel through more efficient traffic routing.
• Provides precise navigation information to boaters.
• Improves precision and efficiency of buoy positioning, sweeping, and dredging operations.
• Enhances efficiency and economy for container management in port facilities.
• Increases safety and security for vessels using the AIS.
Public Safety and Disaster Relief
This is another important area where GPS is useful. It assists in:
• Delivering disaster relief to areas in a timelier and accurate manner, saving lives and restoring critical infrastructure.
• Providing position information for mapping of disaster regions where little or no mapping information is available.
• Enhancing capability for flood prediction and monitoring of seismic precursors and events.
• Providing positional information about individuals with mobile phones and in vehicles in case of emergency.

Rail:
GPS improves rail safety, security, and operational effectiveness. The technology helps reduce accidents, delays, and operating costs, while increasing track capacity, customer satisfaction, and cost effectiveness. It also:
• Increased situational awareness for improved safety of trains and maintenance crews
• Prevention of collisions, derailments, work zone incursions, and rail switch errors.
• Increased capacity and efficiency for all rail users.
• Dependable schedule and equipment location awareness.
• Automated track surveys and inspections.
• Time synchronization for communication systems.

Recreation:
• Highly accurate all-weather positioning information using GPS receivers helps outdoor adventurers with safer exploration anywhere in the world.

•Ability to return to favorite fishing spots, trails, campsites or other locations with precision year after year, despite changing terrain conditions.
•New and interesting activities (based solely on the capabilities of GPS) are developed every day by outdoor enthusiasts and shared with others.
•Relatively small, portable, and affordable handsets can be used for multiple types of recreation activities.

Roads and Highways:
• Higher levels of safety and mobility for all surface transportation system users.
• More accurate position determination to provide greater passenger information
• More effective monitoring to ensure schedule adherence, creating a transit system more responsive to transportation users' needs.
Better location information with electronic maps to provide in-vehicle navigation systems for both commercial and private users.
• Increased efficiencies and reduced costs in surveying roads.

Space:
• Providing high precision positioning with minimum ground control.
• Replacing high cost, and high mass, on-board sensors.

GPS and IOT: A Perfect Match:
IOT could sense when a driver ends up in a crash or stranded due to vehicle malfunction, but GPS tracking provides the location information that emergency vehicles will need to respond in time. Your house pet may run out the front door without you noticing, but a GPS-capable tag may detect the animal is in distress, so you can quickly locate your pet and bring it back home. GPS and IOT complement each other to form a more complete, usable set of interconnected data.
IOT monitors objects and hardware to give you real-time information and data about a devices operation, while GPS provides the physical coordinates of the hardware or object. With these systems working in tandem, they form the foundation of smarter cities, innovative products such as self-driving cars and health-related wearable technologies, and a vast, interconnected ecosystem that allows for smart devices to interact with sophisticated locating capabilities to achieve goals previously thought impossible (www.aeris.com).

THE COMBINATION OF GPS AND IOT

Till now, we have tracked lost smartphones with the help of GPS. Now, we can track lost bags. Symphonic Bags, a smart backpack, comes with GPS tracking. The bag helps parents locate their kids when they are not around. The bag alerts you of its location and helps overcome fear like that of losing your bags at airports or while touring. There is no denying that everyone is excited for an opportunity to get into a self-driving car and sit back relaxed, while the car takes you to your desired destination. And the day is not far! The younger generation might never have to drive their car. They will have the assistance GPS technology powering their cars, making these cars truly 'automatic'. GPS can detect the location of possibly all your valuables. For instance, Sherlock, a startup based in Italy, connects GPS to the IOT network for tracking your bicycle. Such tracing will help bicycle owners to protect their bike from theft. Besides, any changes made to the vehicle will be notified the vehicle owner. Also, GPS, when it combines with IOT technologies, it can help the logistics and supply chain industry. Manufacturers can track their shipments and manage inventory efficiently (Joshi, 2018).

IOT and the Future of GPS:

We all know that IOT is an incredible driver of business upheaval. With the help of IOT-connected devices, industries gather a lot of data that is then used to draw business insights and to make informed decisions. In this way, IOT helps industries to improve their services. On the other hand, when GPS is integrated with IOT, industries get the exact location of the IOT devices. With the exact location, industries can draw insights on what, when, and how things occur. IOT and GPS will together make the tracking of almost objects possible, be it healthcare supplies, luxurious goods, important legal documents, or anything else. With GPS and IOT devices working together, the path towards the development of smarter cities is underway (Joshi, 2018).

CONCLUSION

With the advent of technology and the Internet, we should not continue to live as we did in the past, and we should try to make our work easier and faster with the help of technology.

Today people use the Internet more because it has provided unique services to the people, and with the advent of the Internet of Things, more people have been able to use technology instead of manpower and do their work in less time with less manpower.

The Internet of Things or (IOT) is one of the topics that can meet the above conditions. Using the Internet of Things people can take control of all their home devices, and using the Internet, they can control those devices remotely. So the Internet of Things (IOT) is very important in business, education, and everyday life, and it provides fast service to people. Since all IOT devices work on the Internet, the Internet is essential to control these devices.

And since the Internet of Things can be controlled remotely, every effort should be made to secure these devices and protected the people confidential information. Using IOT devices is not easy because IOT devices need the Internet, electricity, and self-monitoring devices to work, so IOT devices must be used safely and professionally to prevent waste.

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