INTRODUCTION

DEVELOPMENT OF GLOBAL POSITIONING SYSTEM

The Global Positioning System (GPS) is a satellite based radionavigation system that is owned by the United States Government, and run by the United States Air Force. (1) Initially, the United States military had no intention of releasing GPS navigation to the public, intending to keep it strictly for military use. However, after a Soviet SU-15 shot down a Korean passenger flight in 1983, president Ronald Regan opened this system for public use, realizing that worldwide GPS usage could prevent tragedies just like this. However, the general public did not get the most accurate version of the GPS. To ensure that the military had the best version, the public version had its accuracy muddled to a 100 meter radius. This radius was only repealed in 2000 at the tail end of Bill Clinton’s presidency, who stopped the scrambling of GPS signals for the general public and made the system much more accurate (2).

GPS is broken up into multiple different steps in transmitting information. The actual system is composed of at least 24 different satellites. These satellites are able to transmit information despite weather conditions on Earth, and circle our planet twice a day in a precise path. Depending on the number of satellites a system can lock onto, you can determine your location either on a 2D or a 3D plane. To help find an user’s location, these GPS satellites transmit at least two radio signals meant to be picked up by a GPS receiver (3). To find the user’s actual location using this system, a form of trilateration is used. Utilizing the time that a device receives signals from different satellites, and knowing the rate at which the radio signals are transferred, you can calculate the distance from the user to a satellite. Combining multiple satellites, this system can be used to help determine where a user is (4).

This system can be used for both military and civilian use. For military use, soldiers can use GPS systems to find objectives for missions, and help increase organization in handling supplies (5). This system can also be used to accurately target missiles, and help mitigate any civilian casualties (6). For civilian use, GPS is used for navigation for cars, determining a device’s position in real time to allow for pathfinding to recalibrate and determine the best path. GPS also allows for pet owners to locate their pets when lost (6). Despite the many upsides that this GPS system has, there is a specific case where this system is unreliable: Indoor navigation.

ISSUES WITH INDOOR NAVIGATION

Although many would assume that GPS would be perfectly suited for indoor navigation, that is not the case. One of these primary issues has to deal with accuracy. Radio signals sent out by the GPS satellites tend to be blocked by mountains, or walls and buildings. Because of this, when you move into an indoor setting, the GPS proves to be inaccurate in determining a precise position. While outside, a few meters distance can be acceptable for determining position, that is not necessarily the case indoors. A single meter distance off can potentially mess with navigation, and lead to an inaccurate system (8).

Another issue potentially has to deal with maps. Specifically, the creation of a 2D or 3D map can depend on the complexities of a building, combined with what type of application the user can utilize. Depending on how many floors are in a building, and the floor layout, these maps can get very complex, very fast (8). These two issues combined lead GPS to be thrown a bit to the wayside, as accuracy needs to be maintained for a subject matter that can be extremely beneficial for the public.

POTENTIAL SOLUTIONS AND THEIR SHORTCOMINGS

There are multiple ways that this issue has potentially been tackled. Individuals have tried to use assisted GPS to increase the sensitivity on the GPS system to see if they can get the signals to be more accurate. While this system could allow for GPS usage, the effort has not substantially increased accuracy to the point where it can be utilized. Individuals have also tried utilizing a Wi-Fi positioning system, using Wi-Fi signals and the distance from routers to determine position. However, even when knowing where the transmitter is located, the error range is large, and therefore unusable (8). Other individuals have also tried using Augmented Reality on mobile devices to create and show a path for the user to take. This system can work in multiple different ways, either using a specific landmark to start a path, or taking the user’s location in real time to show that path (9). While definitely functionable, the issue of accurate location is still there, and the use of Augmented Reality is not something that is available to all users, only those with the newest devices, which most people don’t own.

To solve these issues, a system needs to be created that allows for the formation of a startpoint and an endpoint, and accurate tracking of the distance an user travels. Combining these two features, indoor navigation becomes more simplified and more accessible for the public. Utilizing a pathfinding algorithm and a mobile pedometer, a mobile application can be created that tracks the amount of steps, or the distance, a user can travel in real time, making the use of GPS almost obsolete. This system is the one I will be tackling for my thesis project.

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