OIL SKIMMING AQUA ROBOT

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Abstract - *Oil spills is one of the major threats to marine as well as human life. It not only takes a toll on marine life but also immensely affects human life as well. Crude Oil spills can have disastrous consequences for society; economically, environmentally, and socially. As a result, oil spill accidents have initiated the concern for environment, bringing many together in a political struggle concerning government response to oil spills and what actions can best prevent them from happening. Due to crude oil being denser in consistency it becomes indomitable task to clean up oceans and sea-beds effectively. The main approach to be adopted for overcoming this problem is to develop an autonomous entity which would effectively clear crude oil debris from oceans. This project is to develop an oil skimming robot which effectively skims off the oil layer over the water and thus simplifying the task of cleaning up oceans. Oil skimming aqua robot uses disc Oil skimmer which is used to remove layer of oil over the water surface. This Android application controlled Robot makes use of Bluetooth module which helps to indicate oil level of the collecting container with the help of ultrasonic level sensor and displays real time location of the system via GPS module.*

***Key Words*: Disc oil skimmer, DC motor, ultrasonic sensor, Bluetooth module, Arduino**

1. INTRODUCTION

According to survey, Crude oil and refined fuel spills from tanker ship accidents have damaged vulnerable ecosystems in Alaska, Gulf of Mexico, Galapagos Islands, France, Sundarbans, Ogoniland, and many other places. The quantity of oil spilled during accidents has ranged from a few hundred tons to several thousand tons. Oil spills at sea are generally much more damaging than those on land, since they can spread for hundreds of nautical miles in a thin oil slick which can cover beaches with a thin coating of oil. These can kill seabirds, mammals, shellfish and other organisms they coat. Various projects were implemented on the basis of swarm robotics [1]. This project helps us with the task of ocean cleanup in case of massive oil spills. Oil skimming aqua robot helps to segregate oil layer above water. Oil skimming aqua robot uses disc skimmer which is highly efficient in skimming out the oil layer from the water. This disc skimmer resides on a mechanical assembly of DC motor, shaft scraping off the oil at the tank assembly in the robot. This project makes use of Arduino Uno which is programmed to control the movement of the robot. The start

and stop mechanism is provided in android application which is connected via bluetooth module. GPS module provides real-time location of the robot. The ultrasonic level sensor monitors the level of the oil collecting and alerts the system if oil level exceeds the given threshold. L293D driver IC is used to drive three DC motors, two of which control robots movement and one motor is used for disc skimmer assembly. This autonomous robot helps to skim off oil layer effectively which makes the task of ocean cleanup easy. Android application makes the task of monitoring the robot easier.

2. PROPOSED SYSTEM

2.1 Arduino uno

The Arduino UNO is a widely used open-source microcontroller board based on the ATmega328P microcontroller and developed by Arduino.cc.
The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. It uses ATMEGA 328p as microntroller. It is 8 bit microcontroller. It is 28 pin IC and has 32KB flash memory. It has 16MHz clock frequency.

Arduino uno is the main controller of the circuit. It assembles all the components and works in the desired way by programming.

