4th International RoboBoat Competision

AUVSI Autonomous Surface Vehicle Journal Paper

(Diponegoro University Roboboat Team)

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Abstract

DiBoat 1.1 is boat that designed by RoboBoat Team from Diponegoro University. This boat using autonomous system to compete in the anual competition in the Virginia Beach by Assosiation Unmanned Vehicle Systems International (AUVSI) 2011. DiBoat 1.1 uses responsive doublehull mechanism with a thrust motor and a rudder tube and an integrated system for the controller, sensors, and electronic component.

In this 4th competition, have a primary mission to navigate the buoy track. And 4 element mission. The fourth competition presents a number of new navigation, object tracking, cognition. DiBoat 1.1 uses effective algorithm that using behaviour base systems. Our goal is to successfully complete all of the challenges posed by this year's competition.

Introduction

Autonomous vehicle have purpose to help human. The Autonomous Surface Vehicle (ASV) have main goal to build a autonomous watercraft robot . This ASV project is for international competition in Virginia Beach. This ASV project or DiBoat 1.1 uses a boat that have two hulls. Controller, various sensor and programs of DiBoat 1.1 to make this boat can navigate in autonomous. Additionaly, it possesses a radio control backup system in case the vehicle become lost, allowing it to be manually controlled back to base port.

Hardware design, for mechanic part, this boat uses catamaran system, so this boat can perform faster and more stably. From this design, probability of deck wetness can be discrease. This boat have one thrust motor and one rudder tube. The rudder tube help it to maneuver. For electronics, this boat have a various sensors, there are camera vision to color filtering and then this boat can differ the buoy colour , red, green, and yellow. Thermal array for temperature detection. Compas and gyroscope is used for yaw angle calculation. And GPS is used for tracking navigation.

Hardware Design

a. Mechanics Design

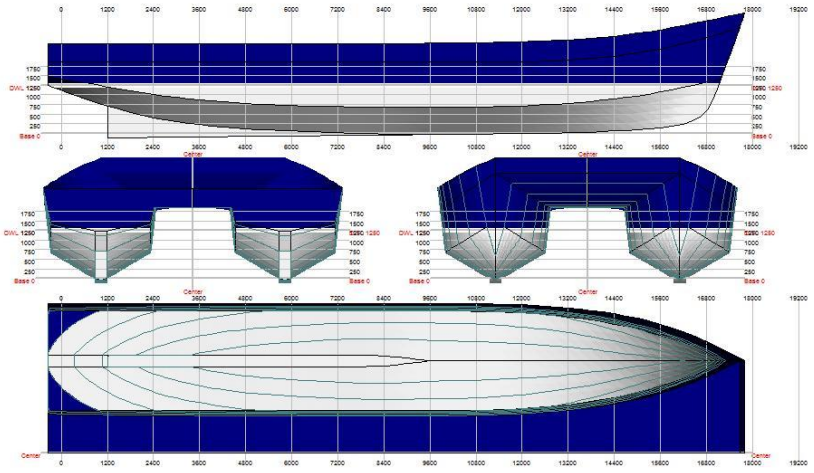

Fig.1 Design of catamaran boat with the scale

Catamaran system in DiBoat 1.1 uses demihull that is connected with bridging structure. So, the boat have a little hull water line and the boat more sensitive with the weight distribution. This boat have lenght 0,86 meters and width 0,50 meters, this combination is suitable choice for catamaran system.

Here, all of the governing equations and vectors are expressed in the Inertial Reference System (IRS) and for a Control Volume (CV) moving with an arbitrary speed of $m\ uv$. In order to capture the interface between two phases, a transport equation is implemented (Volume of Fluid-VoF Method) [2]:

$$\frac{d}{dt}\int_V \alpha \, dV + \int_A \alpha \vec{c} \cdot \vec{n} \, dA = 0$$

This design of Catamaran is researched and developed, because have more advantageus :

1. Shear Resistant of this catamaran is smaller because have value block Coeficient 0,38 and the bow of the boat needing a sharp entry point to move the rest of the hull through the water.
2. This Catamaran is classified as high craft boat.
3. 0,5 meters for the hull widht was chosen because increased of freeboard.
4. Space of deck catamaran more widht than monohull, so the location of equipment easily.

