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Research Article

DESIGN AND IMPLEMENTATION OF SMART SHELLFISH TRAP

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A R T I C L E I N F O

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A B S T R A C T

Commercial fishing has always been a very dominant part in the rural economy of our country. At the present scenario very traditional and outdated fishing techniques form a prime process in the fishing occupation. To have a better output from the fishing industry it becomes a primary concern for us to employ better techniques. Large scale shellfish catching is done by placing several shellfish trap at many locations in the sea bed. There places are selected as per the best previous catches. There traps are then collected after some interval. To build a system where in make use of traps aligned with IR sensor to count the number of shellfish entering to the entrance compartment this ensure number of fishes have entered the trap. Another IR sensor is placed in storage compartment which is used to count the number of fishes entering the storage compartment via the entrance compartment. Then, the proximity sensor is placed in storage compartment, it continuously blinks whenever fish is over it. If this process is done along with the GPS to find the location because using number of traps. It will be implemented by fish tank and depends upon the size of the fish tank the trap will be used.

INTRODUCTION

An Embedded system is a computer system designed to do one or a few dedicated and/or specific functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today. Embedded systems contain processing cores that are typically either microcontrollers or digital signal processors (DSP). The key characteristic, is being dedicated to handle a particular task.

To build a system with sensors, that could detect the number of shellfish that has entered the trap, find whether the trap is filled or not and also used to detect the tear in the trap. Thus enabling the fishermen to gather only the ones which he finds to be completely filled.The fisherman’s effort in gathering traps turn out to be empty and placing extra traps are reduced and also reduce the time duration.This process will help him to determine his profit.

LITERATURE REVIEW

Management implications of fish trap effectiveness in adjacent coral reef and gorgonian habitats Environmental biology of fishes June 1999, Volume 55, issue 1, pp 81-90.

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A combination of visual census and trap sampling in St. John, USVI indicated that traps performed better in gorgonian habitat than in adjacent coral reef habitat. Although most families were seen more commonly in coral habitat, they were caught more often in gorgonian areas. Traps probably fished more effectively in gorgonian habitats, especially for migrating species, because traps provided shelter in the relatively topographically uniform environment of gorgonian dominated habitats. Recently, trap fishermen on St. John have been moving effort away from traditionally fished nearshore coral reefs and into a variety of more homogeneous habitats such as gorgonian habitat. Consequently, exploitation rates of the already over-harvested reef fish resources may be increasing. Reef fish managers and marine reserve designers should consider limiting trap fishing in gorgonian habitats to slow the decline of reef fisheries.

Lobster trap impact on coral reefs: Effects of wind-driven trap movement New Zealand Journal of Marine and Freshwater Research Volume, Issue 1, 2009.

Commercial fishers report finding their lobster traps often great distances from their original location following major hurricanes. But traps also move during lesser wind events, such as during winter cold fronts. To assess trap impact on coral communities following winter storms, lobster traps were placed in hardbottom and reef habitats commonly used by commercial fishers in the Florida Keys, United States. Trap movement, percentage benthic faunal cover, and benthic faunal damage were assessed after 26 wind events occuring over three winters. Traps moved when storms with sustained winds greater than 15 knots (27.8 km/h) persisted for more than 2 days. Winter storms above this threshold moved buoyed traps a mean (±SE) distance of 3.63 ± 0.62 m, 3.21 ± 0.36 m, and 0.73 ± 0.15 m per trap and affected a mean area of 4.66 ± 0.76 m2, 2.88 ± 0.29 m2, and 1.06 ± 0.17 m2, per trap at 4-m, 8-m, and 12-m depths, respectively. Unbuoyed traps, simulating derelict traps, moved a mean distance of 0.43 ± 0.08 m and 0.44 ± 0.02 m, and affected a mean area of 0.77 ± 0.06 m2 and 0.90 ± 0.08 m2 per trap at 4-m and 8-m depths, respectively. Injuries caused by trap movement included scraped, fragmented, and dislodged sessile fauna, resulting in significant damage to stony coral, octocoral, and sponges. Overall, sessile fauna cover along the trap movement path was reduced from 45% to 31%, 51% to 41%, and 41% to 35% at the 4-m, 8-m, and 12-m sites, respectively. Because of the large numbers of traps deployed and reported lost each season, damage to sessile fauna and loss of benthic faunal cover caused by traps needs to be considered to effectively protect coral reefs and manage essential fishery habitat in the future.

