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Dynamic Oil Leakage Perceived in H_2O with Indicator and Navigational System

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Abstract

The Dynamic Oil Leakage Perceive in H20 with Indicator and Navigational System (D.O.L.P.H.I.N.S.) is a continuous monitoring system that uses Electrical Conductivity (EC) sensor and Light Dependent Resistor (LDR) to detect the presence of oil spill on water. It can monitor continuously day and night. Through the use of GSM the device can send SMS containing the information about the oil spill to the Marine Authorities.

Index Terms: *electrical conductivity, light dependent resistor, oil spill*

I. INTRODUCTION

Petroleum, a kind of oil that is the source of gasoline and other products, has a significant role in the lives of the people. To provide the growing demands for petroleum products, suppliers distribute petroleum through various methods of transportation that is accompanied by risks. One of the dangers that can occur during the delivery process is oil spill.

Oil spill is a hazardous phenomenon which can cause marine ecosystem destruction. There are two categories of oil spill, non-accidental spill and accidental spill. The Philippines under the Clean Water Act of 2004 states that discharging of any kind of oil from an oil tanker to a body of water without the discharge permit is prohibited hence the most common cause of oil spill in the country is due to accidental leakage.

As an archipelago, Philippines has rich marine ecosystem which is one of the major sources of livelihood and food for many people. But due to unexpected circumstances, like oil spills, marine life can be in danger. Thus, continuous surveillance and monitoring are essential to control the possible oil spills in any body of water.

D.O.L.P.H.I.N.S, a mnemonic for Dynamic Oil Leakage Perceived in H2O with Indicator and Navigational System, is a monitoring device that will be able to detect the presence of oil on water. Through a text message, with the use of GSM module, the coast guard will be receiving the information regarding the oil spill.

II. OBJECTIVES OF THE STUDY

A. General Objective

The study aimed to design and develop a device capable of detecting oil spill on water with monitoring system.

B. Specific Objectives

Specifically, the study aimed to:

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1) Design a system capable of detecting oil spill on water with SMS monitoring capability.

2) Develop the system using Arduino Mega2560 for oil spill detection and GSM for monitoring system.

3) Test and evaluate the system based on accuracy and reliability.

III. RESEARCH METHODOLOGY

Figure 1 shows the cycle of the project system. The inputs are the signals from the sensors. These signals will be processed by the microprocessor and the output will be the SMS that will be received by the chosen message recipient.

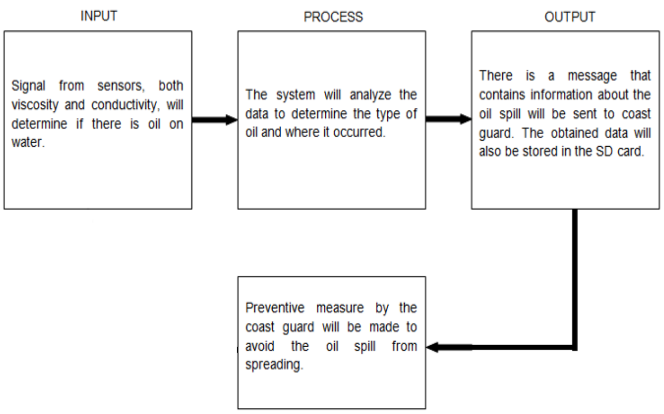

Figure 1. Cycle of the D.O.L.P.H.I.N.S. project system

The system consisted of two sensors with the function of determining if there is oil on water. The system has the capability to transmit the data regarding the oil spill through SMS.

