Development of SPIES (Space Intelligent Eyeing System) for smart vehicle tracing and tracking

Suzanah Abdullah¹, Muhammad Ariffin Osoman², Chua Guan Liyong², Mohd Zulfadhli Mohd Noor², Ikhwan Mohamed¹
¹Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA Seri Iskandar Campus, Seri Iskandar, 32610, Perak, Malaysia,
²Geoinfo Services Sdn Bhd, No 31, Jalan Bandar 2, 53100 Taman Melawati, Kuala Lumpur, Malaysia,

Email: suzan156@perak.uitm.edu.my

Abstract. SPIES or Space-based Intelligent Eyeing System is an intelligent technology which can be utilized for various applications such as gathering spatial information of features on Earth, tracking system for the movement of an object, tracing system to trace the history information, monitoring driving behavior, security and alarm system as an observer in real time and many more. SPIES as will be developed and supplied modularly will encourage the usage based on needs and affordability of users. SPIES are a complete system with camera, GSM, GPS/GNSS and G-Sensor modules with intelligent function and capabilities. Mainly the camera is used to capture pictures and video and sometimes with audio of an event. Its usage is not limited to normal use for nostalgic purpose but can be used as a reference for security and material of evidence when an undesirable event such as crime occurs. When integrated with space based technology of the Global Navigational Satellite System (GNSS), photos and videos can be recorded together with positioning information. A product of the integration of these technologies when integrated with Information, Communication and Technology (ICT) and Geographic Information System (GIS) will produce innovation in the form of information gathering methods in still picture or video with positioning information that can be conveyed in real time via the web to display location on the map hence creating an intelligent eyeing system based on space technology. The importance of providing global positioning information is a challenge but overcome by SPIES even in areas without GNSS signal reception for the purpose of continuous tracking and tracing capability

1. Introduction
The integration of GNSS technology with other technology and sensors allows accurate geo-locational acquisition of remotely sensed imagery by imaging sensors mounted on space borne satellites, ortho-rectified photo by camera mounted on airborne fixed-wing and rotary-wing platforms, and now, videos and still pictures by camera mounted on terrestrial-based vehicle. The output of terrestrial-based vehicle allows measurement to be made from the video and still pictures besides animation that can always be viewed to enable limitless site revisit. Furthermore, the integration of the above technologies and geo-spatial technologies allows geo-locational data to be integrated and utilized through web-based and desk top for tracking applications and others customized viewing, tracking and tracing related applications

The integration of GNSS technology with other technology and sensors allows accurate geo-locational acquisition of remotely sensed imagery by imaging sensors mounted on space borne satellites, ortho-rectified photo by camera mounted on airborne fixed-wing and rotary-wing platforms, and now, videos and still pictures by camera mounted on terrestrial-based vehicle. The output of terrestrial-based vehicle allows measurement to be made from the video and still pictures besides animation that can always be viewed to enable limitless site revisit.
The integration of the above technologies and geo-spatial technologies allows geo-locational data to be integrated and utilized through web-based and desk top for tracking applications and other customized viewing, tracking and tracing related applications. In terrestrial application, one of the challenges of using the GPS is positional data cannot be collected in the absence of GNSS services. As all the above mentioned technologies are capable of recording the visual, time and position, hence, the synchronization of the output along with other technology that allow position can be determined in the absence of GNSS services, will benefit not only the tracking application of a moving vehicle but also with tracing capability of its surrounding event. The purpose of the proposal is to develop a space-based integrated system for real-time monitoring or off-real-time movement of vehicle and its environment using the GNSS services with track and visual tracing capability even in the absence of GNSS services. The benefit of the product is to trace the cause of accident and as a mobile CCTV, it acts as eye-witness of an event.

1.1. Problem statement

Nowadays, many types of accidents cases that occur on the road often hear in the chest of press such as television, radio, internet and many more. Accidents regularly associated with unexpected situations such as human negligence or damage of the vehicle itself. Accident will occur anywhere without know when the accident will happen. It is difficult to describe how the accident happened especially accident cases without proof.

This study will assist in identifying the cause of an accident that happens, whether from human negligence or due to the condition of the vehicle itself. The method how to identify before the accidents occur also can be shown in this project. This study will help to identify how an accident occurred. The recorder system installed on the vehicle can be helpful to find the cause of the accident. This system is used to record an accident that occurred either before or after it periodically.

In terrestrial application, one of the challenges of using the GPS is positional data cannot be collected in the absence of GNSS services. As all the above mentioned technologies are capable of recording the visual, time and position, hence, the synchronization of the output along with other technology that allow position can be determined in the absence of GNSS services, will benefit not only the tracking application of a moving vehicle but also with tracing capability of its surrounding event.

1.2. Objective

The main objective of this study is to propose a new approach deep tackling vehicle user security problem especially to improving their behavior on way of driving that more well-mannered and safe. Meanwhile, the objectives of the study are as follows:

a) To develop a space-based integrated video system for monitoring real-time and archived movement of vehicle using the GNSS services.

b) To record incident with visual and tracking capability even in the absence of GNSS services.

c) To develop a prototype as a mobile CCTV, it acts as an eye-witness of an incident for itself and other vehicles.
2. Literature review

In this section involve with the explanation that based on elaboration of conceptual system tracing and tracking. Since the introduction of GPS Navigation systems in the marketplace, consumers and businesses have been coming up with innovative ways to use the technology in their everyday life. GPS Navigation and Tracking Systems keep us away from getting lost when we are in strange locations, they monitor children when they are away from home, keep track of business vehicles and can even let us know where a philandering partner is all the times (Khraisat et al., 2011). Mobile application is the most of the convenience way for everybody to access information. Combination of Voice, video, GPS, SMS, accelerometer and WIFI will introduce most intelligence gadget in a recent technology.

