

ITS to monitor small vessels movements within port area - A study at Santos estuary

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Abstract— Ports connect the world through maritime transportation networks, promote international trade, and support global economic growth. In Brazil cargos are shipped in vessels and also several kinds of goods are shipped in all kinds of recreation boats and motorboats. In this paper, it was investigated the Santos estuary focusing on small vessels, considering only those endowed with some sort of mechanical propulsion, within specific requirements, where they are a great concern for port security. By using Intelligent Transportation Systems (ITS), we came to the feasible solution to deal with small vessels at the Santos estuary by monitoring its movements within that specific area.

Keywords— small vessels monitoring, port, ITS, RFID.

I. INTRODUCTION

PORTS installed near cities have to adapt their activities to the city routine. As examples, cargo transported to port terminal must consider its effects over the city traffic, and large proportion vessels must coexist with recreation boats and motorboats on the estuary. That necessity results in many conflicts of operational and social nature, since many of these small transportation boats carry a large number of passengers

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susceptible of suffering hazardous consequences.

The control of the displacement of vessels allows one to check the vessel route and speed. Sized vessels at high-speed cause sea waves, which can contribute to sink small vessels. In other words, it can result in life and property losses. Another issue to be noted is motorized vessels distance from beaches for bathers safety.

Ports around the world still have very diversified practices and standards regarding “secure” [1]. In Brazilian estuary areas sized vessels speed cannot exceed the 6 knots and motorized vessels must be 200m distant from shore [2].

Brazil has many ports and Port of Santos is the main one, as the largest commercial harbor in Latin America and the most important metallurgical and petrochemical industrial center in Brazil, with more than 1100 industries, are also established in, and adjacent to, this estuary [Fig. 1].

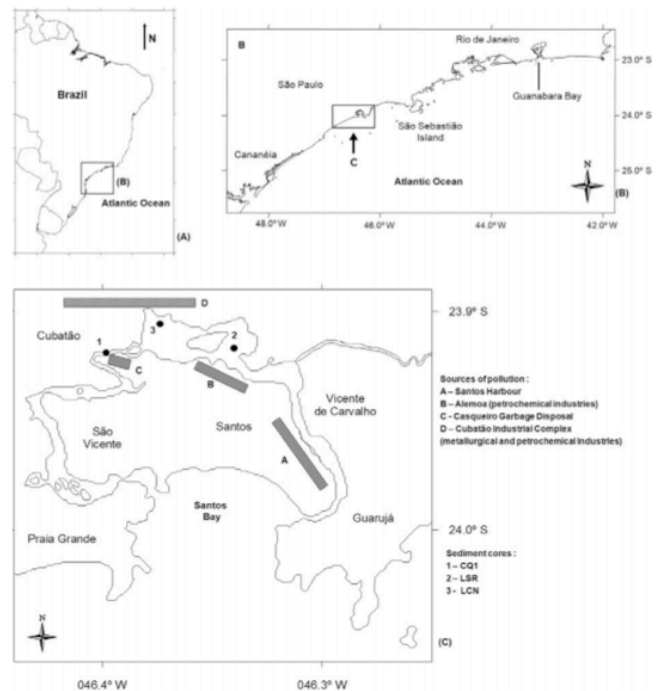


Fig. 1 - Map of the study area showing the sediment sampling sites (CQ1, LSR and LCN) in the Santos Estuary

Port of Santos is situated in the estuary of Santos, which is highly populated [3], therefore presenting many conflicts of operational and social nature.

The present article addresses monitoring small vessels movements within the port area by using Intelligent Transportation Systems (ITS), focusing on Port of Santos given his size and operational relevance to cargo distribution in Latin America.

This paper is divided in 6 sections. Section I presents an introduction and the article objective. Section II section presents aspects of vessels security and the necessity of effective vessel identification system at Port areas. Section III focuses on the dangers of small vessels not being monitored within the estuary area, exposing the objective of this study. Section IV presents the proposed approach using the Intelligent Transportation Systems (ITS), which is detailed over section V, that describes the proposed model. Section VI presents the conclusions.

II. ASPECTS OF VESSELS SECURITY

Being the sea/land interface and critical nodal points, ports security is crucial to ensure the smoothness and efficiency of supplies chains increasingly complex [4]. In this regard, vulnerabilities to potential threats are often high within such nodes due to the presence of numerous stakeholders and rather complex interactions among themselves) [5].