Fig.2 Brushless DC Motor

The chosen of propulsion is used Nosel of propeler. Now, what brushless DC motor will be chosen knowing that our propulsion system is FMS and the voltage is 500 KV.The design of this rudder is tube shape. The dimention of tube have 0,076 meters for diameters and 0,075 meter for lenght of rudder. The tube concep can be drag of boat for better maneuver.

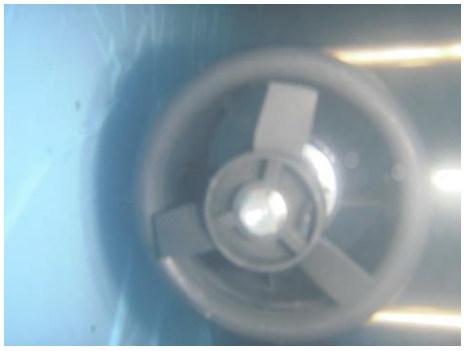

Fig.3 Propeller (in the water)

Fig. 4 Propeller

b. Electronics Design

Contect diagram of this system can be describe like this picture.

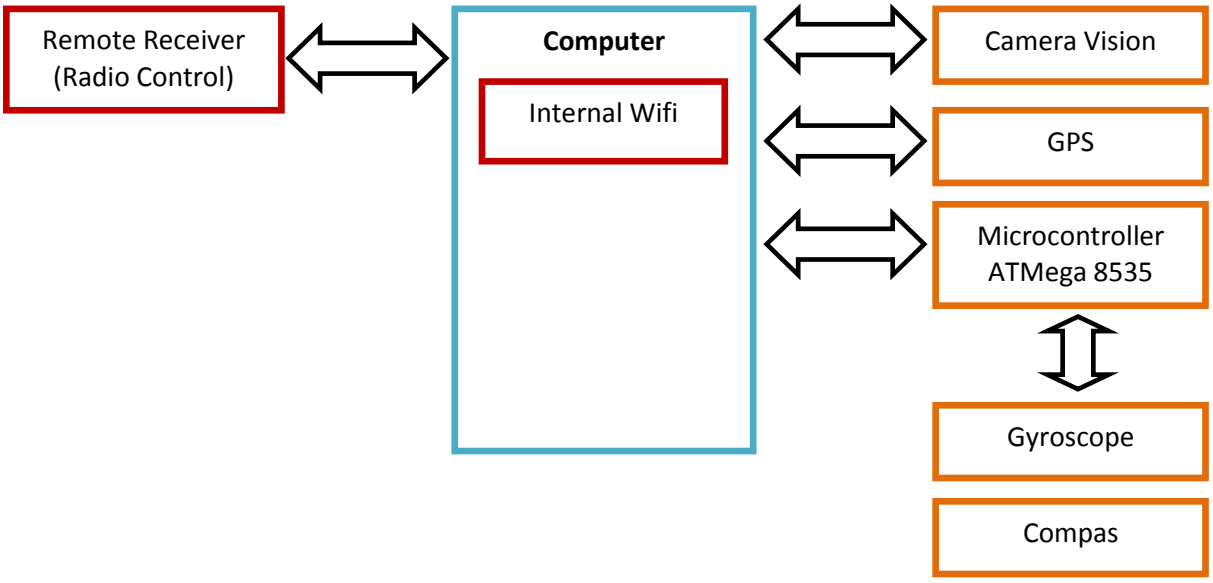

Fig.5 Contect diagram

Vision camera is used for object detecting from its colour. This colour filtering have purpose to differ the buoy colour and it's used for navigation system in the primary mission. By using Visual Studio 2008 from Microsoft, the colour filtering calculation is did. This design uses reference from AForge.Net. This figure is example of colour detecting.