Mobile phones have made significant improvements from providing voice communications to advanced features such as camera, GPS, WI-FI, SMS, voice recognition, Internet surfing, and touch screen (Huei, 2012). The global Positioning System which also known as GPS is a satellite-based navigation system designed to help navigate on the earth, in the air and under water. It provides users with positioning, navigation and timing services(Al-Khedher 2012; RAKESH 2014). The GPS system was created by the Department of Defense of the United States and nowadays is still owed and operated by the United States. Originally, it was used exclusively by the U.S. military, but in 1983 an order allowed anyone to use the system.

The system was declared fully operational in 1995(Abbott and Powell 1999). In recent times, other Global Navigation Satellite Systems (GNSS) have been either launched or being developed, such as the Russian GLONASS system, the European Union Galileo satellite navigation system, the Chinese Beidou and Indian satellite navigation system(Marron Monteserin 2014). Today GPS-based navigation systems can be found in motor vehicles, farming and mining equipment and variety of other land-based vehicles.

3. Methodology

In this section will explain the methods to be implemented in this research from the beginning until the end of the study. Methodology is an important thing to explain the appropriate method used in this project to achieve the objectives of the study. This chapter also important to arrange the process of analysis in order to making the good result based on the objective. The study was carried out by identifying issues for study, so it is necessary to plan the project to be implemented. The process of collecting information or data will also be described in this chapter to ensure that data required depends on the objectives of the study. Methodology is the systematic, theoretical analysis of the method applied to a field of study. It comprises the theoretical analysis of methods and principles associated with the branch of knowledge. Figure below shows the flow chart of methodology process.
3.1 Application of tracking and tracing technology

The preliminary part of the project is to study the availability of terrestrial imaging-tracking-tracing technologies and applications. The study shall improvise the existing system if available and prioritize applications in the results will be used for the final synthesis of the prototype. The protocol interoperability between sensors to be used for the hardware proposed and applications to convert the data captured in real-time and off-real-time application will be studied to enable data transfer.

3.2 Development of vehicle subsystem

The vehicle subsystem will be developed as a device capable of imaging-tracking-tracing and time synchronization with and without GNSS Services. The output of the device is real-time and off-real-time or recorded data. The imaging capability of the device all be able to capture the environment in video mode and in still picture with time and positioning synchronization to enable tracing of event when applicable. The vehicle sub-system is a system to collect data. The system is hardware to be mounted on to the vehicle comprises the integration of GNSS receiver to receive the positioning information from the GNSS services; Video recorder to record video in the field of view of the camera along the route of the moving vehicle. The video can be record the front or rear view and even both of the moving vehicles depending on the position and number of the hardware to be mounted; Gyroscope which is a rotation sensor, continuously calculate the position of the vehicle by using a previously known position without the need for external.

3.3 Development of application subsystem

The development of the system is divided into two applications: web-based and desktop. The application sub-system is a system to process the data collected into information. The web application receives the GNSS data (position) from the vehicle sub-system in real-time and off-real-time to monitor the movement and environmental vie (still picture) captured of the vehicle using map viewer. The desktop application retrieves the recorded data (video embedded with GNSS positional data or
still picture) in the vehicle sub-system to further process and analysis for various view-track-trace related off-real-time applications.

3.4 Integration of subsystem

The completed vehicle and applications subsystems will be integrated as a prototype. Verification of its performance will be assessed upon its accuracy for imaging, positioning and time synchronization for real-time data capturing, recorded data capturing and tracking with and without GNSS services.

4. Expected Outcome

The result will be achieved in the implementation of this project are as below:

a) This prototype able to help track vehicle either real time or off real time.

b) This prototype also integrate with semi HD camera which is able to record incident either in video mode or still picture.

c) In the absence of satellite services, this prototype also developed with Gyro sensor which is able to continue calculation the position of movement from the last position stored by GNSS services.

d) Act as a mobile CCTV, it can be used as an eye-witness of an accident for itself and other vehicle.

e) Developed with system to view the movement of vehicle real time and also playback the recorded video in offline mode.

Conclusion

The project fulfils the first objective by successfully developing an intelligent space based integrated video system for monitoring real time and archived movement of vehicle using the GNSS services at prototype level. To fulfil the second objective of recording incident with visual and tracking capability even in the absence of GNSS services, the system exploits the data measured and recorded by the Gyroscope sensor by continuing the position of movement from the last known position stored by GNSS services.

References

[1] Al-Kherher, M. A. ((2012)). "Hybrid GPS-GSM localization of automobile tracking system." arXiv preprint arXiv:1201.2630.

[2] Alharaki, O. O., F. S. Alaieri, et al. (2010). "The integration of gps navigator device with vehicles tracking system for rental cars firms." International Journal of Computer Science and Information Security 8(6): 47-51.

[3] Chadil, Chadil, N., A. Russameesawang, et al. (2008). Real-time tracking management system using GPS, GPRS and Google earth. Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology, 2008. ECTI-CON 2008. 5th International Conference on, IEEE.

[4] Forssell, U., P. Hall, et al. (2002). "Map-aided positioning system." Proceedings, International Federation of Automotive Engineering Societies.

[5] Kodavati, B., V. Raju, et al. (2011). "GSM and GPS based vehicle location and tracking system." International Journal of Engineering Research and Applications (IJERA) ISSN:
2248-9622.

[6] Mansell, J. P. and W. M. Riley (1993). Vehicle tracking and security system, Google Patents.