Unauthorized approach for criminal purposes may occur on high seas, in anchoring point or even in the ship dock. At Santos estuary, seaborne attacks occur with the use of small speedy boats operated by armed individuals seeking to steal transported goods and personal belongings of the crew. Table 1 presents the number of boats attacks in Brazil and in the world from 2008 until the first quarter of 2011.

Table 1 - Boats attacks in Brazil and in the world from 2008 until 1st quarter 2011 (Source: IMB/International Maritime Bureau)

YEAR	Attacks in Brazil	World
2008	1	293
2009	5	406
2010	9	445
2011	1*	439

*1st quarter 2011

In the case of merchant vessels, the guidelines are for the civilians (passengers and crews members) to report the occurrence immediately by radio and take refuge in their cabins, avoiding confrontation with the invaders, in order to prevent personal injury (or even death) and limit losses to material goods.

The event will be subject to investigation and verification by the competent authority and eventually by interested stakeholders, such as an insurance company, if the shipping company contracted it. In this case the cargo and eventually subtracted goods will be object of repair measures by insurance companies.

When anchored on the estuary, but not at the port, the vessel is more willing to suffer from such events, given its

relative distance from the mainland, therefore the difficulty to mobilize rescue at the sea. That is why air support near the coast is an important aid to combat and avoid it.

The estuarine area of the port of Santos has always been considered a risk, between other causes, because of boats attacks. In current times, the effective action of the Federal Police to combat this type of criminal act resulted in the rout of two local gangs. In the last two years there have not been reported robberies on board ships in the complex. Unfortunately, still occur attacks on fishing boats and land banking facilities near to shore, by leaking vessels.

The use of effective vessel identification systems that allow monitoring of its movement thus becomes an important element of control and identification of vessels, promoting increased security of persons and property, hindering the criminal actions. The annual report of the International Maritime Bureau of the International Chamber of Commerce informed that, in 2013, there was a 40% reduction in pirate attacks.

III. VESSELS AND ITS DANGERS ON THE ESTUARY AREA

Port operations emphasize the large vessels, with ever increasing gross weight allowing scale economy, with higher productivity and cost savings. These vessels are, in overwhelming majority, ships built and equipped to the various types of cargo, including containers, dry and liquid bulk, general cargo and special cargo.

However, the aquatic modal, besides the ships have a lot of types of vessels and boats that play auxiliary roles to port operations, moving in ports and adjacent estuarine areas. Besides these, other vessels/boats for people transport and/or recreation yachts also circulate by these water and harbor areas. Despite all the existing surveillance is easy to see the passage of boats and yachts in open exhibition, in flagrant disregard of legal restrictions.

The vessels also constitute an environmental issue, as "the use of motorized boats in estuarine and coastal areas can result in the emission and exhaust gases, loss of fuel and lubricant for the water environment, direct contact with propellers, generating ripples and turbulence for propulsion and noise emissions and odors, which in turn can have multiple effects on the environment and on the development of other recreational activities (windsurfing, kayaking, swimming, snorkeling, bird watching etc.) and commercial systems (fishing, aquaculture etc.).

Among these striking effects, we highlight the continuous suspension of sediments, contamination of air, water and sediment, and disturbance of fauna and aquatic flora associated with these systems, and the erosion of margins." [6]

Monitoring allows checking whether obliged conditions have been observed. In other words, the control of the displacement of vessels lets one check the routes and the speed of this displacement. Given that, it allows authorities to have a better control over vessels (large or small) movements, preventing hazardous situations for people, goods and environment.

This article addresses the monitoring of these smaller

vessels movements within the port area, considering only those endowed with some sort of mechanical propulsion, within specific requirements.

IV. PROPOSED SOLUTION

The focus of this study was to propose a new process using an electronic device based on RFID technology to identify the BOAT/BOARD/ETC and a smartphone application to track in real time - each 60 seconds - the position of the user.

The proposed solution uses the concept of issuing a RFID HF NFC compatible tag [Fig. 2], with a QR-CODE [fig.3] containing the same identification for each BOAT/BOARD/ETC. This tag can be bought in the market, allowing several suppliers, and the user is responsible for the identification.

