

# **Underwater Vehicle Monitoring using Raspberry Pi**

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**ABSTRACT:** The studies about ocean research, monitoring of marine biotic and abiotic components life, submarine earthquakes and for research are with the help of under vehicle. While the existing projects high cost and less effective. To solve this problem we use raspberry pi with excellent features like image processing, video streaming and it has ability to work based on internet things. In this paper a low cost and an efficient underwater vehicle is designed and it has ability to measure temperature, pressure, speed, and direction sensors

**KEYWORDS:** Underwater Vehicle, Raspberry pi.

## **I. INTRODUCTION**

In world majority earth the control mechanism surface is covered with water. There are many research works and study of marine ecosystem are carried out. So the collection of data is indispensable for studies and development. Thus there is need for low cost, highly efficient underwater vehicle, which perform many tasks such as surveillance and monitoring of aquatic ecosystem. Under robotic technology are divided into basic groups which are Remotely Operated Vehicles (ROVs) and autonomous underwater vehicles (AOVs). Remotely Operated Vehicles (ROVs) are the vehicles which are remotely operated by a highly skilled and trained human operator. Due to rapid failure of remote communication technologies underwater, in order to allow for remote control, these vehicles are physically connected over a tether cable to a remote operation unit. These vehicles greatly improve efficiency of all kinds of underwater operations by removing the requirement of human presence inside the submersible. Being remotely operated these vehicles can also be deployed in missions which pose a great risk to human life. ROVs gained quick popularity because of their cost effectiveness and high mission applicability. When such underwater vehicles are made, it is necessary to consider about the following things. 1) Seawater and Water Pressure Environment, 2) Sink, 3) There are no Gas or Battery Charge Stations, 4) Global Positioning System cannot use, 5) Radio waves cannot use.

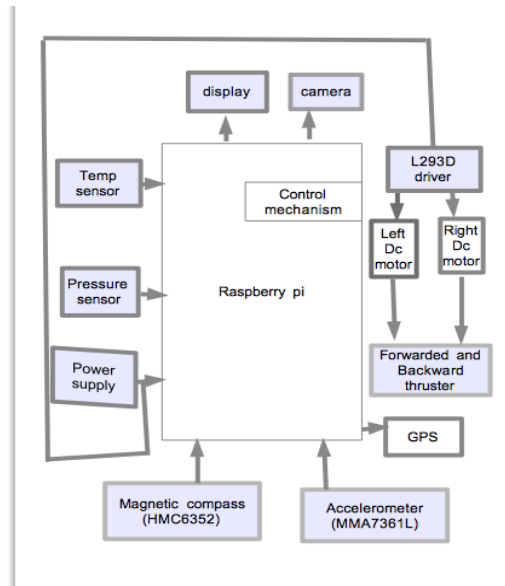
## **II. PROJECT DESCRIPTION**

The model designed is made up of simple PVC pipes which has a diameter of 1 inch assembled with different lengths of PVC pipes. The design consists several U joints and T joints for assembling the ROV to the required shape. Sealing is done with the use of silicon glue to prevent water entering into driving system. The movements of the vehicle is controlled with the help of Thrusters which are used for moving the vehicle in forward, backward, up, down, left and right movements of the vehicle. The Thrusters are controlled with the Dc motors driven by L293D driver circuit. The entire vehicle is controlled with help of a credit card size computer Raspberry Pi, which is used for interfacing with various sensors like Temperature sensor, Pressure sensor, Accelerometer, and magnetometer which are used for measuring various physical parameters under water.

## **III. BLOCK DIAGRAM**

The system has temperature sensor and pressure sensor which is used to measure temperature and pressure of underwater and displays the parameter in display which is interfaced with raspberry pi. The inertial measurement unit is magnetometer and accelerometer for finding direction and speed of vehicle. The control mechanism is done by thruster used for moving vehicle in required direction and it is controlled by dc motor. The raspberry pi is credit card size

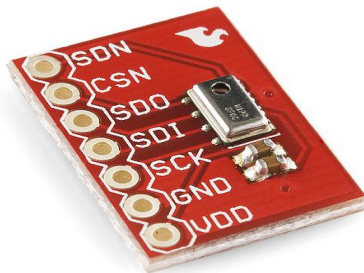
.ingle board computer which is used as a micro controller for controlling various operations, has a separate operating system Linux and has built in memory ,ADC ,camera module etc.