Objective

Commercial fishing is the activity of catching fish and other sea foods for commercial profit. It provides a large quantity of food to many countries around the world, but those who practice it as an industry must often pursue fish far into the ocean under adverse conditions. Commercial fishing uses many different methods to effectively catch a large variety of species.

In this variety of species, the shellfish items are very costly and increase the commercial profit. They have all the features based on the fishing process like using GPS for location finding, using sensor for detecting underground obstacles like mountains, plates…etc., and also detect the fish maap. But they do know what happening in the trap at underground. For this problem, we proposed a simple system.

The main concept of our paper is implement a smart shellfish trap that could monitoring the process of catching fish in the trap at underground water and display the information about that in monitor. It will be very helpful for fisheries by reducing the time duration, reducing the extra traps, tear detection and simply done the large scale fishing. Monitoring purpose using some hardware tools and displaying purpose using some software tools.

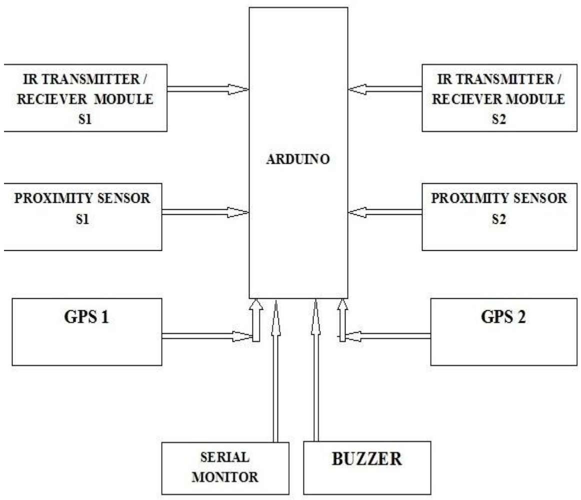

Fig 1 Block Diagram of Proposed System

Components Required

Software requirement

- The open-source Arduino software (IDE) makes it easy to write code and upload it to the board.It runs on Windows, Mac OS X, and Linux. This can be written in java and based on processing and other open-source software. This software can be used with any Arduino board.
- The Proteus software is a Virtual System Modeling and circuit simulation, animated components and microprocessor models to facilate co-simulation of complete microcontroller based design.
- Proteus was initially created as a multiplatform (DOS, Windows, Linux) system utility, to manipulate text and binary files and to create CGI scripts.
- The language was later focused on Windows, by adding hundreds of specialized functions for: network and serial communication, database interrogation, system service creation, console applications, keyboard emulation, ISAPI scripting (for IIS).
- Most of these additional functions are only available in the Windows flavour of the interpreter, even though a Linux version is still available

Hardware requirement

Arduino is common term for a software company, paper, and user community that designs and manufactures computer open- source hardware, open-source software and microcontroller- based kits for buildings digital devices and interactive objects that can sense and control physical devices. The paper is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that

Fig 2 Arduino UNO broad can interface to various expansion boards and other circuits.

The boards feature serial communication interfaces, including universal serial bus (USB) on some models, for loading programs for personal computers. For programming the microcontrollers, the Arduino paper provides an integrated development environment (IDE) based on a programming language named processing, which also supports the language C and C++.

IR sensor communication is a common, inexpensive, and easy to use wireless communication technology. To build a system where in make use of traps aligned with IR sensor to count the number of shellfish entering to the entrance compartment this ensure number of fishes have entered the trap. Another IR sensor is placed in storage compartment which is used to count the number of fishes entering the storage compartment via the entrance compartment. IR sensor to transmit and receive IR data using an Arduino. IR light is very similar to visible light, except that it has a slightlty longer wavelength. This means IR is undetectable to the human eye - perfect for wireless communication.

Fig 3 IR sensor

A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact. A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. This sensor used in the storage compartment of trap , it is used to count the number of shellfish in the trap , and to find the tear detection and also find if number of fishes is high, the rate of blink is high then it produces as buzzer alarm vice-versa if. This process is done along with the GPS by using number of traps. The object being sensed is often referred to as the proximity sensor's target.

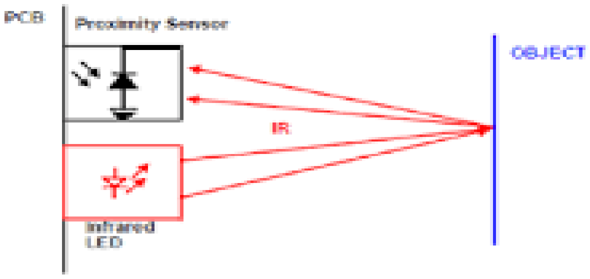

Fig 4 Proximity Sensor

The Global Positioning System (GPS) is a space-based navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. This GPS is connected to each trap and to identify location of the trap. The system provides critical capabilities to military, civil, and commercial users around the world. The United States government created the system, maintains it, and makes it freely accessible to anyone with a GPS receiver.

