

Context-Aware Security using Gimbal based Sensor Control System

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Abstract

Objectives: In order to provide efficient knowledge for location aware computing system in mobile applications, this paper proposes an experimental analysis considering user's location information. **Methods/Analysis:** These systems can entail information from array of sensors. Context aware management system combining central, distributed management scheme along with sensors, which can be utilized for location application. In order to provide better context/location aware management system, sensors (magnetometers) are mounted on Gimbal platform. This sensor platform synchronizes the device direction in all three axes. **Findings:** Magnetometer sensor can detect ground changes with respect to orientation angle with maximum accuracy. These possessions are validated with magnetic field intensity & rotation headings towards the north direction. Calibration of magnetometer reduces the noise and drift variations in the output. **Conclusion :** The proposed analysis offers displacement of the device and ensures the quality of service.

Keywords: Context Aware, Gimbals, Location Awareness, Magnetometer, Orientation Angle, Sensors

1. Introduction

Heterogeneous wireless networks have become more ubiquitous and security management of mobile devices with beyond 3G interconnections has become more demanding task. Context aware¹⁻³ management assignment is a simple scheme, where by combining central and distributed management, privacy can be preserved even in presence of a capillary deployment of low-range base stations. This management system is autonomic and proactive.

Nearby research projects, there exists also a variety of application that is used for gathering information about context from mobile devices. Gimbal method of context aware⁴⁻¹⁰ is mostly concerned with low-level context data acquisition from sensors, suitable further context identification. The inclusion of the sensor in phone will enable users to receive appropriate, sensible and personalized communications.

2. Methodology

The context aware entity of smart phone includes three main stratum, equipped with intellectual stratum between sensors and context based implication stratum methodology¹¹⁻¹⁴.

The main element of sensors such as accelerometer, gyroscope, magnetometer and barometer collect information and perform the initial processing. Mobile devices^{15,16} directly collect information through the sensors¹⁷⁻¹⁹. Accelerometer offers reorientation of the mobile device and inertial routing in all three directions. Primarily it concentrates movement and titling of the device. If the mobile device²⁰⁻²² is held horizontally or vertically, pitch axis deals displacement away from the unit, yaw deals with left/right direction and roll concentrates displacement above/below. Since the oscillatory movement of the device can be controlled in all three axis. Based on the various capacitor measurements with gravitation drag, it measures distance and movement of the mobile device.

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The sensor, gyroscope provides information by footpath rotation or twist. A gyro on the other hand measures the angular rotational velocity. Magnetometer (digital compass) provides mobile phones with a simple orientation in relation to the Earth's magnetic field.

Based on the sensors gathering data, context based reasoning and knowledge management is done by intellectual stratum.

3. Context Aware-Security and Privacy

In heterogeneous networks the key concept in security issues are privacy issues²³⁻²⁹ and identity information. Authenticating location³⁰⁻³³ information is complicated because widespread sensor systems typically rely on technologies such as active symbols that can be removed from the mobile objects they represent. In addition to securing mutual end to end communication, origin and destination of content should also be protected. The heterogeneous security includes confidentiality (protecting information from unauthorized entities, Integrity (without any modification in the original information) and privacy.

Realizing context-aware in privacy and confidentiality is very difficult assignment, because sharing of private information is very confidential and not to reveal to other entities. Implementing data integrity between users in the context aware systems should be established to the anticipated nodes with integrity and without tampering.

3.1 Authentication Process

Authentication protocol is used to protect the user identity and provide seamless authentication between various

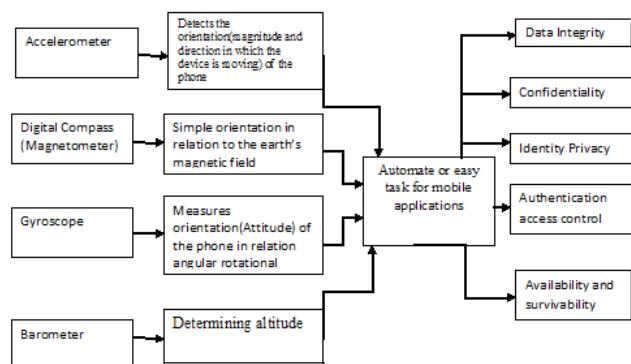


Figure 1. Smart Mobile Phone System.

heterogeneous networks with the services of context based systems.