2.2 Ultrasonic level sensor

It is used to detect the layer of oil and estimate the distance from the surface of oil layer to the threshold of container. These sensors emit short, high-frequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they are reflected back as echo signals to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo. As the distance to an object is determined by measuring the time of flight and not by the intensity of the sound, ultrasonic sensors are excellent at suppressing background interference.
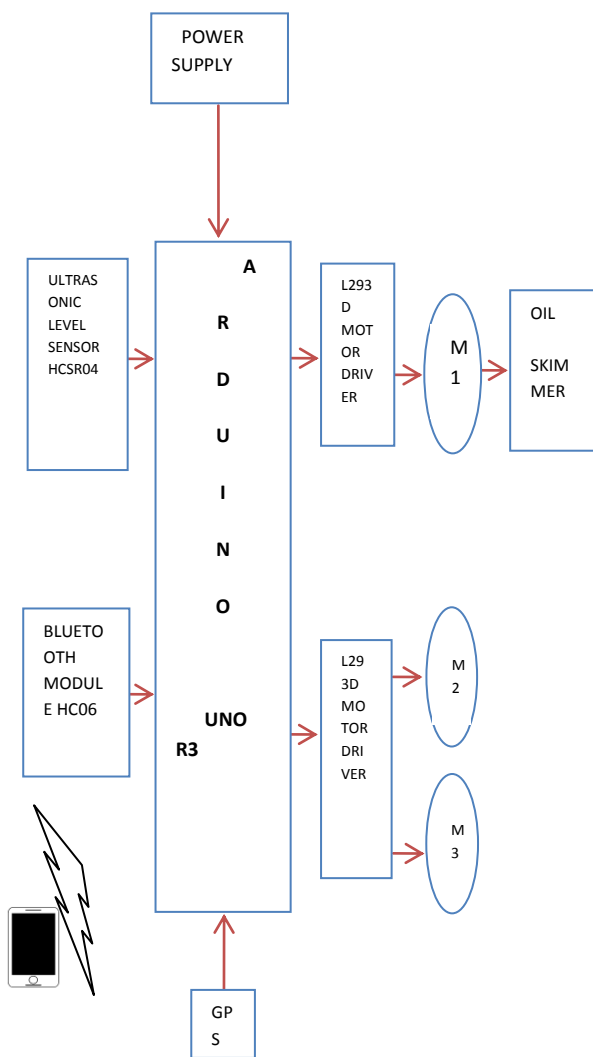
Fig -1: Block diagram of the system

2.3 Bluetooth Module

The HC-06 is a class 2 slave bluetooth module designed for transparent wireless serial communication. Once it is paired to a mater bluetooth device such as PC, smart phones and tablet, its operation becomes transparent to the user.

All data received through the serial input is immediately transmitted over the air. When the module receives wireless data, it is sent out through the serial interface exactly is needed at all in the user micro-controller program.

2.4 Motor driver IC (l293d)

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 means that you can control two DC motor with a single L293D IC.It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. Voltage is needed to

change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. It is used to control skimmer motor and robot

2.5 GPS Module

The Global Positioning System (GPS), is a satellite-based radio-navigation system. It is a global navigation satellite system that provides geo-location and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

Obstacles such as mountains and buildings block the relatively weak GPS signals. The GPS does not require the user to transmit any data, and it operates independently of any telephonic or internet   reception, though these technologies can enhance the usefulness of the GPS positioning information.

GPS module is used to detect the location of the robot and display the same on android application in terms of latitude and longitude.

2.6 DC MOTOR

A DC motor in simple words is a device that converts electrical energy (direct current system) into mechanical energy. The very basic construction of a DC motor contains a current carrying armature which is connected to the supply end through commutator segments and brushes.

The armature is placed in between north south poles of a permanent or an electromagnet as shown in the diagram above. As soon as we supply direct current in the armature, a mechanical force acts on it due to the electromagnetic effect of the magnet.

A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field winding.

2.7 Oil Skimmer

Skimmers are often used in conjunction with booms. A skimmer is a device that collects and removes oil from the surface of the water. Skimmers can be towed, self-propelled in river currents, or even used from shore. Many types of skimmers are available for use, depending on the kind of oil spilled and the weather conditions. Disc skimmers are floating skimmers with a series of rotating discs that remove floating oil and fuel from the water. Disc skimmers are available in a variety of sizes and are suitable to use on ponds, or in the ocean, sumps, pits, dams, rivers, harbour and marinas.

2.8 Android Application

An application program (app or application for short) is a computer program designed to perform a group of coordinated functions, tasks, or activities for the benefit of the user. An Android app is a software application running on the Android platform.

Because the Android platform is built for mobile devices, a typical Android app is designed for a smart phone or a tablet PC running on the Android OS. Android apps are written in the Java programming language and use Java core libraries.