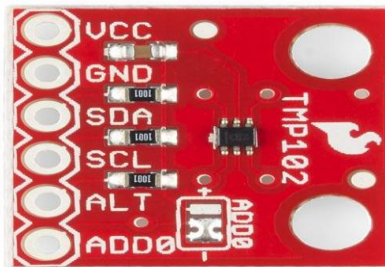
#### IV. PRESSURE SENSOR

A pressure sensor which converts physical quality – pressure in to a signal suitable for processing –electrical signal. The specific pressure sensor used is the MPL115A1 , which is a digital barometric pressure sensor that uses MEMs technology to give accurate pressure measurements between 50kPa and 115kPa. The communication takes place through the SPI(serial peripheral interface) interface version of the sensor. The MPL115A1 is an absolute pressure sensor with digital output for low cost applications. A Low current consumption of 5  $\mu$ A during Active mode and 1  $\mu$ A during Shutdown (Sleep) mode.

**Temperature Sensor:** The Temperature sensor is used to measure the temperature. It converts physical quality – temperature to a signal suitable for processing –electrical signal using a display unit that is attached



to a system which uses an inter integrated circuits for communication . It is a monolithic temperature sensor that generates a modulated serial digital output (PWM) which varies in direct proportion to the temperature of the devices. T. It offers a high temperature accuracy of  $\pm 1^{\circ}\text{C}$  from  $-55$  to  $150^{\circ}\text{C}$  with excellent transducer linearity.



**Power Supply :**

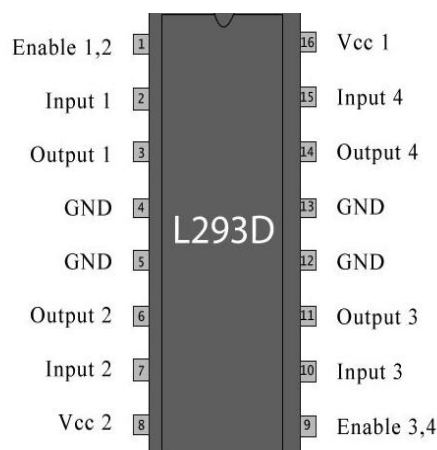
A power supply is a device that supplies electrical energy to one or more electric loads.. The supply voltage is 12v. The supply voltage is provided with the use of battery.

**Thruster:**

Thruster is used for controlling the movement in the required direction. The two thrusters are used for forward movement and backward movement of the system and the two backward thrusters are used for right and left movements of the system. A thruster is a propulsive device used by water craft for station keeping, attitude control, in the reaction of control system or long duration, low thrust acceleration.

**Dc motor :**

A dc motor is a machine which converts electrical energy into mechanical energy which can be utilized for controlling the thruster. It works on the principle of Fleming's Left hand rule. The dc motor is driven by the driver circuit LN293D which is used for driving the dc motor. A single driver can drive two dc motors .since four dc motors are used two drivers are required to drive four dc motors.It is 16-pin Ic which can control a two set of dc motor simultaneously in any direction.

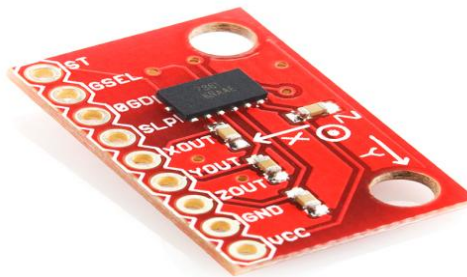


**IC L293D Driver:**

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It has a Dual H-bridge Motor Driver integrated circuit (IC).

**Accelerometer:**

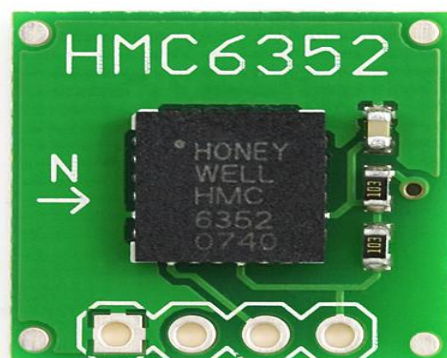
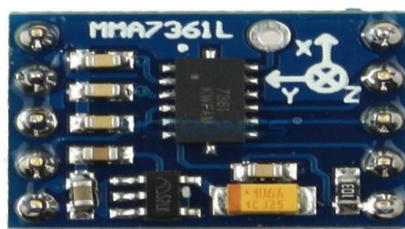
The accelerometer which is used for measuring the speed .MMA7361L is a three-axis analog MEMS accelerometer.It has a g-select input which switches the accelerometer between  $\pm 1.5g$  and  $\pm 6g$  measurement ranges. The MMA7361L is a low power, low profile capacitive micro machined accelerometer featuring signal conditioning, a 1-pole low pass filter ,temperature compensation, self-test, 0g-Detect which detects linear free-fall, and g-Select which allows for the selection between 2 sensitivities. Zero-g off set and sensitivity are factory set and require no external devices.



