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ENERGY EFFICIENT GPS SYSTEM USING CLOUD OFFLOADING

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ABSTRACT

Location is a fundamental service for mobile computing. Typical GPS receivers, although widely available for navigation purposes, may consume too much energy to be useful for many applications. Observing that in many sensing scenarios, the location information can be post-processed when the data is uploaded to a server, the proposed cloud-offloaded GPS (CO-GPS) solution that allows a sensing device to aggressively duty-cycle its GPS receiver and log just enough raw GPS signal for post-processing. Leveraging publicly available information such as GNSS satellite ephemeris and an Earth elevation database, a cloud service can derive good quality GPS locations from a few milliseconds of raw data. Using the portable sensing device platform called CLEON, the accuracy and efficiency of the solution can be evaluated. Compared to more than 30 seconds of heavy signal processing on standalone GPS receivers, COGPS can achieve three orders of magnitude low energy consumption per location tagging.

Keywords: GPS, SNSS, CLEON, COGPS

INTRODUCTION

When a GPS receiver is turned on, it first downloads orbit information of all the satellites. This process, the first time, can take as long as 12.5 minutes, but once this information is downloaded; it is stored in the receiver memory for future use. Even though the GPS receiver knows the precise location of the satellites in space, it still needs to know the distance from each satellite it is receiving a signal from. That distance is calculated, by the receiver, by multiplying the velocity of the transmitted signal by the time it takes the signal to reach the receiver. The receiver already knows the velocity, which is the speed of a radio wave. To determine the time part of the formula, the receiver matches satellites transmitted code to its own code, and by comparing them determines how much it needs to delay its code to match the satellites code. This delayed time is multiplied by the speed of light to get the distance. The GPS receiver clock is less accurate than the atomic clock in the satellite; therefore, each distance measurement must be corrected to account for the GPS receiver's internal clock error. (Vasanthy and Jeganathan 2007, Vasanthy et.al., 2008, Raajasubramanian et.al., 2011, Jeganathan et.al., 2012, 2014,

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Sridhar et.al., 2012, Gunaselvi et.al., 2014, Premalatha et.al., 2015, Seshadri et.al., 2015, Shakila et.al., 2015, Ashok et.al., 2016, Satheesh Kumar et.al., 2016).

2D Positioning: In terms of a GPS receiver, this means that the receiver is only able to lock on to three satellites which only allows for a two dimensional position fix. Without an altitude, there may be a substantial error in the horizontal co-ordinate.

3D Positioning: Position calculations in three dimensions. The GPS receiver has locked on to 4 satellites. This provides an altitude in an addition to a horizontal coordinate, which means a much more accurate position fix.

Real Time Differential GPS: Real-time DGPS employs a second, stationary GPS receiver at a precisely measured spot (usually established through h traditional survey methods). This receiver corrects any errors found in the GPS signals, including atmospheric distortion, orbital anomalies, Selective Availability (when it existed), and other errors. A DGPS station is able to do this because its computer already knows its precise location, and can easily determine the amount of error provided by the GPS signals. DGPS corrects or reduces the effects of Orbital errors, Atmospheric distortion, Selective Availability, Satellite clock errors, Receiver clock errors.

Internet -Based Cloud Computing: In cloud computing, the word cloud is used as a metaphor for "the Internet," so the phrase cloud computing means "a type of Internet-based computing," where different services —such as servers, storage and applications—are delivered to an organization's computers and devices through the Internet.

Cloud Computing Applications: The applications of cloud computing are practically limitless. With the right middleware, a cloud computing system could execute all the programs a normal computer could run. Potentially, everything from generic word processing software to customized computer programs designed for a specific company could work on a cloud computing

LITERATURE SURVEY

The location information can be post-processed when the data is uploaded to a server, we design a cloud-offloaded GPS (CO-GPS) solution that allows a sensing device to aggressively duty-cycle its GPS receiver and log just enough raw GPS signal for post-processing. Leveraging publicly available information such as GNSS satellite ephemeris and an Earth elevation database, a cloud service can derive good quality GPS locations from a few milliseconds of raw data. Using our design of a portable sensing device platform called CLEON; we evaluate the accuracy and efficiency of the solution. Compared to more than 30 seconds of heavy signal processing on standalone GPS receivers, we can achieve three orders of magnitude lower energy consumption per location tagging [1]. The proposed TripNav, a localization and navigation system that is implemented entirely on resource-constrained wireless sensor nodes. Localization is realized using radio interferometric angle of arrival estimation, in which bearings to a mobile node from a