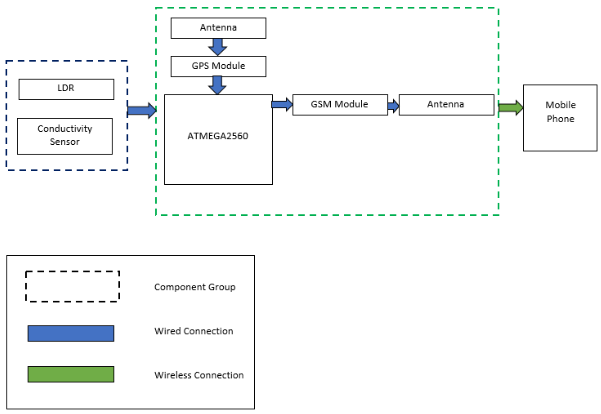

Figure 2. D.O.L.P.H.I.N.S. system block diagram

The following flowchart shows the flow of the whole system. The input components are the conductivity sensor and LDR. The two sensors were used to detecting oil spill on water. When the system acquired all necessary information, it will automatically send a SMS to the recipient of the message.

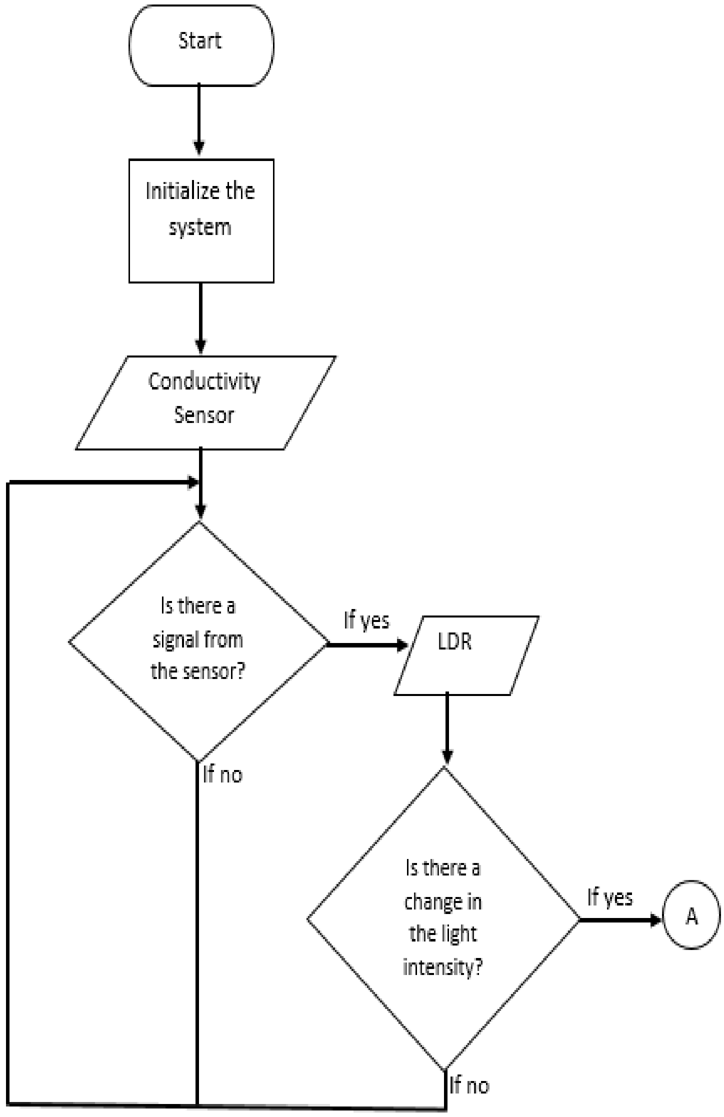

Figure 3. D.O.L.P.H.I.N.S. system's flowchart

Figure 4 and figure 5 present the project layout. The system used a waterproof case and a floater for the sensors. This was installed in a protected marine ecosystem.

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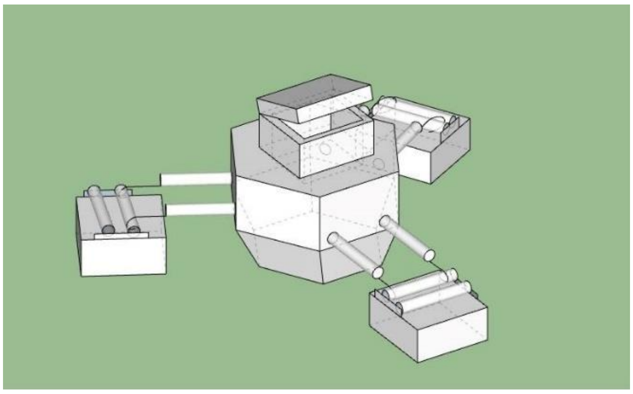