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices. It will be used Hi-watt 9v battery has an input voltage of Arduino UNO, IR sensor E1 and S1, Proximity sensor, buzzer and GPS(3.3v). A battery has a positive terminal, or cathode, and a negative terminal, or anode. The terminal marked positive is at a higher electrical potential energy than is the terminal marked negative. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device.

Fig 5 Battery

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

Fig 6 Buzzer

It is placed in proximity senor after getting full loaded of trap buzzer will produces as the beeper sound it has an input voltage as 5v.

A lobster trap or lobster pot is a portable trap that traps lobsters or crayfish and is used in lobster fishing. In Scotland (chiefly in the north), the word creel is used to refer to a device used to catch lobsters and other crustaceans. A lobster trap can hold several lobsters. Lobster traps can be constructed of wire and wood, or metal and netting or rigid plastic. An opening permits the lobster to enter a tunnel of netting or other one way device. Pots are sometimes constructed in two parts, called the "chamber" or “kitchen”, where there is bait, and exits into the “parlour”, where it is trapped from escape. Lobster pots are usually dropped to the sea floor about a dozen at a time, and are marked by a buoy so they can be picked up later. The trap can consist of a wooden frame surrounded by a rope mesh. The majority of the newer traps found in the Northeast of the USA and the Canadian Maritimes consist of a plastic-coated metal frame.

A piece of bait, often fish or chum, is placed inside the trap, and the traps are dropped onto the sea floor. A long rope is attached to each trap, at the end of which is a plastic or styrofoam buoy that bears the owner's license number. The entrances to the traps are designed to be one-way entrances only. The traps are checked every other day by the fisherman and rebaited if necessary. One study indicated that lobster traps are very inefficient and allow almost all lobsters to escape. Automatic rebaiting improves efficiency.

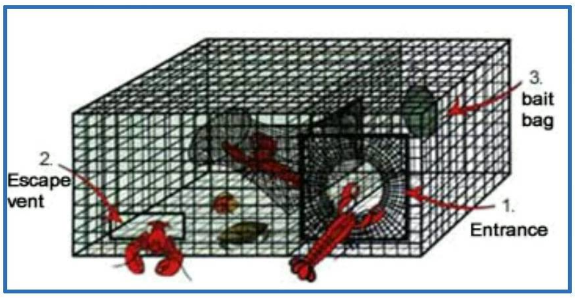

Fig. 7 LOBSTER TRAP

Working procedure

The process of fishing in this paper is, for example crab, Walking speed of the crab is 0.01 m/s.Conversion to cm per min = 26.82. Considering trap size, bait will be placed at 5 cm from the entrance sensor. So it will take approx 11.20 secs to reach the bait considering that the entrance allows only one crab a time and the average size of a crab is 2 cm.We can deduce that it will a crab will follow another crab with an interval of 4.5 seconds (conversion factor 60/26.8 = 2.24).

So in 45 seconds there would be almost 10 crabs in entrance compartment considering the size of entrance compartment and size of each crab, at this point it starts getting crowded and the first crab almost full will try to leave. If there is a tear, (since inside is crowded, the crabs will only try to leave and not try to enter through tear) the crabs inside trying to leave will have two openings to choose from storage compartment and tear.

It is a random choice since for the crab, both the ways are a way out. Considering the sample space being either one of two the probability of the crab entering the Storage Chamber S1 = 1/2 = 0.5 that means after 45 seconds, due to the congestion within the chamber and the first crab having fed enough decides to leave .Considering that a crabs choosing to leave through the storage chamber will take approx 16.8 seconds to reach the S1 (7.5cm * 2.24). SO in approx minimum 1min 2 seconds, a crab should have entered the second compartment. Considering the above scenario, we can expect a crab to enter the second compartment in about 2min 2 seconds, that is double the time we have predicted.

Otherwise a warning will be sent saying " Crabs density low or Tear "Considering the scenario that the trap is healthy, when the first crab enters storage chamber, we can safely assume that there will be atleast 12 crabs in the chamber (4.5 seconds per crab - 1 crab that entered) from this we can start deducing that if the probability of crabs deciding to enter the chamber is 0.5, for 12 crabs in the chamber, when the next 12 come in (making E1 count = 24) there should not be less than 6 crabs entering storage compartment.

