Journal of Engineering and Applied Sciences 13 (Special Issue 5): 4562-4565, 2018
ISSN: 1816-949X

River Steering System Using Sovereign Exterior Vessel

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Abstract: This study shows a route system for an Autonomous Surface Vessel (ASV) fit for moving in riverine situations. A continuous vision-based route framework is utilized for ASV to go along the waterway. The ASV is outfitted with propeller and rudder to control the speed and heading course, separately. Tireless stream of pictures are gotten by camera that mounted on ASV and sent to the base station over system continuously. A photo division computation in light of Hough transform strategy is completed for waterline area. The motivation behind utilizing Hough transform is to perform visual based route that track alongside the stream. Besides, a high accuracy GPS receiver is installed on the ASV to provide the latitude and longitude coordinates. Data logger system helps to save the data and important information for further analysis and processing. The optical stream calculation is executed to recognize and keep away from snag. The ASV's route, control and undertaking particular vision have been assessed through analyses with results introduced to exhibit its abilities.

Key words: Autonomous Surface Vessel (ASV), image segmentation, Hough transform, data logger, analyses, photo division

INTRODUCTION

Autonomous Surface Vessel (ASV) also known as Unmanned Surface Vehicle (USV) is a robotic boat that operates on the surface of the water. ASV is designed to traverse and explore unstructured and unknown environments sufficiently in order to construct a complete map. Autonomous river exploration is discussed by Jain *et al*. (2015). It additionally fulfills a testing assignment with least human impedance. Subsequently, the employments of ASV with nonappearance of human will decrease the hazard in hazardous circumstance because of flighty effects on the earth. Navigation of a small boat is explained by Santos *et al*. (2013).

Route framework is essential to enable ASV to explore to a particular area. Worldwide Positioning System (GPS) route method is broadly utilized as a part of ASV. Autonomous surface vehicle is described by Mattos *et al*. (2016). The locally available sensors generally contain GPS together with compass and Inertial Measurement Unit (IMU). The ASV equipped with GPS, compass and IMU increase the efficiency of navigation system. Perception for a river mapping robot is discussed by Chambers *et al.* (2011). However, it is challenging that ASV need to perform navigation on riverine environment due to complex and unstructured environment. Sometimes, the GPS signal may be loss or blocked by thick and high canopy. Stereo vision-based navigation for autonomous surface vessels is described by Huntsberger *et al*. (2011). Hence, vision-based navigation is another technique that can be used in ASV.

The principle target of this venture is to build up a calculation to play out a self-ruling route along the stream. A PC vision sensor direction framework is produced to find and guide the ASV to explore along the stream self-governingly and safety assessment of wind farm support vessels is discussed by Gopinath (2015). An ongoing route framework requires programming coordination, equipment interfacing, control framework and apply autonomy. Isolation, optimization and extraction of microbial pigments from marine is described by Muthezhilan *et al*. (2014). The control system existed in all hardware and software such as heading control, network communication and signal conditioning. One of the computer vision fields is image analysis which involves processing an image, information extraction and statistical analysis. Shrimp shell wastes using immobilized marine associated pseudomonad is discussed by Bhagat *et al*. (2015).

MATERIALS AND METHODS

In this approach, ASV is expected to navigate along the river by keeping the distance between ASV and shoreline. In order to keep ASV travelled along the edge of shoreline, the ASV heading is controlled by comparing

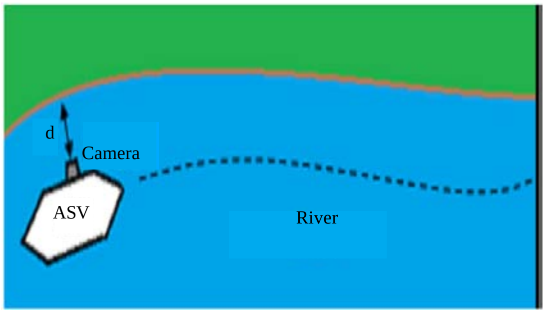

Fig. 1: Illustration of ASV navigation on river

the di, desired distance. As shown in Fig. 1, d is distance of riverbank to port of the ASV. The position of riverbank is detected as straight line by lateral camera. It is computed by pixels to control the heading of ASV. The condition to control the position or orientation of ASV:

- If d>di, then the orientation of ASV turned to left
- If d<di, then the orientation of ASV turned to right
- If d = di, then the ASV travelled along the edge of shoreline

There are two parts in the power support system used in ASV. The first part is two rechargeable batteries which are used for devices that require high voltage. The second part is one 20000 mAh USB mobile charger (power bank) which is used to power the two microcontrollers through USB port. The portable charger gives energy to the microcontroller to bolster its deciphering, remote correspondence and video gushing from camera. The Li-Po batteries can keep the engine running for roughly 3h. The switch is fueled by a three cell Li-Po battery, creating more than 12 V to turn on the remote association between two microcontrollers and portable workstation. Shoreline location assumes a key part in vision based safe route for self-governing surface vessel. Shoreline always changes as a result of the dynamic nature of the coastal zone due to physical impact and climate change.