Figure 4. D.O.L.P.H.I.N.S. system's layout side view

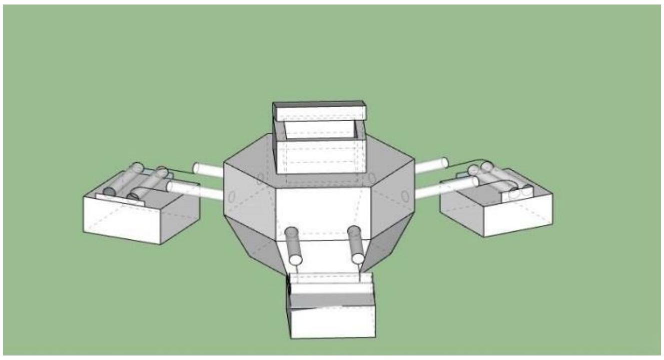

Figure 5. D.O.L.P.H.I.N.S. system's layout front view

IV. RESULTS AND DISCUSSIONS

This contains the data gathered during the test phase and the development of the proposed system. Included in this section are the test results of the GSM Module, GPS Module, EC Sensor, LDR and the test result of the design projects.

A. GPS

Table 1, 2, and 3 present the expected coordinates and the actual coordinates from 3 different places using GPS Shield. The data gathered was proven to give 99.9% accuracy in terms of its navigational system.

Table 1

GPS shield accuracy test

GPS TEST 1						
Trials	Expected Value		Actual Value		Percentage Error	
	Google Map		D.O.L.P.H.I.N.S GPS			
	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
1	14.656624	120.991563	14.656625	120.992462	0.00001%	0.0007%
2			14.656670	120.992454	0.0003%	0.0007%
3			14.656670	120.992454	0.0003%	0.0007%
4			14.656670	120.992454	0.0003%	0.0007%
5			14.656670	120.992454	0.0003%	0.0007%
6			14.656670	120.992454	0.0003%	0.0007%
7			14.656670	120.992454	0.0003%	0.0007%
8			14.656625	120.992462	0.00001%	0.0007%
9			14.656625	120.992462	0.00001%	0.0007%
10			14.656625	120.992462	0.00001%	0.0007%
Average Percentage Error					0.0002%	0.0007%
Reliability Test					99.9998%	99.9993%

Table 2

GPS shield accuracy test 2

GPS TEST 2						
Trials	Expected Value		Actual Value		Percentage Error	
	Google Map		D.O.L.P.H.I.N.S GPS			
	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
1	14.696882	121.085802	14.696877	121.085810	0.00003%	0.00001%
2			14.696877	121.085810	0.00003%	0.00001%
3			14.696877	121.085810	0.00003%	0.00001%
4			14.696879	121.085811	0.00002%	0.00001%
5			14.696877	121.085810	0.00003%	0.00001%
6			14.696879	121.085811	0.00002%	0.00001%
7			14.696879	121.085811	0.00002%	0.00001%
8			14.696879	121.085811	0.00002%	0.00001%
9			14.696879	121.085811	0.00002%	0.00001%
10			14.696879	121.085811	0.00002%	0.00001%
Average Percentage Error					0.00002%	0.00001%
Reliability Test					99.99998%	99.99999%

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Table 3

GPS shield accuracy test 3

GPS TEST 3						
Trials	Expected Value		Actual Value		Percentage Error	
	Google Map		D.O.L.P.H.I.N.S GPS			
	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
1			14.693735	121.079280	0.00001%	0.001%
2			14.693735	121.079280	0.0003%	0.001%
3			14.693735	121.079280	0.0003%	0.001%
4			14.693735	121.079280	0.0003%	0.001%
5	14.693734	121.079202	14.693734	121.079281	0%	0.00007%
6			14.693734	121.079281	0%	0.00007%
7			14.693734	121.079281	0%	0.00007%
8			14.693734	121.079281	0%	0.00007%
9			14.693734	121.079281	0%	0.00007%
10			14.693734	121.079281	0%	0.00007%
Average Percentage Error					0.0001%	0.0004%
Reliability Test					99.9999%	99.9996%

B. GSM

Table 4 shows SMS receiving time from the device. From the period where the marine officer sends the corresponding code until the marine officer receives the data information, the coordinates of the location of the oil spill and the battery level.

