

## Marine Environmental Monitoring Using an Open Source Autonomous Marine Surface Vehicle

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**Abstract :** An open source based autonomous unmanned marine surface vehicle (UMSV) is developed for some of the marine applications such as pollution control, environmental monitoring and thermal imaging. A double rotomoulded hull boat is deployed which is rugged, tough, quick to deploy and moves faster. It is suitable for environmental monitoring, and it is designed for easy maintenance. A 2HP electric outboard marine motor is used which is powered by a lithium-ion battery and can also be charged from a solar charger. All connections are completely waterproof to IP67 ratings. In full throttle speed, the marine motor is capable of up to 7 kmph. The motor is integrated with an open source based controller using cortex M4F for adjusting the direction of the motor. This UMSV can be operated by three modes: semi-autonomous, manual and fully automated. One of the channels of a 2.4GHz radio link 8 channel transmitter is used for toggling between different modes of the UMSV. In this electric outboard marine motor an on board GPS system has been fitted to find the range and GPS positioning. The entire system can be assembled in the field in less than 10 minutes. A Flir Lepton thermal camera core, is integrated with a 64-bit quad-core Linux based open source processor, facilitating real-time capturing of thermal images and the results are stored in a micro SD card which is a data storage device for the system. The thermal camera is interfaced to an open source processor through SPI protocol. These thermal images are used for finding oil spills and to look for people who are drowning at low visibility during the night time. A Real Time clock (RTC) module is attached with the battery to provide the date and time of thermal images captured. For the live video feed, a 900MHz long range video transmitter and receiver is setup by which from a higher power output a longer range of 40miles has been achieved. A Multi-parameter probe is used to measure the following parameters: conductivity, salinity, resistivity, density, dissolved oxygen content, ORP (Oxidation-Reduction Potential), pH level, temperature, water level and pressure (absolute).The maximum pressure it can withstand 160 psi, up to 100m. This work represents a field demonstration of an open source based autonomous navigation system for a marine surface vehicle.

**Keywords :** open source, autonomous navigation, environmental monitoring, UMSV, outboard motor, multi-parameter probe

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