Border Alert System for Fisherman with Boat Speedometer Using RSSI

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Abstract – This work presents a low power outdoor localization system that implements a power management technique in order to control the wakeup and sleep of the different modules in the system. Through this technique, the system achieves 6.7 µA in sleep mode. A new weighted least mean squares solution algorithm that is based on received signal strength indicator (RSSI) measurements is introduced. Early experimentation demonstrated that the low bandwidth of BLE signals compared to WiFi is the cause of significant measurement error when coupled with the use of three BLE advertising channels. The physics underlying this behavior is verified in simulation. The proposed system is not only capable of obstacle avoidance but also of path planning in complex environments which include fast moving obstacles. Results obtained on real sonar data are shown and discussed. Possible applications to sonar serving and real-time motion Estimation are also discussed.

Index Terms – RSSI, Border Alert, Fisherman, Boat Speedometer.

1. INTRODUCTION

Localization and safe evacuation of passengers in large ships during emergency is a growing and important need recently in the maritime industry. Through the Lynceus2Market project [1], it is aimed to develop an overboard localization system that can determine the position of passengers in case they fell overboard the ship into the sea. Through active reflector tags, which will be integrated within the passengers life jackets, passengers' positions can be determined by an unmanned aerial vehicle (UAV) equipped with global positioning system (GPS) surveying the area around the ship.

RSSI= Pr = Pt × ($\lambda\ 4\pi d$)

FIG: Microprocessor board bottom view with Zigbee.

The active reflector tags will use 24 GHz switched injection locked oscillator (SILO) for high resolution localization and it will also incorporate 868 MHz Zigbee transceivers for long-distance communications, which is up to 8 km in an outdoor line of sight scenario with an output transmit power of 14 dBm. The 868 MHz Zigbee will also provide RSSI which can be used to implement a less-accurate localization system for far away passengers which are not in the range of the SILO radar. The advantage of RSSI localization is that it is nearly implemented in all receivers, so it does not require dedicated hardware. Despite its low accuracy as it can suffer greatly from multipath interferences and noise, it will still have fair accuracy if it is deployed outdoors where no strong multipath interference is present. The automated detection and classification of maritime traffic is a challenging problem and is of great importance to many organizations. For marine protected areas (MPAs), an automated boat detection system could alert authorities of vessel traffic. However, in some MPAs commercial snorkeling and diving boats are authorized while fishing vessels are not. For this reason, a classification system is needed to discriminate these different types of boats. The need for similar systems arises in the monitoring of harbor traffic for national security. There are many different methods for boat detection, examples including radar, electro-optic (EO) and infrared (IR) cameras, and both active and passive sonar. Active sonar and radar provide little additional information beyond detection. Radar and optical methods are limited by line of sight for detection, and optical systems can be obscured by rain, fog, or may require daylight. Active sonar can be used for detection of quiet targets, but the high level of reverberation in shallow water environments.

2. RELATED WORK

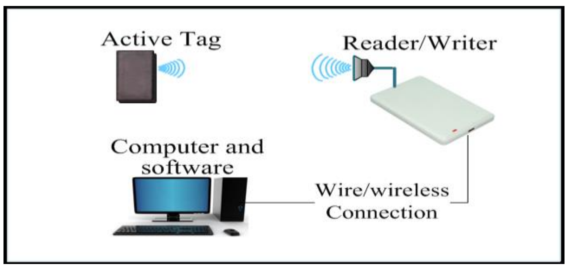
A. Ble Beacon

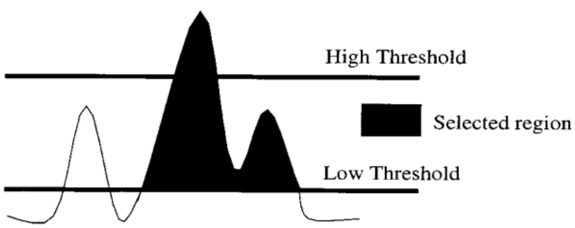
A BLE beacon (set to 20Hz advertising rate) and WiFi access point were placed at the far end of a 45 metre corridor (see Figure 10) and two smartphones (an iPhone and an Android-based Samsung S4) were mounted to a pedestrian who walked away from the devices at a slow pace, and then turned around and slowly walked back. BLE data were logged with both devices; WiFi could only be logged using the S4. The WiFi data and iPhone BLE data is shown below in Figure 6. As expected from the previous analysis, the WiFi data exhibits lower apparent measurement error than the BLE data as it provides great resilience to fast fading in environments of typical indoor dimensions.