In ubiquitous network, the major problem is IMSI revelation. To get the new access of the network, authentication with context aware conform the identity to movement. Also, it protects the context information from corrupted information by a third party. The context integrity should be provided by a specific authentication protocol. It includes EAP-AKA, EAP-TLS, EAP-AKA', EAP-TTLS and LEAP protocol. Since the authentication protocol includes hash functions or public key digital signatures to protect the information.

EAP-AKA protocol uses unkeyed hash algorithm such as SHA-1, SHA-256, provide a very short level of data integrity with respect to the use of data in request adaptation. With keyed hash function, such as message authentication code, is a pre-shared key between the context information providers and the context-aware systems.

EAP-TLS protocol uses Public key digital signature, PKI-based approach might not be always suitable for context-aware systems, especially in distributed systems including low-cost sensors.

4. Heterogeneous Networks-Context Awareness

For providing seamless communication in the heterogeneous environment developing a new structure for context-aware security services. It is responsible for providing accurate and secure context information to context-aware applications.

Heterogeneous Environment consists of several classes of communication: a stand-alone system operated by a network belonging to a different administrative domain than the entity requesting context information, a service that is operated by a user belonging to the same administrative domain as the entity requesting context information and Intra-domain service or a service integrated in another server.

5. Sensor-Gimbal Method

Context associated to physical environment which includes absolute position, relative position, co-location, and infrastructure, adjacent resources for computation and communication, noise level, light, pressure level.

For finding Context about the human users of the infrastructure, position, affiliation, or attention- a magnetometer is used in the platform of gimbals structure.

6. Calibration of the Magnetometer

With reference of Figure 2, experiments were conducted using^{34,35} Magnetometer, is mounted horizontally in the space of the Z axis with X axis of the magnetometer meaningful towards the North direction. The attitude output of digital compass reveal an attitude performance specification of 0.5 deg in static situations and 1 degree in dynamic situations.

6.1 Roll Axis Rotation-Raw Values

Keeping Y and Z axes rings stationary and varying X axis about 360 degrees rotation, corresponding readings are acquired through³⁶ Arduino. Figure 3 shows that the magnetic field intensity values with respect to the time.

The heading accuracy values of the magnetometer shown in the above Figure 4. The X axis when pointed towards the North the Heading value is Zero (0) degree and increased to 360 degree for one rotation.

6.2 Pitch Axis Rotation-Raw Values

Keeping X and Z axes rings are stationary and varying Y axis Gimbal ring is about 360 degrees rotation, while readings are serially acquired through the Arduino. Figure 5 shows pitch rotation raw values of magnetic field intensity.

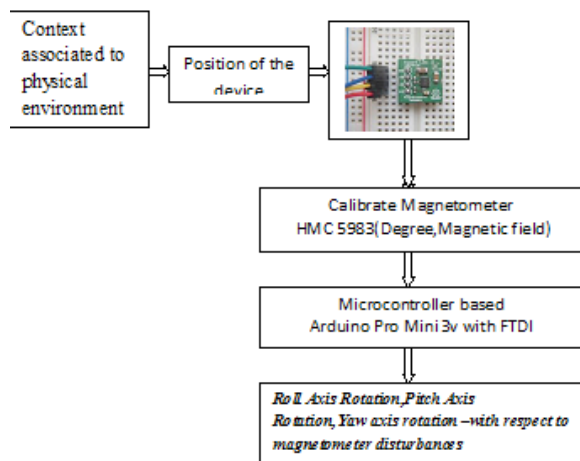


Figure 2. Calibration of Magnetometer.