The android application in oil skimming aqua robot is used to control the direction of the robot and also used to show the current location of the robot.

3. Calculations

T = total oil collected by skimmer in one rotation

R= radius of disc of oil skimmer(cm)

t = thickness of oil film(mm)

  R = 6cm

t= 1mm

$T = \Pi \times R^2 \times t$

  $= \Pi \times (6)^2 \times 0.001$

  = 0.113 ml

R= rate of oil collected

 R = T × RPM

  = 0.113 × 50

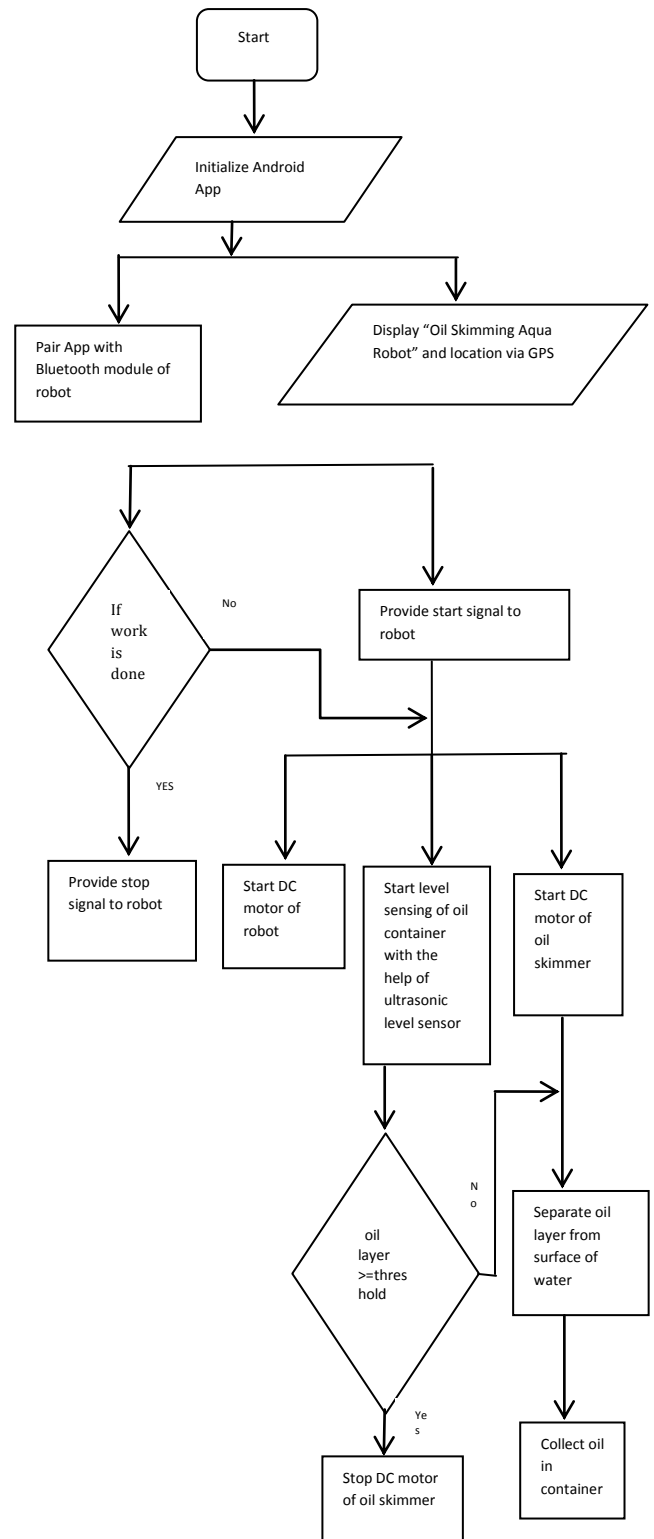 = 5.65 ml/min

4. Oil Skimming Process

Fig 2: Flowchart

1. Start

2. Check android app is started.

3. Take the real time location robot

4. Provide start signal to robot via bluetooth.

5. Start DC motor of skimmer.

6. Separate oil layer from water surface.

7. Start DC motor of robot and robot will move forward, right, left.

8. Check the oil level in container with the help of ultrasonic sensor.

9. If the oil layer is greater than threshold value go to next step otherwise go to step 6.

10. Stop DC motor of skimmer

5. Results

Figure 3: Snapshot of oil skimming aqua robot

Figure 4: Snapshot of Android application

TEST RESULTS:

Table 1: Test results

SR. NO	OIL SPILLED (ml)	COLLECTED OIL (ml)	TIME (min)	RATE OF OIL COLLECTED
1.	200	180	37	5.4ml/min
2.	400	360	66.6	5.4ml/min
3.	600	560	107.6	5.2ml/min

RPM = 40

Average rate of oil collected = 5.33ml/min

Average recovery rate = 93%

6. Application and Future Modification

Applications:

1. The Oil Skimmer is used metal working industries to separate the lubricating oil from the coolant.

2. Used in case of oil spills in sea as well as sea-beds.

3. Oil skimming aqua robot can be used to separate thick viscous chemicals dumped into rivers by factories, thus reducing water pollution.