The flowchart for the algorithm to segment and detect the shoreline is shown in Fig. 2. A continual stream of frames is captured by camera. Each jpeg frame is extracted from network stream and taken as byte stream. The byte stream is decoded into readable matrix format for image processing. Each frame is converted to grayscale image in which the colors are shades with gray color. The grayscale image is threshold to separate out the building

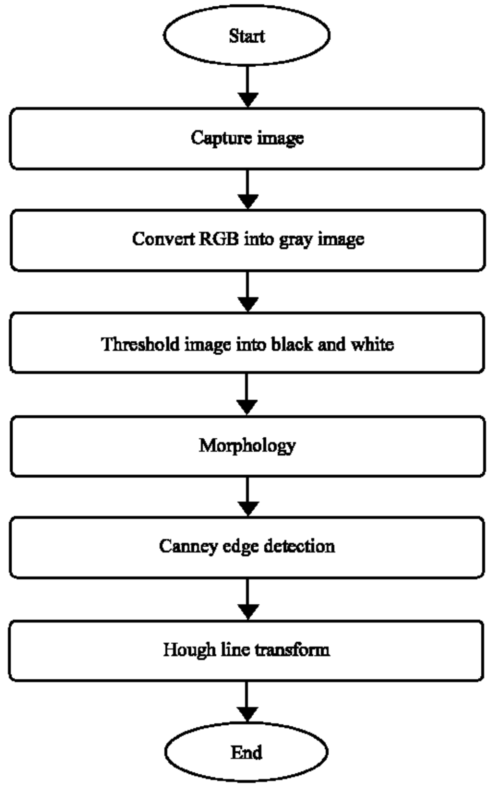

Fig. 2: Flow chart of image segmentation

and water. The threshold image is app lied for morphology and canny edge detection to extract the water boundary. Morphology operation is used to remove imperfections introduced during segmentation. In mathematical morphology, closing is used for noise removal such as pepper noise. Canny edge detection algorithm is used for accurate edge detection.

RESULTS AND DISCUSSION

The shoreline detection algorithm was tested on the set of 10 videos. The video is recorded from the Kerian river that is located in Nibong Tebal, Penang. The result of the test is shown in Fig. 3 and 4. The result shows that both of images are detected the shoreline perfectly.

The navigation process is carried out autonomously at the swimming pool located at the Universiti Sains Malaysia (Main Campus) by using ASV. Purple line represents the slope of the desired line. This line was estimated for ASV to navigate along the pool. The distance travelled from initial position to final position is around 20 m. The overall process from starting point A to final destination is shown in Fig. 5.

Fig. 3: Simulation results of shoreline detection constrained Hough transform

Fig. 4: Simulation result of obstacle detection

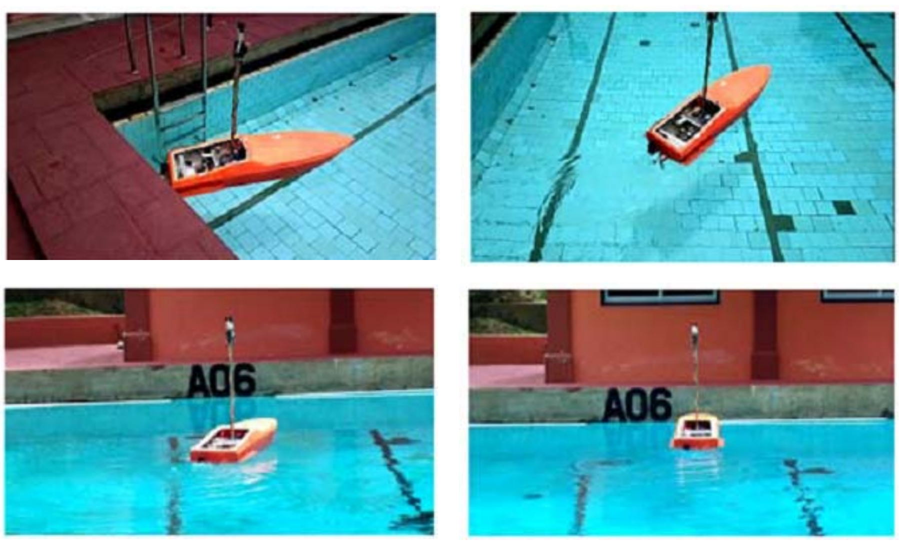

Fig. 5: ASV is travelled along the pool side

CONCLUSION

It can be reasoned that the route framework has ended up being an achievement in plunging pool by recognizing the waterline. The ASV can go along the pool side without false activating by identifying the false waterline. The idea of the framework can be connected to ASV with better precision of GPS framework and better snag shirking framework. The result from this examination ready to give a proof of idea to ASV stream route framework and it can be additionally enhanced by time.

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