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EFFICIENT RUDDER CONTROL MECHANISM FOR UNMANNED SHIP NAVIGATION

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ABSTRACT: The automatic steering of ship from one place to another along a planned track is a principle of track keeping problem. The heading of the ship must be in such a way that the distance from the desired (predefined) track should be minimum. The designing of an accurate track keeping controller is a challenging task, in which the desired heading angle is decided by the current position of the ship and the reference waypoint because ship and sea environment are cluttered and dynamic in nature.

LITERATURE SURVEY

Procedures for avoiding collisions at sea are defined in the International Maritime Organization's collision regulations (COLREGS), the rules of the road for marine navigation. They provide various guidelines about how to control the ship navigation effectively and efficiently.

The autonomous navigation of ship is gaining increasing attention due to difficulties in their manual navigation and control. The research reported in the literature generally uses methods based on modern control theory.

These methods, however require precise mathematical models of the dynamic behavior of the given marine vehicles, but it is complicated to decide the dynamics of water. Therefore, an approach using artificial intelligence and soft computing may be a promising choice as reported in the literature.

Ship collision avoidance is a complex problem. The degree of complexity depends on (weather and waterways traffic density) and endogenous (ship type, onboard technologies etc.) navigation influencing factors.

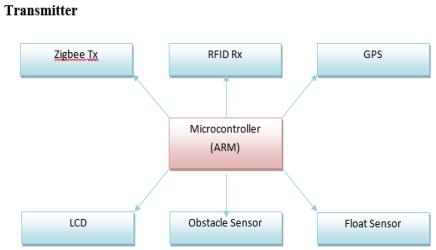
METHODOLOGY

In order to avoid the human errors, an autonomous navigator is installed on the ship. These navigators utilize the data logged from different sensors in data fusion systems to estimate the locations of obstacles such as submarine, boats, or other objects that are either dynamic or static on the water or the shore. Since information provided by the sensors is rapidly changing, the ship should be guided towards the target instantly.

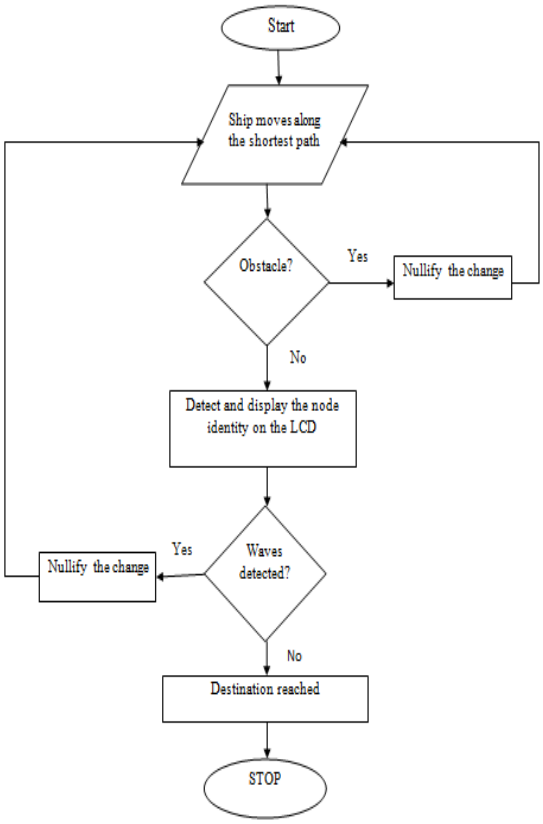
The collision avoidance algorithm has the ability to handle static and /or moving obstacles. The Neural expert rules will be designed deliberately under COLREG guidelines.

Adaptive neural network algorithm will give less computational time and provides collision avoidance and shortest path tracking for precise navigation.

BLOCK DIAGRAM



FLOW CHART



WORKING

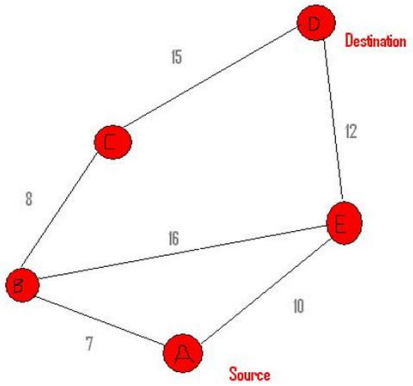
The project "Efficient rudder control mechanism of unmanned vehicle" deals with the efficient propagation and control of unmanned ship.