Future modification:

1. With further modifications it can be used to extinguish fire on board ships.

2. Can be tracked the master ship and automatically come to master ship.
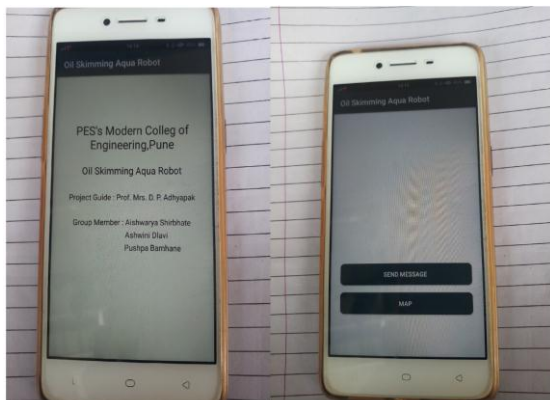
7. Conclusion

Oil skimming aqua robot helps in cleaning of water bodies in case of oil spillage. This robot effectively collects oil from the oil spillage area at a recovery rate of 93%.This robot can be controlled by android application. It not only collects the oil from the water surface but also shows real time location of the robot. Oil skimming aqua robot avoids the work of manually collecting oil. This project helps in protecting environment due oil spills in turn reducing threats to marine life.

8. References

[1] Emmad Mohammed H. Zahugi, Mohamed M Shanta, T.V. Prasad, "Design of Multi-Robot System For Cleaning Up Marine Oil Spill", IJAIT ,Vol. 2, no.4, August 2012.

[2] Isamu Fujita, Muneo Yoshie ," An Onboard Air Conveyer Oil Skimmer", IEEE Ocean Conference,1-4244-0115-1/06 ,Boston 18 Sept 2006.

[3] Prof.P.A.Patil , Mr.Pratik Shinde , Mr.Ashish Shetty , Mr.Siddarth Lodha , Mr.Nikhil Vaidya , "Design And Fabrication of Oil Skimmer" , International Research journal of engineering and technology ,Vol. 4,May-2017.

[4] Subrajit Bhattacharya, Hordur Heidarsson, Gaurav Sukhatme, Vijay Kumar, "Cooperative Control of Autonomous Surface Vehicles For Oil Skimming And Cleanup", IEEE International Conference on Robotics and Automation,2011.

[5] Suraj Nair, Kajol Kamble, Sayali Shewale, Sanjay Lohar, "Design And Fabrication of Disc Type Oil Skimmer", IJSART International Journal for Science and Advance Research in Technology, Vol.3, April 2017.