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Deep Sea Fishermen Patrol System for Coastal Intruder Positioning and Inshore Fishery Control

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Abstract

In this paper proposes and implements a deep sea fishermen patrol system for coastal intruder positioning and inshore fishery control. To alert the coastguard when an intruder or poacher is found within the protected sea waters using the help of fishermen community. The project also warns and prevents the fishermen in not crossing the national sea border. An innovative device is therefore used to alert the coastguard when an intruder or poacher is found within the protected sea waters using an innovative technology seeking the help of fishermen community.

Keywords: In this paper, a mechanism is based on GSM, ARM Cortex- Mo Microcontroller and MEMS compass module.

Introduction

Wireless sensor network is composed of many sensor nodes that have abilities of wireless communications. Sensor nodes can sense data or transfer information. When a node senses some data, it can transfer them into the data collecting center with some routing path mechanism. In wireless sensor networks, it is helpful to data transferring when we obtain the locations of many of the sensor nodes and execute that target checking accurately. Localization of sensor nodes is thus an important issue in the study of wireless sensor networks (WSNs), since location-awareness is a key feature of future-generation networks, enabling a large number of pervasive applications. Existing work finds that higher localization accuracy can be achieved if beacons are placed in a convex hull around the network. Placing additional beacons in the center of the network is also helpful. Many localization algorithms are proposed and it is common that existing localization algorithms are based on the trilateral method. Trilateration, as a basic building block of many existing localization approaches, often wrongly recognizes localizable graphs as non-localizable. The theory of graph rigidity in 2D has been relatively well understood. For example, there is a combinatorial condition, the Laman condition, to characterize graphs that are generically rigid. There is also an efficient algorithm, the pebble game to test whether a graph is generically rigid in time O(n^2).Similarly, both a combinatorial characterization of globally rigid graphs and polynomial algorithms for testing such graphs are known. wireless networks are ubiquitous and utilized for a wide range of applications, and for many applications it is valuable to know the locations of nodes. In sensor network deployments, for example, for environmental monitoring, sensor data needs to be tagged with sensor location. Cost and power restrictions, however, often prevent the use of satellite based systems such as the global position system (GPS) to locate the nodes. Mobile ad hoc networks (MANETS) can be deployed for providing Communication to fire fighters in building or to miners in underground mines. In both applications Personnel safety is enhanced by tracking their locations. The use of GPS, however, is not possible, since it is not available in these environments. A natural solution for these examples is to use the wireless network that is being used for communication, for localization and tracking as well. Accurate network localization is based on determining the range between nodes, usually estimated based on the measurement of the received signal strength (RSS), time of arrival (TOA), or time difference of arrival (TDOA) . In conventional localization a network will contain nodes with known locations, called anchor nodes, and the position of a mobile node is determined if the range can be estimated from it to at least three anchor nodes (for two dimensional (2-D) positioning). In complex propagation environments, such as within buildings, the propagation range of radio signals is short relative to the area to be covered due to high path loss exponent and regulatory restrictions on transmit power it is not possible to significantly increase coverage, unless a large number of anchor nodes can be deployed, which is often impractical. For tracking fire fighters it is not possible to survey the location of interior anchor node sprier to fire fighters entering the building. For environmental sensor networks, requiring a large number of nodes with GPS increases the deployment cost.

