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A study on Navigation/tracking System Combining GPS and NFC Technologies

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ABSTRACT

According to recent statistics the International Telecommunication Union (ITU) states that the number of mobile devices in the world reached 60.835 billion at the end of 2025. Furthermore, the number of distinct devices is still growing. Thereby wireless technology continues to improve and wireless networks are even more extensively deployed at certain environment which in turn the feasibility of developing Location-Based Services (LBS) has become more attracted research interest for both academician and industries. Moreover, indoor navigation systems have recently become a popular research field due to the lack of Global Positioning System (GPS) signals at indoor surroundings. Several indoors navigation systems have already been proposed in order to eliminate deficiencies however each of them has several technical and usability limitations. To overcome this, the research study demonstrates Near Field Communication (NFC) based indoor navigation system which promotes users to navigate through building or complex by enabling a specific location update by touching NFC tags those are spread around and orient users to the destination. Further, this paper initially presents the system requirements and the viability of NFC internal specification with prototype application that directs the future research development.

Keywords: GPS, NFC, Wireless Technology, Indoor Navigation, Mobile Phone.

I. INTRODUCTION

NFC is a set of protocols used for close-proximity wireless communications between two devices. Among the contactless communication technology NFC services have proven mass market from the past 10 years. There are more than 2 billion NFC-enabled devices by 2021. Lately many businesses are implementing NFC technology in ticketing, payment and management systems. NFC transfer data up to 424 Kbits per second and runs at 13.56 MHz and the main advantage of NFC is that mobile devices can be both information storage and NFC reader.

Global Positioning System (GPS) technology is used widely in the navigation, tourism and engineering fields. GPS depends on the strength between the user and navigation satellite. It functions well in an open environment and affects dramatically in mountainous areas or build-up urban areas. Indoor environment is a complicated space, where GPS signals cannot be used and outstretched of wireless is easily affected by interior structure of the building. Therefore, precise technology is needed. Thus, for many years Google Map services have been applied in public construction fundamental facilities, road or outdoor large areas.

Mobile devices are irreplaceable in daily in daily life, currently it is limited by their short battery lives, which encourages the need for frequent recharging. To address this issue, many mobile devices use Bluetooth Low Energy (BLE). It has many advantages including stable signal, ease of distribution, low cost and extensive connectivity with existing wireless device. BLE has remarkable potential as an enabling technology for indoor LBS application.

To increase the application of finding systems and to enable smart mobiles to become key equipment of augmented humanity. It can effectively enhance convenience. It is based on short distance wireless communication technology, which combines NFC, BLE beacon and NFC technology, which is suitable for indoor buildings. This combines BLE, GPS AND NFC technology to realize a seamless outdoor-indoor user localization for implementation on smart phone. In the suggested

plan user localization and guidance app is suitable for implementation in smart phones.

II. REVIEW OF RESEARCH

We will now point out some important concepts those are closely related with NFC Internal model. First, existing positioning technologies enabling outdoor and indoor navigation are briefly explained by using several comprehensive studies from the literature; the challenges of these systems are given as well. In the second subsection, NFC technology, its operating modes, and other NFC related issues are described for a clear understanding of the NFC communication aspects of the NFC Internal system.

The brief research background will be helpful for understanding the significance of the contributions of NFC-based navigation systems compared to existing ones. Indoor Positioning Technologies In recent years, positioning systems have become a popular field in both academic and industry research and there already exist several research and commercial products in this area. Indoor Sensors navigation systems have become an especially hot research area recently, due to the unavailability of GPS in indoor environments, as explained in the introduction section. With the aim of circumventing this lack of performance, an assortment of technologies has been tested and new designs generated for indoor navigation in the literature.

Positioning systems enable the appropriate device to determine its position, and make the location information available for position-based services [5]. Positioning system topology is an important issue for understanding and developing a positioning system. According to four different system topologies are defined for wireless positioning systems: (a) remote positioning; (b) self-positioning; (c) indirect remote positioning and (d) indirect self-positioning. In case of a remote positioning system, there is a signal transmitter and several fixed measuring units. The signal transmitter is mobile, and fixed measuring units receive the transmitter's signal. The location of the transmitter is computed in a master station after collection of all data from measuring units.

In a self-positioning system, the measuring unit is mobile and it receives the signals of several transmitters placed in known places, and with the help of these signals, it can compute its location. In the case of indirect remote positioning, a self-positioning measuring unit sends the measurement results to the remote side via a wireless data link. A remote positioning unit can also send measurement results to a mobile unit, which is then named indirect self-positioning. According to another study [3], indoor positioning techniques can be divided into two categories: network dependent systems and device dependent (network independent) systems. Network dependent navigation systems are based on networking technologies such as IR, sensors, ultrasound, WLANs, UWB, Bluetooth, RFID technologies, whereas independent navigation systems provide autonomous user positions such as A-GPS as an indoor GPS system.