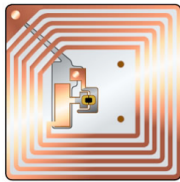


Fig. 2 - Example of a tag RFID
Source: <http://www2.ministries-online.org/biometrics/rfidchip2.html>



Fig. 3 - Example of QR CODE

Before starting the journey/use of the BOAT/BOARD/ETC, the user need to install a smartphone app thar will collect the RFID identification or capture the QR CODE using the camera.

The app will ask for user basic informations, such as social security number, sex, age and will start to collect the GPS data each 60 seconds and transmit the data to the cloud monitoring software, using 3G cellular networks.



Fig. 4 - Example of a mobile device that will be used in the field.

Some mobile devices [fig.4] need to be protected with special cases in order to have contact with water.

The whole process of communication between the mobile application and the backoffice is initiated by the mobile application.

Once stored in the backoffice, other players can monitor the position of the user and anticipate some potential risks.

Fig. 5 presents the proposed model.

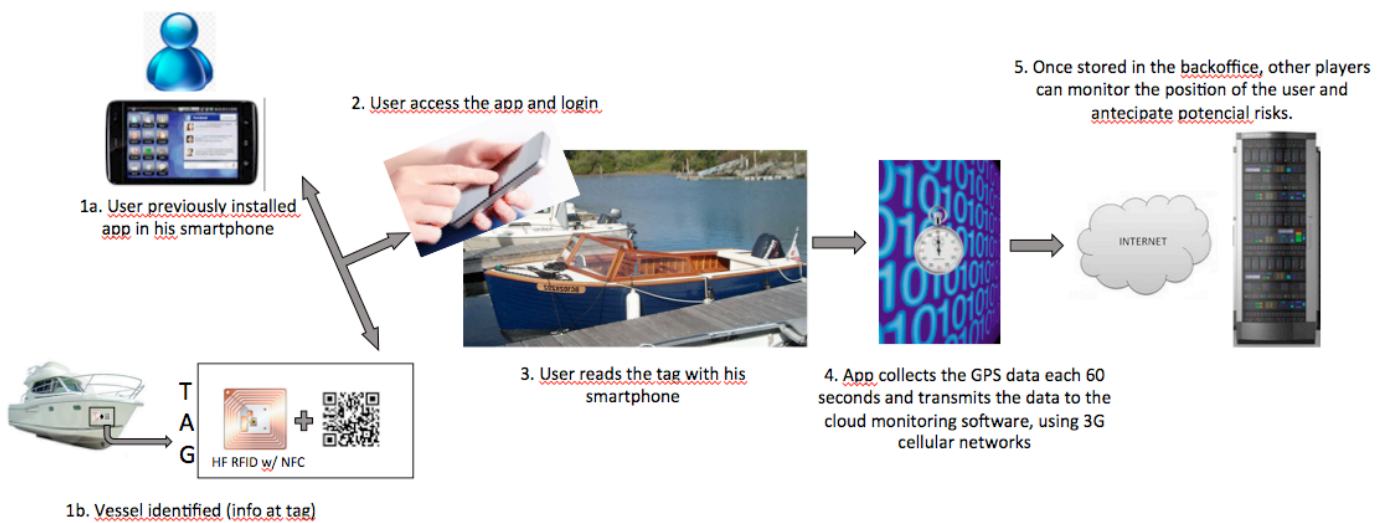


Fig. 5 - Proposed model

V. CONCLUSION

This work has a major operational and social interest, since many of these vessels carry large number of passengers, so they are susceptible of suffering hazardous consequences for failure to comply with relevant legislation.

It is important to monitor small vessel, specially the ones with some sort of mechanical propulsion, within specific requirements, when they share space with big vessels, such as the ones that transport containers and large amount of people (v.g. cruise ships). This sharing can cause major accidents, to people, cargos and, it must be consider, the environment.

Given this scenario, the present work presents a solution based on RFID technology to identify the vessel, in combination with a QR CODE, that will be readable by an app, installed in a smartphone. When the user uses his smartphone (with the app) to read the identification code (QR CODE or tag RFID), he will link the vessel to a user. By capturing the GPS data it will be possible to monitor the vessel, therefore, if the authorities have access to them they can have the necessary control to give effectiveness to the safety and security of the estuary.

It is necessary to make a pilot project of the app to analyze its real effects over this scenario and how the users and authorities will react to this reality.

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