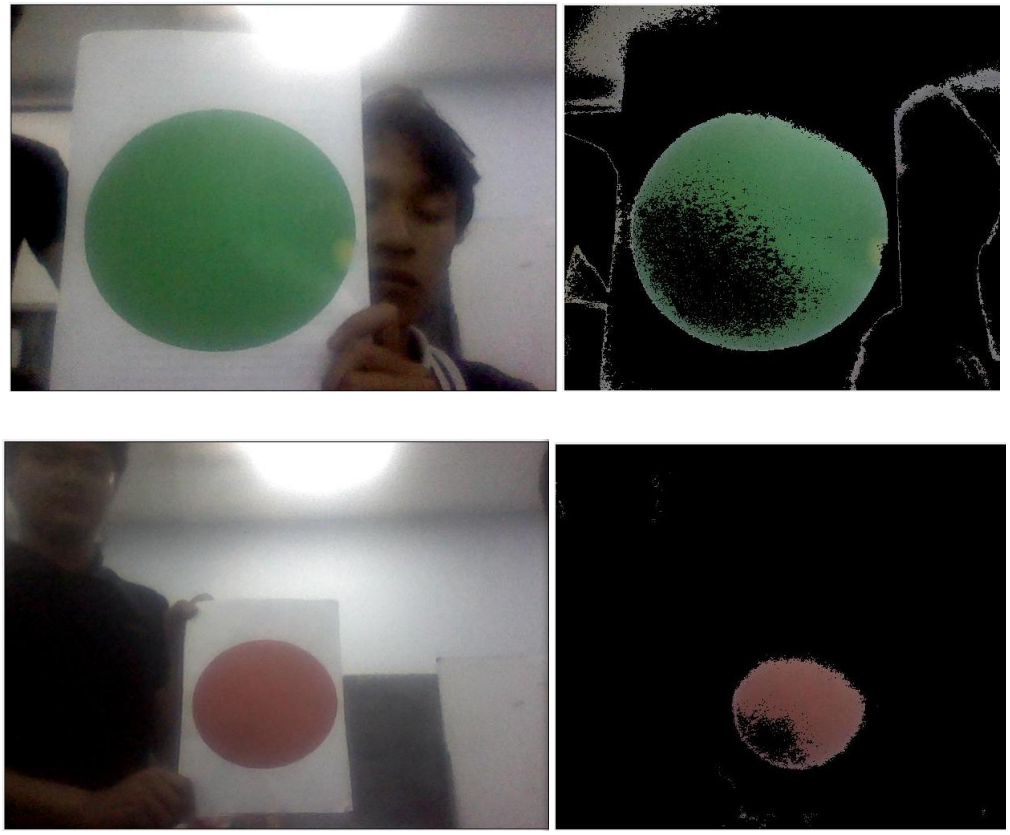

Fig.6 Colour detecting

Sensor compas is used for calculate the angle of boat to the earth magnetic field. And gyroscope is used for calculate angle of boat in the body fix frame. This angle information the boat can calculate the navigation behaviour action. For obtional mission, the boat must detect the temperature that is configure by commitee. And then the boat must send a data location from the output of GPS. Thermal array sensor (TPA) is used for detecting temperature for this mission.

Conclution

DiBoat 1.1 is autonomous surface vehicle designed and manufactured by Engineering students at Diponegoro University which assembled from various department such us, Naval Architecture, Electrical Engineering and Mechanical Engineering. Despite this competition having various challenge, we will to be completed to have a fully autonomous boat.

We have been tried to coporated each system, hull design, propulsion system, rudder system, vision and compass. We developed a product that will be reasonably competitive in

this year's ASV competition. But during this research was been did, there are problem on this system.This certainly shows that if more time was allotted, more thought could of gone into subsystems and a better engineered ASV boat could have been built

References

[1] "2011 Final Rules 4th International RoboBoat Competition," Associationfor Unmanned Vehicle Systems International.

[2] Jahanbakhsh, Ebrahim ; Panahi ,Roozbeh ; Saeed Seif ,Mohammad. "Catamaran Motion Simulation Based on Moving Grid Technique" *Journal of Marine Science and Technology, Vol. 17, No. 2, pp. 128-136 (2009)*