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small number of infrastructure nodes are estimated based on the observed phase differences of an RF interference signal. A digital compass is also employed to keep the mobile node from deviating from the desired trajectory. The demonstration using a real-world implementation that a resource-constrained mobile sensor node can accurately perform waypoint navigation with an average position error of 0.95 m. This is a future direction for our MWSN localization and navigation research, and we have already obtained encouraging preliminary results [2]. This paper architecture, implementation, and applications of Live Synergy a system that provides reliable proximity sensing and open interactive abstractions for physical spaces and objects, to enable rich interactions between humans and their environment [10]. A large number of context-inference applications run on off-theshelf smart-phones and infer context from the data acquired by means of the sensors embedded in these devices. The use of efficient and effective sampling technique is of key importance for these applications. Aggressive sampling can ensure a more fine-grained and accurate construction of context information but, at the same time, continuous querying of sensor data might lead to rapid battery depletion. This paper represents an adaptive sensor sampling methodology which relies on dynamic selection of sampling functions depending on history of context events [9]. (Manikandan et.al., 2016, Sethuraman et.al., 2016, Senthil Thambi et.al., 2016).

EXISTING SYSTEM

Doppler Frequency Shift GPS: The rate of that change is reflected in the constant variation of thesignal's Doppler shift. But if the receiver's oscillator frequency is matching these variations exactly, as they are happening, it will duplicate the incoming signal's Doppler shift and phase. This strategy of making measurements using the carrier beat phase observable is a matter of counting the elapsed cycles and adding the fractional phase of the receiver's own oscillator.

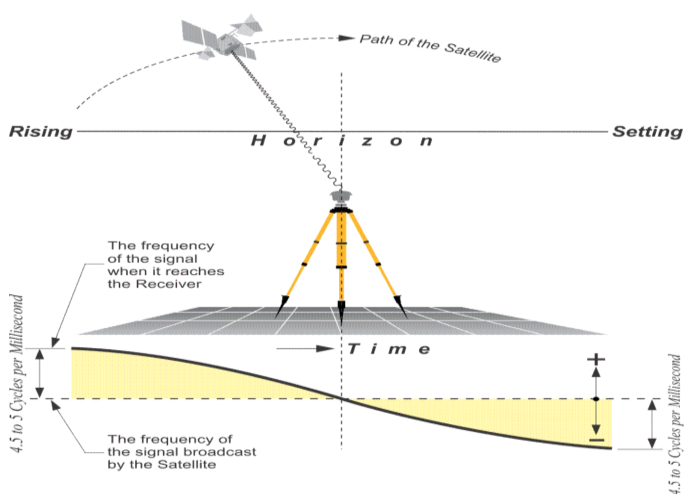

Fig 1: Typical Doppler shift

Now the continuous integration of the Doppler shift is one of the ways that the observable can be used to refine position. The difference between the two, that means the incoming frequency and

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the reference frequency generated by the receiver, this intermediate or IF that we've talked about is a beat frequency over a given time interval known as Doppler count for that interval. Since the beats can be counted much more precisely than the continuously changing frequency can be measured, most GPS receivers keep track of the accumulated cycles, or the Doppler count. Now this is an aspect of a receiver, continuously integrated Doppler or CID that is a welcome addition to the full complement of observables used by the receiver to determine a position.

Drawbacks of Existing System: 1. In this process the accuracy of Argos is only within a few kilometers. 2. Doppler information's no longer useful, and the device must spend substantial energy to re-acquire the satellites. 3. The duty cycle of this system is more. 4. The data consumption of this system is more.

PROPOSED SYSTEM

This system is designed in order to overcome the drawbacks of the existing system by enhancing the performance and energy efficiency. The performance and energy efficiency is enhanced by using a cloud offloaded GPS system.