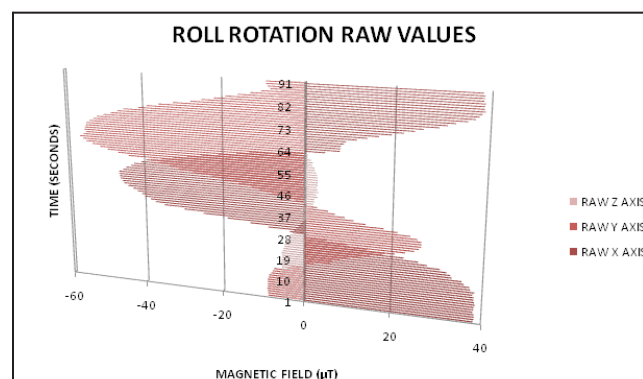


Figure 3. Magnetic field Intensity values (μT) Vs. Time (sec).

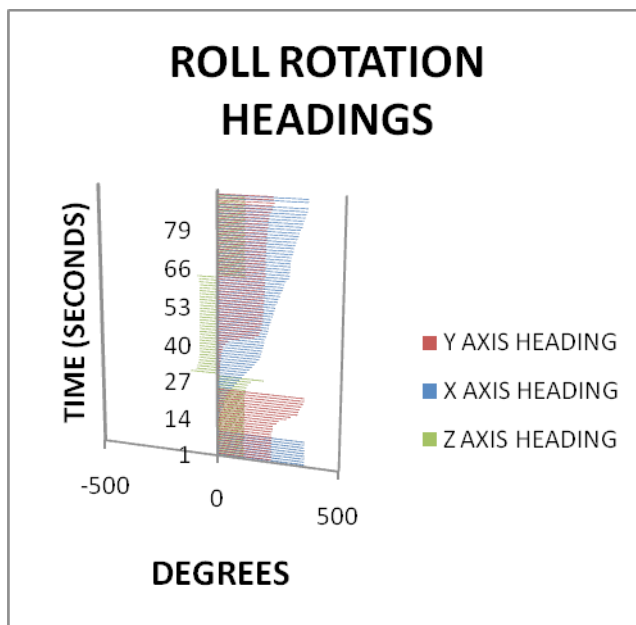


Figure 4. Roll Rotation Headings Degree Vs. Time (Sec).

From the Figure 6, graph provides the magnetometer heading values. The X axis of the magnetometer when pointed towards the North the Heading value is 360 degree and it is constant till the X axis reaching the 120 degree and suddenly fallen and zero (0) degree and remained constant for a yaw rotation.

6.3 Yaw Axis Rotation-Raw Values

The Z axis Gimbal ring is rotated 360 degrees while the X and Y axes rings are stationary the readings are serially acquired through the Arduino and are plotted as the following graphs in Figure 7 and Figure 8.

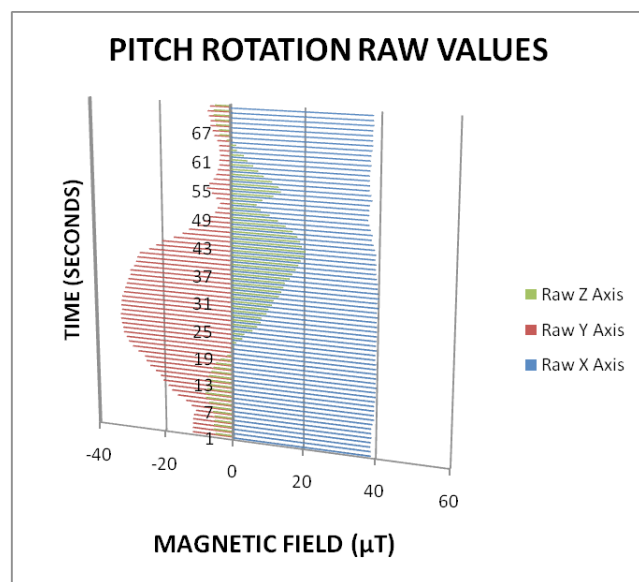


Figure 5. Pitch Rotation Raw values Magnetic field Intensity values (μT) Vs. Time (sec).