The study in [7] defines two approaches for indoor positioning: locating in relative coordinates and locating at choke points. Locating in relative coordinates requires usage of active devices i.e., devices that use their own power sources for positioning, however passive devices can also be used for locating at choke points. In case of locating in relative coordinates, reference transmitters determine the position of the user and the accuracy of positioning depends on the range and coverage of reference transmitters [1]. These systems usually calculate the position of the mobile object using the signal strength at reception time, which is expressed by the Received Signal Strength Indication (RSSI) technique. The technologies used in this method are IR, ultrasound technologies (e.g., Active Bat, Crickets, Dolphin [6]), UWB (e.g., Ubisense [6]), WLAN (e.g., RADAR, Ekahau, COMPAS [6,9]), Bluetooth (e.g., Topaz [5]), active RFID (e.g., LANDMARC [13,14]). In case of locating at choke points, the sensors are located at fixed points, which provide location values in the network. In this approach, tagged objects including location coordinates determine the location [2]; some technologies for this approach are Quick Response (QR) codes, Passive RFID and NFC.

Uses of NFC: The special advantage of NFC is its straightforward mode of use, simply place a device close to tag to initiate the desired service. Some typical uses are:

1. Service Initiation- In this, an NFC-enabled phone touched against an NFC tag can read information such as URL, text etc, based on which an action will be defined. Example: In smart poster NFC tags have been placed containing some information in NFC data format. When an NFC-enabled phone touches a tag in the poster, it reads the information present.

Depending on the information type, the phone opens web browser, or ask the user for telephone call.

2. Ticketing- Ticketing can be done using NFC enabled phone by touching your phone to ticket reader. Here phone works in a card emulation mode and therefore act as a card. For using NFC phone as travel ticket, secure element (SE) should be present on the phone running ticketing application.

3. Payment- A payment in a similar way as Ticketing can be done using NFC phone provided phone uses a secure element which runs payment application.

4. Sharing- Peer-to-peer communication mode allows NFC enabled mobile phones to share data. For example, NFC-enabled phones can share information of business card by sending radio signal to the other phone in the range. The information is shared in the NDEF format which is identified by both devices. Generally sharing is done through Bluetooth, NFC is only used to initiate Bluetooth.

5. Connecting devices- NFC device can connect with any other device without the need of any configuration or set-up. Ex: An NFC enabled phone needs to be touch in order to connect with Bluetooth headset. For this Bluetooth device should have NFC tag containing all the pairing information required in NDEF format.

III. TOOLS & TECHNOLOGY

Tools Used

1. Eclipse: Eclipse is a multi-language Integrated development environment consisting of a workspace and a plug-in system for customization. Mostly it is written in Java. It can be used to develop java applications and, through various plug-ins, application of other programming languages like Ada, C, C++, COBOL, Fortran, Haskell, JavaScript, Perl, PHP, Python can also be developed.

2. Android SDK: Android SDK provides the developer tools and API libraries required to build, test, and debug android apps. Generally android SDK is installed as a plugin in eclipse to provide easy coding support.

3. JOSM: JOSM is the" Java OpenStreetMap Editor", a desktop application providing an interface for building maps. This tool is linked with open street maps so maps from osm can be downloaded and changes done in them will get reflected to osm maps, and so can be accessed by everyone.

IV. TECHNOLOGY USED

1. Near Field Communication (NFC) : NFC is a short range wireless communication technology which works at a distance less than 10cm. It allows to share small payloads of data between two Android-powered devices or a tag and NFC device. NFC uses some standard protocols for communication like NDEF for data exchange, and thus are based on existing RFID standards.

2. QR Code: Quick Response Codes are a type of barcode either 1-D or 2-D that can be read by smartphones or dedicated QR reading devices, that is linked with phone numbers, text, emails etc. A barcode is attached to the item and contains information about that item. Barcode initially came for automotive industry but due to its greater storage capacity and fast readability it has become popular outside. A QR code consists of a square grid on a white background with full of black modules arranged, which can be read by a camera and processed through error correction method. Once the image is interpreted appropriately, data can then be found out from patterns present in both vertical components and horizontal of the image.

V. CONCLUSION

In this paper, a study in indoor positioning and navigation techniques and technologies which can maximize positioning has been done considering with following metrics such as NFC, GPS and so on. These metrics are an offshoot of measurement characteristics such as angle, distance and signal strength. While these techniques aid effective positioning, their right application is critical in a system. The indoor navigation-based application of these techniques will determine the degree of accuracy, scalability, complexity and performance of a wireless system.

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