The heart of this working model is constantly controlled by LPC2148 ARM controller, to which all the external peripherals such as LCD display, DC motor, GPS module, RFID sensor, float switches are interfaced.

In our project we are placing nodes using RFID tags, the RFID reader is placed at the bottom of the ship so that it can read the RFID tags connected to the nodes. After reaching the node, the name of node will be displayed on the LCD along with the GPS coordinates. The LCD is interfaced with the ARM micro controller.

Obstacle sensor is connected to the ship, if any obstacle was detected in its path then it will turn in left or right direction and again nullify its direction change and reach the destination. IR sensor is used as obstacle sensor.

Float switch or float sensor are connected on both sides of the ship, if there are high tides or waves present, then the ship will move in opposite direction of the tides or waves, so that the ship will not get tilted , nullifies the change in direction and finally reaches the destination.



The above is the proposed path in our project, the nodes are connected to A, B, C , D and E. It means RFID tags are attached at A, B, C, D and E positions. Node A is taken as the source and D is taken as destination. When the ship starts moving from source (Node A), it will have two paths to reach the destination.

The two available paths to reach the destination if the source is considered as **'A'** are

1. A→B→C→D
2. A→E→D

These are the two available paths. But the first path is the longest path and the second is the shortest path. The ship will take **the available shortest path, i.e, the second path A→E→D**.

The location of the ship as it travels through the path AED, is sent to the pc. The .net and asp.net is used to convert the received data so that it will be suitable to pinpoint the ship location on google map.

LPC2148 CONTROLLER Features

In our project we use LPC2148 arm controller because it requires less power ,it can be programmed easily, it has two UART ports we can transmit and receive data can take place simultaneously. It has 64 pins that can be configured to work in many modes.

POWER SUPPLY

Variable voltage power supply is essential because we need different voltages for different applications. So it becomes impossible to use multiple fixed power supplies all the time. Also, this variable power supply circuit ensures the protection of other circuit parts from voltage fluctuations. This supply unit uses a LM3 17 voltage regulator IC. The rectified output from the full wave bridge rectifier is fed to a LM317 regulator IC. By changing the value of potentiometer used in this circuit, the output voltage can be controlled easily. Voltage can be varied from 1-12V.

DC MOTOR

We use DC motor in our project to run the fan that is attached to the rudder so that it controls the direction of the ship. Since the dc motor requires constant power to run ,we cannot use battery as the power source, so we use direct power supply to control the motors.

GPS module

We use GPS module to collect the exact location of the ship as it travels to the destination and it is interfaced to the external peripherals.

Zigbee Module

ZigBee devices can transmit data over long distances by passing data through a mesh network . ZigBee is typically used in low data rate applications that require long battery life.
Zigbee collects the information and sends to the Zigbee receiver that is connected to the pc so that we can map the values on the google map.

RFID: Radio-frequency identification (RFID READER AND TAGS)

RFID is the wireless use of electromagnetic fields to transfer data, for the purpose of automatically identifying and tracking tags attached to objects. We have used RFID reader to detect the nodes while the ship is moving, The nodes used are the passive RFID tags that contains information in it.

Obstacle sensor

The basic concept of IR (infrared) obstacle detection is to transmit the IR signal (radiation) in a direction and a signal is received at the IR receiver when the IR radiation bounces back from a surface of the object.

Float sensor

It is used to detect the level of liquids and other fluids and fluidized solids, including slurries, granular materials, and powders that exhibit an upper free surface. Float sensors are attached to both sides of the boat.

RESULT

The ship model that we have prepared is able to achieve the following criteria's:
1)shortest path
2)obstacle sensing and collision avoidance
3)high wave detection

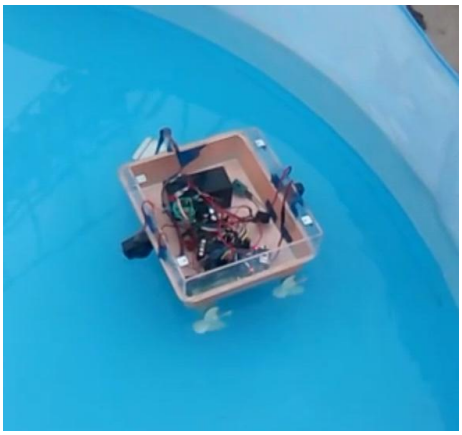


Fig: Working model of our project

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