Table 4

GSM shield accuracy test

GSM TEST	
Trial	SMS Receiving Time
1	12.8
2	9.06
3	9.68
4	8.9
5	9.01
6	8.06
7	8.57
8	8.35
9	8.98
10	8.65
Average Time	9.21

C. EC Sensor

Table 5 shows the output values from the EC sensor during the testing. Since oil has a low conductivity in water the values decreased when the sensor detected an oil.

Table 5

EC sensor accuracy test

EC SENSOR TEST			
Trial	Electrical Conductivity in Water		Remarks
	Without Oil	With Oil	
1	57	45	Passed
2	59	44	Passed
3	55	47	Passed
4	56	49	Passed
5	56	43	Passed
6	58	42	Passed
7	51	44	Passed
8	52	42	Passed
9	55	44	Passed
10	57	44	Passed
Accuracy Test			100%

D. LDR

Table 6 shows the testing for the Light Dependent Resistor which serves as the secondary sensor that will help confirm the oil spill.

Table 6

LDR accuracy test

LDR TEST			
Trial	Without Oil	With Oil	Remarks
1	387	106	Passed
2	403	111	Passed
3	364	120	Passed
4	378	103	Passed
5	364	119	Passed
6	398	127	Passed
7	369	109	Passed
8	397	112	Passed
9	384	111	Passed
10	377	121	Passed
Accuracy Test			100%

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E. D.O.L.P.H.I.N.S

Table 7 shows the testing for the design. When the electrical conductivity drops, it will send a signal to the LDR to confirm the reading. Once the reading is confirmed, the GPS will locate the spill and send the data to the GSM. Then the GSM will send the message containing the data gathered to the Marine Authorities.

Table 7

D.O.L.P.H.I.N.S test

D.O.L.P.H.I.N.S. TEST				
Trial	Electrical Conductivity	LDR	GPS	GSM
1	45	7	14.656625, 120.992462	9.87
2	44	5	14.656670, 120.992454	9.06
3	47	9	14.656625, 120.992462	8.65
4	49	10	14.656625, 120.992462	8.01
5	43	3	14.656625, 120.992462	7.67
6	42	0	14.656625, 120.992462	8.09
7	44	5	14.656670, 120.992454	8.99
8	42	0	14.656670, 120.992454	9.24
9	44	5	14.656625, 120.992462	9.37
10	44	5	14.656625, 120.992462	8.95

CONCLUSIONS

Oil can be a threat to marine life. With that said, the proponents designed an on-site sensing device that can detect oil continuously day time or night time. Dynamic Oil Spill Perceived in H20 with Indicator and Navigational System, D.O.L.P.H.I.N.S., can detect oil spill and send information about it to the marine authorities.

The device is run with the aid of the microprocessor, Arduino ATMega2560, which serves as the brain of the system, a GSM shield that receives and sends the data information and a GPS shield that is responsible for the navigational system.

The oil detection is based on the two sensors, conductivity and LDR. An electrical conductivity sensor is set to distinguish oil from water through its conductivity while the LDR detects if there is a light intensity change. With the two sensors combined, it gives out a reliable information regarding the presence of oil-in-water. These two sensors are tested with the presence of a heavy oil to examine their corresponding response and the output data the sensors have collected depending on its role on the device.

Tabulating and analysing the cost of production and the output performance of the device, the proponents can conclude that there is a balance between the two extremes. The cost of production is just enough to produce an output at that level.

Undergoing a series of test for the different features and sensors of the device and with the tables provided, it was proven that the information it give is reliable and dependable.

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