B.Feature Extraction

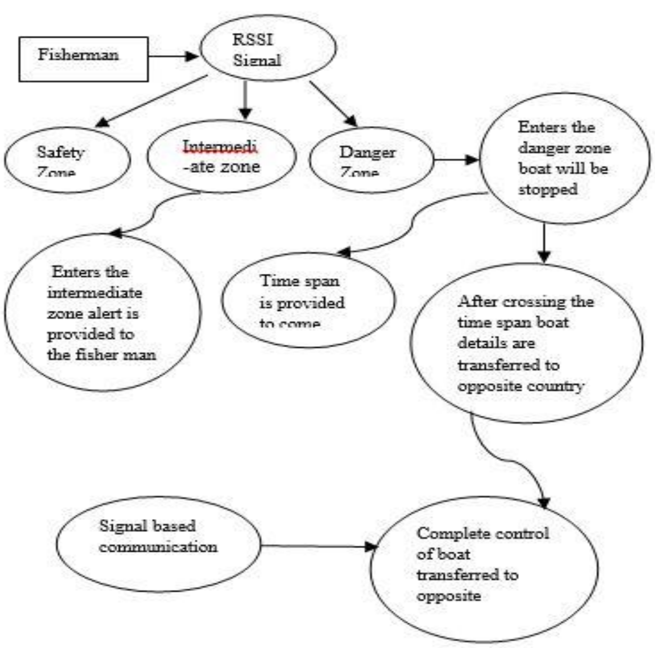
Once the image has been segmented, potential obstacles and their features (position, moments, and area) are computed. These features will be used later to discard false alarms and track the obstacles and the vehicle.

- Position in the image (the position is calculated as the centroid of the object);
- Area of the object in pixels
- Perimeter of the object in pixels





3. SYSTEM ARCHITECTURE



- Target trajectories will appear straighter than the tracks presented here, and the wake orientations will be consistent

4. SYSTEM ANALYSIS

1. RSSI based embedded hardware fabrication

Received Signal Strength Indicator (RSSI) is a measure of the power present in a received radio signal. RSSI is usually invisible to a user of a receiving device. However, because signal strength can vary greatly and affect functionality in, IEEE 802.11 devices often make the measurement available to users. It is a measure of the power level that a RF client device is receiving from an, for example. RSSI is the relative signal strength in a wireless environment and can be measured in any unit of power. It is often expressed in decibels (db), or as percentage values between1-100, and can be either a negative, or a positive value.

2. Trizonal implementation

In this module implement the three zones, that is safety zone, intermediate zone and danger zone. Ultrasonic sensors are based on measuring the properties of sound waves with frequency above the human audible range. They are based on three physical principles: time of flight, the Doppler effect, and the attenuation of sound waves. Ultrasonic sensors are non-intrusive in that they do not require physical contact with their target, and can detect certain clear or shiny targets otherwise obscured to some vision-based sensors. On the other hand, their measurements are very sensitive to temperature and to the angle of the target.

3. Control System

In this module, if they didn’t respond to alert and move their boats back to the safe zone, the boat’s control comes under control room of foreign port through ZigBee and fishermen’s manual control is disabled. Through ZigBee, the boat shall be operated by control room. Using this control technique, we can enquire if any illegal transportation is carried out. This technique helps fishermen to sail in safe zone without getting into trouble. In addition to this Ultrasonic sensor is used to help fishermen to find any obstacle on the way. If in case of any problem, the fisherman can also send an emergency message to the control room and so that the coast guard can reach out for them.

4. Obstacle detection using ultrasonic sensor

In this module, we can design and implementation of detect the obstacles. Ultrasonic sensors are based on measuring the properties of sound waves with frequency above the human audible range. They are based on three physical principles: time of flight, the Doppler Effect, and the attenuation of sound waves. Ultrasonic sensors are non-intrusive in that they do not require physical contact with their target, and can detect certain clear or shiny targets otherwise obscured to some vision-based sensors. On the other hand, their measurements are very sensitive to temperature and to the angle of the target.

5. Security alert

In this module, a buzzer alert will be given to the fishermen if the boat crosses the intermediate zone and danger zone. If the boat crosses the danger zone, the boat will be stopped and automatically gives buzzer alert. A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows.

6. Tracking Update

Once the data association has been applied, we can update the tracking. Three cases are then possible:

• There is a new observation matching the predicted position.

- ➢ The Kalman filter recursion is applied, a new state

• No new observation matches the prediction. The obstacle prediction is updated using the Kalman filter internal values which are not updated. If no match is found between the observations and a given tracked object on a predefined number of frames, the tracked object is discarded as a false alarm.

• An observation is not associated with any tracked object, a new object is created and its corresponding Kalman filter.

5. CONCLUSION AND FUTURE WORK

In this work, a low power RSSI outdoor localization system was built using Zigbee-868 modules controlled by an Atmega-324A microcontroller. The proposed power management technique decreased the current consumption from 30 mA in active mode to 6.7 μA in sleep mode. A weighted LMS solution is proposed for the positioning algorithm. The new weighted LMS solution produces RMS error reduction by over 50% compared to the conventional unweighted solution. Future work will include measurements conditions with larger distance scenarios. Also, the effect of weather on measured RSSI is to be investigated and formulated.

The position and heading given by the inertial navigation system are available, enabling benchmarking our results. The inertial sensors cannot take currents into account leading to uncertainties in the position while the heading remains accurate. We have used the heading values as a benchmark for our tracking. Assuming the objects are still, the tracking in fact detects.

Motion of the vehicle with respect to the seabed. Estimating the rotation of the objects between frames in the image yields an estimation of the vehicle rotation in the world reference frame.

Therefore, we can compare the readings of the INS heading difference between two frames and the corresponding estimated heading difference using the tracking.

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