**Magnetometer :**

The magnetometer is used for finding the direction of the system .The magnetometer used is HMC6352 which can be used for finding the direction. It is a fully integrated compass module that combines 2-axis magneto resistive sensors with the required analog and digital support circuits, microprocessor . By combining the sensor elements, processing electronics, and firmware in to 6.5mm by 6.5mm by 1.5mm LCC package, Honeywell offers a complete, ready to use electronic compass. This provides the simplest solution to integrate high volume, cost effective compasses into wireless consumer electronics, vehicle compassing, and antenna positioning.

**V. RASPBERRY PI**



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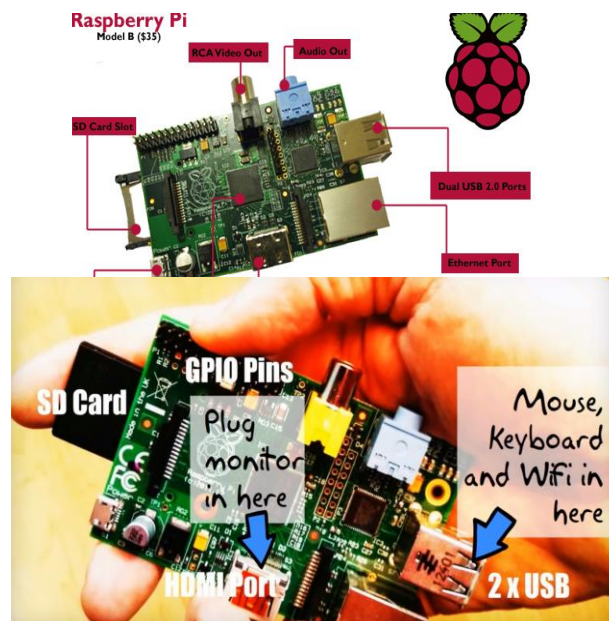
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The micro controller used is Raspberry pi, which measures the analog parameters such as temperature, pressure and display the values with the help of a display unit. In addition it can be used for controlling the movements of the system with the help of the thruster which can be moved to the required position with the help of a dc motor driven by driver IC L293D. Raspberry Pi has a Broadcom BCM 2835 system on chip (SoC), which includes an ARM1176JZF, 700 MHZ Processor, video core GPU and was originally shipped with 256 Megabytes of RAM, later upgraded with 512 MB. It does not include a built-in hard disk or solid-state drive but it uses an SD card for booting and persistent storage, with them model B+ using a Micro SD and has a 32 bit processor. Tools are available for Python as the main programming language, with support for BBC BASIC. Raspberry pi does not work with windows operating system and it needs a separating operating system Linux for programming. It has an excellent capability for image processing, video streaming and the ability to work based on internet of things.

### Display:

Raspberry pi can be very useful to connect remotely using nearby network and laptop. When there is no network available the laptop screen and keyboard can be used with the help of a TTL serial cable, which provides only slow



access. A good way to remotely control a raspberry pi is to connect to a network. This will provide access to the terminal by using SSH(secure socket shell), with the ability to view desktop using VNC( virtual network computing) and the ability to run graphical programs directly on the laptop itself. If raspberry pi is directly connected to a network it will try to automatically find an IP address by requesting from the router or other device running a DHCP server(dynamic host configuration protocol).

GPS:GPS is a global positioning system and the GPS used is globalstar br305 GPS features of GPS

receiver (Navigation: );

CPU: (OS: );

Flash: (external: );

GPS: 20 channels,( waas;egnos;msas, );

Display: , Connectivity: bluetooth;

Internal: Batteries: internal Li-ion

addresses:POIs

mass storage mode:waterproof

note:1.Shipped with Windows program for configuration and downloads.



2.Can log position; position, time, speed or position, time, speed and altitude. Recording interval could also be changed.



## VI. WORKING MODEL

The working model of the system is the sensor interfacing which is interfaced with raspberry pi where communication takes place through the protocols I2C and SPI. The Temperature sensor used is TMP 106 which is a Digital Temperature Sensor has Low voltage operation of 1.4 to 3.6V and uses I2C Serial communication Interface. It also has an on chip 12 bit Resolution ADC and Compatible for battery powered applications. The Magnetic Compass used is (HMC6352) which has a Low voltage operation - 2.7 to 5.2v and it uses I2C Serial communication Interface. It has a Field Range - 0.10 to 0.75 gauss (Max Exposed Field-10000 gauss) and can withstand strong magnetic field environment. The Thrusters are controlled with the dc motors driven by l293d driver.

## VII. CONCLUSION

Thus underwater vehicles play an important role in monitoring, protecting and maintaining the underwater which is polluted by leakage in oil spills, accidents caused due to ships etc. Robotics technologies have found many commercial, scientific, defense and academic applications. As the research in this field increases and other innovations are introduced into the operations of unmanned underwater vehicles (UUVs), UV's will become increasingly more common and highly cost effective.

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