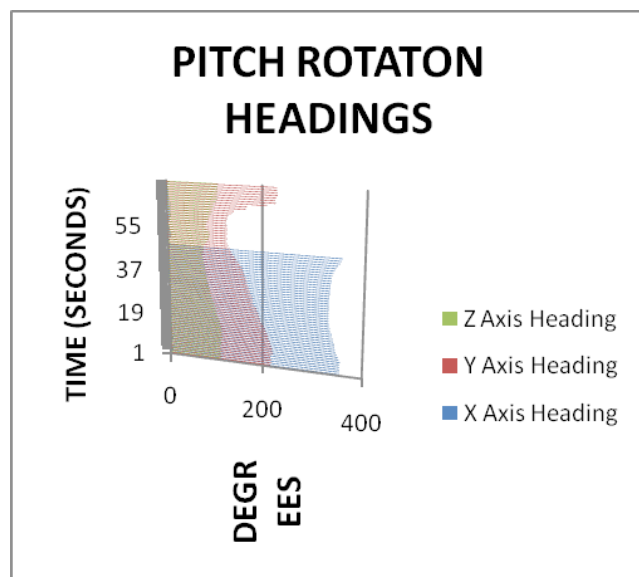


Figure 6. Pitch Rotation Headings (Degree Vs. Time).

While X axis of the magnetometer when pointed towards the Geographic North direction.

7. Conclusion

This paper has introduced some of the basic concepts, issues of context-aware security system and sensor based Gimbal system. Position and Orientation of the sensor based on the Gimbal is developed for three axis control.

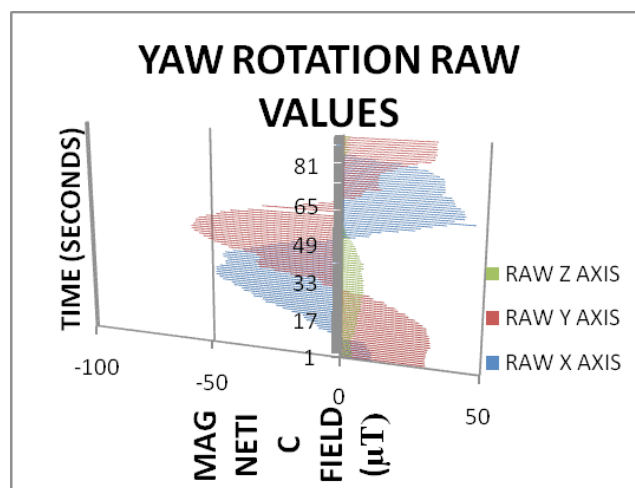


Figure 7. Yaw Rotation Raw values (Magnetic field Vs. Time).

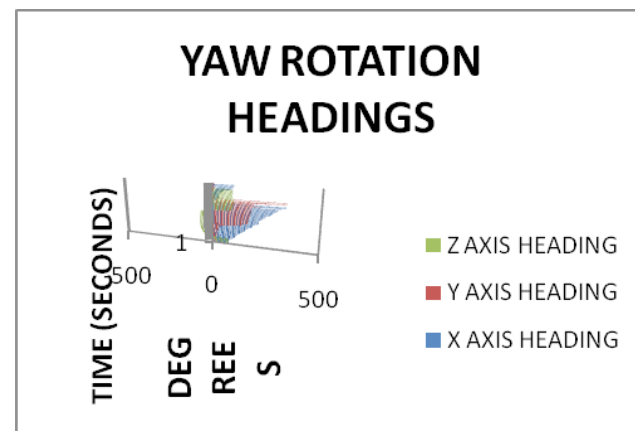


Figure 8. Yaw Rotation Raw values.

Keeping one of the axes of Gimbal (360 degree) as the reference and other two axes are kept stationary. The calibration of magnetometer provides the position of the device with respect to the north direction. The three axis processing developed using microcontroller based Arduino system.

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