Related Work

A number of publications have addressed the problem of cooperative localization, i.e., determining the positions of the mobile nodes at a particular time given the measurement matrix Z(k). For example, [23] proposed an iterative multilateration algorithm in which a node that is connected to at least three anchor nodes computes its location, and serves as a pseudo anchor to any of its neighboring nodes. In the TERRAIN algorithm [22] each anchor node propagates its own local coordinate system (LCS) assuming it is located at the origin, and a mobile node that can obtain its location in a particular anchor's LCS calculates its range to that anchor. When a mobile node has calculated the range to three or more anchors, it uses multilateration to calculate its location in the global coordinate system. The Euclidean propagation algorithm [18] uses geometric calculations to find the actual distance of a node from anchors and propagates it. Performance of these algorithms is satisfactory only if the fraction of the anchors is high. The DV-distance and N-hop bounding box algorithms use distance vector routing for propagating the anchor locations and they do not require a high density of anchor nodes. Whereas the DV-distance algorithm uses triangulation to estimate the node locations, the N-hop algorithm uses a bounding box based on the multichip distances. The approach of [11] is to represent cooperative localization as a graphical model and then use nonparametric belief propagation to infer the node locations. Following the graphical modeling approach of [11], in [30] cooperative localization is modeled using a factor graph and the node locations are obtained by executing the sum product algorithm. The resulting algorithm is called SPAWN and it can handle temporal tracking of the mobile nodes as well. Whereas the SPAWN algorithm can provide near optimal tracking performance, a direct implementation of the algorithms' not practical in resource constrained wireless networks. This is because the SPAWN algorithm propagates the probability distribution of the locations of the mobile nodes through time and assumes that samples of the distribution are exchanged between nodes. Exchanging samples of the distribution would require high data rate communication links between nodes. Further, incorporating the sampled position distribution in state estimation effectively requires convolution between the location distribution and the range error distribution, which is a computationally intensive task. Although it is possible to transmit a summary of the node distribution between neighbors, how the uncertainty in the summary information can be handled by the neighboring nodes is not discussed in [30].An alternate approach for cooperative tracking is to estimate the locations of the mobiles nodes at every time step using any one of the multichip localization algorithms. The estimated locations of the nodes can then be used as a composite measurement within a Kalman filter to estimate the states. The downside of such a simple algorithm is that multichip localization algorithms are based on network-wide communication, requiring significant communication overhead. It is preferable in wireless networks to restrict the communication to the local neighborhood.

Bayesian Cooperative Tracking

The algorithm that we propose in this paper views cooperative tracking from a conventional target tracking point of view, where the state estimation is considered as a Bayesian inference on the state-space model defined by state and measurement equations. The optimal Bayesian inference to the state estimation is the following recursion [1]:$p(\mathbf{x}i(k)|\mathbf{Z}i(k)) = p(\mathbf{z}i(k)|\mathbf{x}i(k))p(\mathbf{x}i(k)|\mathbf{Z}i(k-1)) \times \_$
$p(\mathbf{x}i(k)|\mathbf{x}i(k-1))p(\mathbf{x}i(k-1)|\mathbf{Z}i(k-1))d\mathbf{x}i(k-1)$
where $\mathbf{Z}i(k)$ denotes all the measurements of node i up to and including that at time k, $p(\mathbf{x}i(k-1)|\mathbf{Z}i(k-1))$ is the posterior density at time $k-1$, which is known from the previous recursions, and prior density $p(\mathbf{x}i(k)|\mathbf{x}i(k-1))$ and the likelihood $p(\mathbf{z}i(k)|\mathbf{x}i(k))$ are obtained from the state (2) and measurement (1) models, respectively. In conventional target tracking, for example, with radar or sonar, an important and challenging issue is that the association between the targets and measurements is unknown. This is referred to as the data association problem and must be handled within the tracking algorithm [4]. Even when the association is known the recursion in (5) is only conceptual and cannot be determined analytically, except in some special cases [1]. Therefore, suboptimal filters are required for the node state estimation depending on the characteristics of the state-space model as discussed later. Unlike conventional tracking system, in wireless networks ,the nodes have an identifier associated with their transmission, for example the MAC (medium access control) address, and hence, the association between the nodes and measurements is known. Further, in wireless networks, the range measurements between

the two mobile nodes depended on their locations and this dependency will introduce dependency between the posterior distribution of the states of two mobile nodes. As a result the Bayesian recursion in (5) an approximation.

An Overview of the FACT Algorithm

The first step of the FACT algorithm is to initialize the states of the mobile nodes from the first set of measurements Z(1). As mentioned previously, it is possible that most or all of the mobile nodes are unable to measure the range to three or more anchors, requiring a multi hop localization algorithm to obtain their positions. We have found that the DV-distance algorithm with a subsequent refinement step is computationally efficient, easily distributable, and provides good initial position estimates. This is used for initial positioning in our algorithm, but not for subsequent tracking as it has a much higher communication overhead. A node that is not within the radio range of at least three other nodes will not receive a position estimate from the DV-distance algorithm. Any such node is not initialized at $k = 1$.In the subsequent time steps each node broadcasts its predicted position and covariance, which are received by all nodes that are within the node's radio range. This is in contrast to the SPAWN algorithm where samples of the node position distribution are passed to the neighbors, which would require a high data rate link between nodes. For example, for 2-D tracking, if 500 samples are passed to neighbors, then1000 values need to be exchanged between the mobile nodes. For the FACT algorithm, however, only six values are required to be exchanged between nodes (two for position and four for covariance).Note that the position exchange between the nodes is in addition to the communication required for the TOA ranging. Given only a few values are transmitted by the FACT algorithm, these values may be piggy-backed in the TOA measurement packets, which may not be possible for the SPAWN algorithm. In any case the packet size of the FACT algorithm is significantly smaller. Mobile nodes use the range measurements to their neighbors to update their state linearization approach to account for the uncertainty in the estimated location. In practical systems range using a nonlinear filtering algorithm. This update is performed at the end of a TDMA frame, when all possible measurements between this nodes and its neighbors are available.1 If a neighbor is an anchor, then its location is known accurately, however, if a neighbor is a mobile node only an estimate of its location is available. We propose a simple measurements will contain outliers, which can severely degrade the system performance. For example, indoor ranging systems often exhibit outliers due to multipath and NLoS, and signal processing artifacts. Outlier range measurements are detected using validation gating in the FACT algorithm. Nodes may enter or leave the area of operation through physical movement or signal loss. A track maintenance stage detects new tracks and deletes the tracks that are lost. It also attempts to restart the tracks that are lost. Intermittent loss of range measurements for a short period of time is handled using prediction without restarting a track.