CO-GPS Design: The design of cloud-offloaded GPS leverages the CTN principle but removes the dependency on nearby landmarks. For embedded sensors without cellular connections that are always possible to provide nearby landmarks. Our key idea is to leverage the computing resources in the cloud or generate a number of candidate landmarks and then geographical constraints to filter out the wrong solutions for the problem. When the device needs to sense its location, it simply turns on then GPS receiving front end and records a few milliseconds of GPS signal. Our goal is to derive the receiver location offline solely from the short signal and the coarse time stamp.

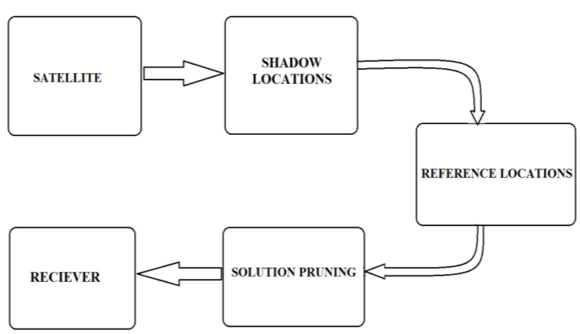

Fig 2: Block diagram of CO-GPS

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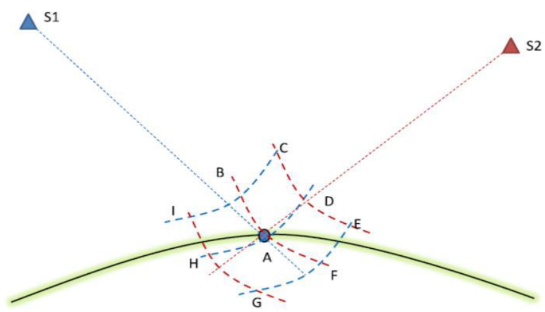

Fig 3: An illustration of multiple feasible solutions under NMS ambiguity

Here, we model the pseudo ranges from each SV as a set of waves, each 1 light-ms apart. Clearly, these waves intersect at multiple locations. Since we do not know the exact millisecond part of the propagation delay, all intersections, A; B; C; D; . . . are feasible solutions, even though only one of them is the correct location. When more satellites are visible, more constraints are added to the triangulation, which helps resolve the ambiguity. However, a larger number of satellites alone are not enough. To illustrate this empirically, we take a 1 ms raw GPS trace and apply CTN with an array of landmarks across the globe. There are six satellites in view. The landmarks are generated by dividing the latitude a longitude with a 1-degree resolution around the globe. In other words, we picked 180 _ 360 ¼ 64; 800 landmarks with adjacent distance up to 111 km on the equator.

RESULTS AND DISCUSSION

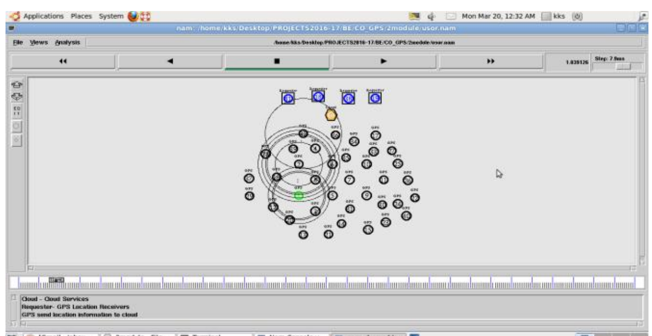

Fig 4: Initialization Process

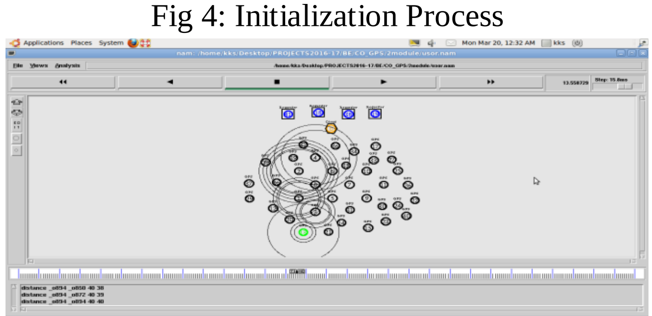

Fig 5: Cloud Uploading Process

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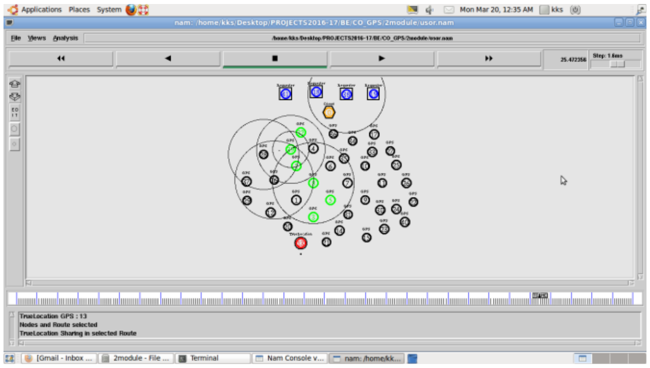

Fig 6: Finding True Location from the Reference Location

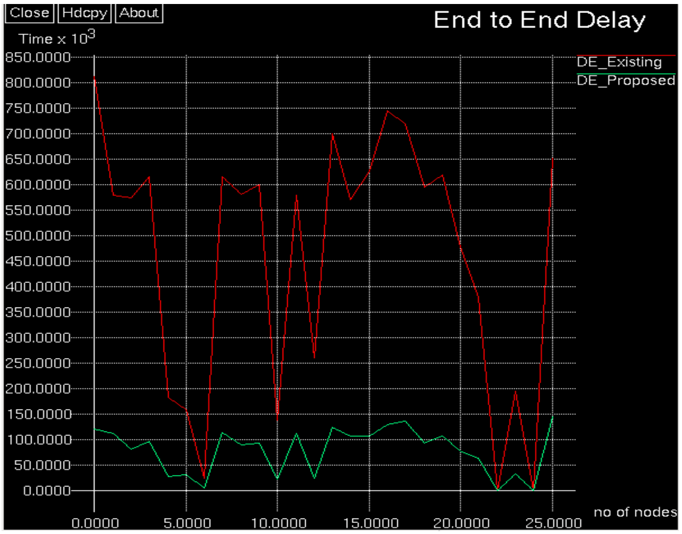

Fig 7: Comparison of End to End Delay

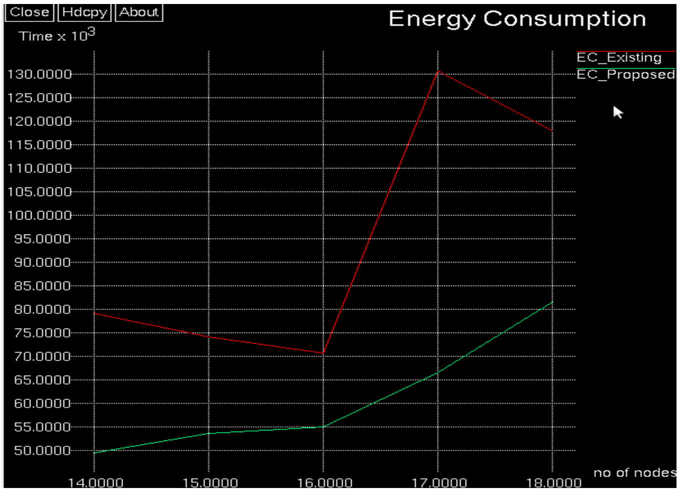

Fig 8: Comparison of Energy Consumption

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CONCLUSION AND FUTURE WORK

Motivated by the possibility of offloading GPS processing to the cloud, we propose a novel embedded GPS sensing approach called COGPS (Cloud Offloaded-GPS). By using a coarse-time navigation technique and leveraging information that is already available on the web, such as satellite ephemeris, we show that 2 ms of raw GPS signals is enough to obtain a location fix. By averaging multiple such short chunks over a short period of time, CO-GPS can achieve <20m location accuracy using 10 ms of raw data (40 KB). Without the need to do satellite acquisition, tracking and decoding, the GPS receiver can be very simple and aggressively duty cycled. We built an experimental platform using a GPS front end, a serial to parallel conversion circuit, a microcontroller and external storage. On this platform, sensing a GPS location takes orders of magnitude less energy than self-contained GPS modules.

The initial success of CO-GPS motivates us to extend the work further. We will exploit various compression techniques, especially those based on compressive sensing principles, to further reduce the storage requirements. We plan to release the hardware reference design and make the LEAP web services available to research communities.

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