In the following subsections details of various stages of the FACT algorithm are provided.

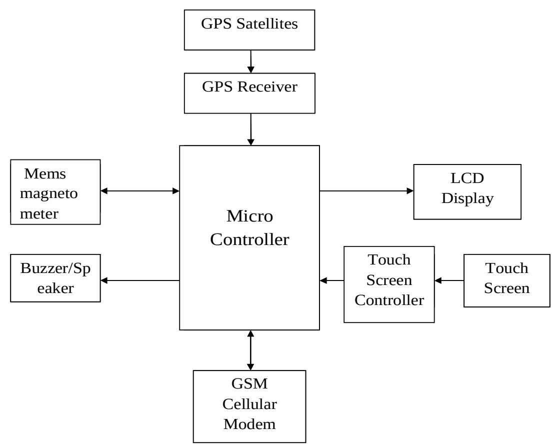
Initialization using DV-distance Algorithm

The DV-distance algorithm was one of the first techniques presented for cooperative localization. In this algorithm the anchor nodes propagate their positions throughout the network using flooding, which also allows the nodes to find the multihop distances to the anchors. Each anchor can calculate the distances to other anchors using their actual locations and also have estimates for these distances in the form of multihop distances. Since the multihop distance is greater than the true distance, each anchor calculates a correction factor, which when multiplied by the multihop distance will better approximate the true distance. Anchor nodes propagate the correction factor they calculated throughout the network using a second network flooding. Mobile nodes will retain one of the correction factors and use this and the multichip distance to the anchors to estimate the range to the anchors. A node that has range estimates to three or more anchors obtains its position using multilateration, which is solved using the iterative least squares (ILS) algorithm. The position estimates obtained using the DV-distance algorithm are often coarse and they can be improved using a refinement step [22]. In this step mobile nodes use only the directly measured ranges to their neighbors. Assuming that the DV-distance algorithm estimated positions of its neighbors as their exact positions, a mobile node updates its position using the LS formulation. Then nodes exchange their updated positions with the neighbors and all the nodes update their position assuming the current positions of its neighbors as their exact positions. This process is repeated until the improvement in the updated node position is less than a predefined threshold or when the number of iterations exceeds a predefined value. The initial state of mobile node i is set to **x**i(1) =[ˆxi, ˆyi, 0, 0]T, where (ˆxi, ˆyi) is the position estimate of node i returned by the DV-distance algorithm. The covariance matrix corresponding to the initial state is given by Pi(1) =diag(Ppi (1), V 2maxI2/3), where Ppi (1) is the (literalized) covariance obtained from the ILS algorithm, I2 is a two dimensional identity matrix, and Vmax is the maximum speed of the node.

Experimental Result

This project plays a major role in all sea areas. ARM Cortex- M0 microcontroller is used in this project; it was developed to control the peripheral devices. Upon sighting an intruder or poacher, the fishermen enters the distance and direction of intrusion using the GUI interface displayed on the TFT Touch screen Display. The intruder position is calculated by combining this data with the known position of the fishermen device using the integrated GPS receiver. The resulting intrusion location (approximate) will be sent to the nearest coastguard station via GSM communication. The coastguard could then be able to dispatch a patrol boat to intercept the intruder. The device warns the fishermen (beep and vibrate) when they approach near the national sea border and controls them to trawl (go fishing) within the correct region safely. This involves monitoring boat location using GPS and the boat direction using a Digital MEMS Compass module. If they cross the sea border it will send a notification SMS using GSM to the coastguard and fishermen authority. An innovative device is therefore used to alert the coastguard when an intruder or poacher is found within the protected sea waters using an innovative technology seeking the help of fishermen community. The project uses ARM Cortex M3 controller, which is the next generation 32 bit ARM processor for embedded applications based on ARMv7-M architecture, for the general architecture. The speciality of this ARM controller is Harvard architecture. The separate instruction and data buses allow parallel instruction fetching and data storage. Some of the other features of ARM controller are listed belowIntegrated bus matrix

- Configurable nested vectored interrupt controller (NVIC).
- Advanced debug and trace components (DAP, SWV, ETM).
- Wakeup Interrupt Controller (WIC)
- Memory Protection Unit (MPU)
- High Performance RISC CPU.
- Greater performance efficiency, without increasing the frequency or power requirements.
- Low power consumption, enabling longer battery life.
- Improved code density, ensuring that code fits in even the smallest memory footprints.
- Providing easier programmability and debugging.
- Wide choice of development tools.
- Up to 42 General Purpose I/O (GPIO) pins with configurable pull-up/pull-down resistors.
- In addition, a configurable open-drain mode is supported on the
- LPC1100L and LPC1100XL series.
- GPIO pins can be used as edge and level sensitive interrupt sources.
- High-current output driver (20 mA) on one pin.
- High-current sink drivers (20 mA) on two I2C-bus pins in Fast-mode Plus (not onLPC1112FDH20/102).
- Four general purpose counter/timers with up to eight capture inputs and up to 13match outputs.
- Programmable WatchDog Timer (WDT) the LPC1100 series only.
- Programmable windowed WDT on the LPC1100L and LPC1100XL series only.



Over all block diagram

Power Supply

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

Transformer

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

Bridge Rectifier

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners. Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4. The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit. The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 v0lts, as result of the small voltage drop across the diode.

IC Voltage Regulation

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

GSM Wireless Modem

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between *them is* that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.As mentioned in earlier sections of this SMS tutorial, computers use AT commands to control modems. Both GSM modems and dial-up modems support a common set of standard AT commands. You can use a GSM modem just like a dial-up modem.

FAT32 File System with EFSL.

File Allocation Table (**FAT**) is the name of computer file architecture and a family of industry standard files systems utilizing it. The FAT file system is a legacy file system which is simple and robust. It offers good performance even in light-weight implementations, but cannot deliver the same performance, reliability and scalability as some modern file systems. It is however supported for compatibility reasons by virtually all existing operating systems for personal computers, and thus is a well-suited format for data exchange between computers and devices of almost any type and age from the early 1980s up to the present. Originally designed in the late 1970s for use on floppy disks, it was soon adapted and used almost universally on hard disks throughout the DOS and Windows 9x eras for two decades. With the introduction of more powerful computers and operating systems, and the development of more complex file systems for them, it is no longer the default file system for usage on hard drives by most modern desktop operating systems. Today, FAT file systems are still commonly found on floppy disks, solid-state memory cards, memory cards, and on many portable and embedded devices. It is also utilized in the boot stage of EFI-compliant computers. The name of the file system originates from the file system's prominent usage of an index table, the FAT, statically allocated at the time of formatting. The table contains entries for each cluster, a contiguous area of disk storage. Each entry contains either the number of the next cluster in the file, or else a marker indicating end of file, unused disk space, or special reserved areas of the disk. The root directory of the disk contains the number of the first cluster of each file in that directory; the operating system can then traverse the FAT table, looking up the cluster number of each successive part of the disk file as acluster chain until the end of the file is reached. In much the same way, sub-directories are implemented as special files containing the directory entries of their respective files. As disk drives have evolved, the maximum number of clusters has significantly increased, and so the number of bits used to identify each cluster has grown. The successive major versions of the FAT format are named after the number of table element bits: 12 (FAT12), 16 (FAT16), and 32 (FAT32). Each of these variants is still in use. The FAT standard has also been expanded in other ways while generally preserving backward compatibility with existing software.

Conclusion and Future Enhancement

In our project is whenever the fisherman reach to nearby border that time The device would also warn the fishermen (beep and vibrate) when they approach near the national sea border and controls them to trawl (go fishing) within the correct region safely. At the same time the fisherman identify an intruder or poacher, the device allows fishermen to calculate its exact location using the integrated GPS receiver, and radio the information to the nearest coastguard station via GSM communication. In Future if we are integrated to wireless camera and wireless communication means the camera capture the image of intruder boat and sent the image to monitoring unit through wireless communication.

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