Hence we fix 6 crabs with starting count 24 as a threshold factor to determine a tear, if there are less than 6 then there is definitely a tear for storage chamber, we make use of time. We set an IR proximity sensor to crabs crossing over it. So the IR status will not show ON constantly until the second chamber is completely full. Formula for probability is = number of favourable conditions/ Total number of possible outcomes. Considering the above, the number of favourable outcomes for us is: in all, 2/48 .so in all we have 2/48 chance of detecting a crab in our sensor for every 4.5 seconds, considering it that as the time it takes for the crab to migrate from one block to another.

Converting to time, the chance for detecting the IR every 4.5 seconds is 0.4166 (if we consider 2/48 chance for one sec, in 24 seconds we can detect atleast one crab). The denominator 48 will keep reducing as a crab enters the storage chamber. To make this probability simpler we start counting after 12 crabs enter the chamber. Considering the storage capacity we can decide that it would need almost 48 crabs to fill up the chamber. If after 48 crabs we still receive OFF condition on the proximity sensor we can decide that there is a tear in the chamber.

Entrance Compartment Counting:

It count the number of shellfish entering the entrance compartment via an IR sensor (IR 1).This ensure how many fishes have entered the trap

Storage Compartment

Again another IR sensor (IR 2) is used for storage counting. It counts the number of fishes entering the storage compartment via the entrance compartment.

Detecting a Tear in Entrance Compartment:

Let's say, IR1 has detected 10 fishes.IR 2 detects only 5 fishes.After 20 mins, IR1 has detected 20 fishes.IR 2 still detects only 5 fishes.

This means the fishes are entering the trap but are escaping before entering the storage compartment.

This leads us to believe that there is a tear in the net of Entrance Compartment

Detecting a Tear in Storage Compartment:

Detecting tear in storage compartment, we have two methods

Method 1

The proximity sensor blinks whenever a fish crosses over it. Hence if number of fishes is low, the rate of blink is less. Vice-versa if number of fishes is more the rate of blinking the LED is more.

Method 2

We know the number of fishes entering the storage compartment. Hence by assumption we can determine there has to be so many numbers of blinks. If we do not have that many number of blinks then that means there is a tear in the storage compartment.

RESULT AND DISCUSSION

Condition 1

In trap1 when IR sensor E1 (Entrance compartment) is ON state and S1 (Storage compartment) is OFF state then the P1(Proximity sensor) is OFF state. E1 sensor is to count the number of shellfish enters to the Entrance compartment then it goes to the storage compartment S1.In the condition S1 is OFF state so, it has an tear in the E1.E1 is increased based on shellfish enters to entrance compartment at the tear area the shellfish will be lossed.

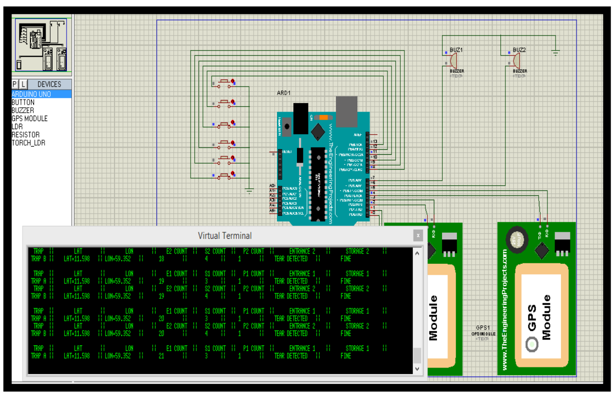

Fig 8 When E1 is ON, S1 is OFF, P1 is Low Blink Rate and E2 is ON, S2 is OFF, P2 is Low Blink Rate

Then, it indicates the tear detected output in the serial monitoring and it produces the beeper sound as emergency alarm. Same process is done at the Trap2, this is shown in fig.8

The transmission and receiving signal is done by wired communication at digital form. The circuit is connected at the wired medium in proteus software and it shows an stimulated output in virtual termial display.

Condition 2

In trap1 when IR sensor E1 (Entrance compartment) is ON state and S1(Storage compartment) is ON state then the P1(Proximity sensor) is OFF state. E1 sensor is to count the number of shellfish enters to the entrance compartment then it goes to the storage compartment S1.

In the condition S1 is ON state and proximity sensor blink is goes on low. So, it has an tear in the S1.S1 is increased based on shellfish enters to entrance compartment at the tear area the shellfish will be lossed. The same process will done at Trap2, this is shown in fig 9.

Then, it indicates the tear detected output in the serial monitoring and it produces the beeper sound as emergency alarm.

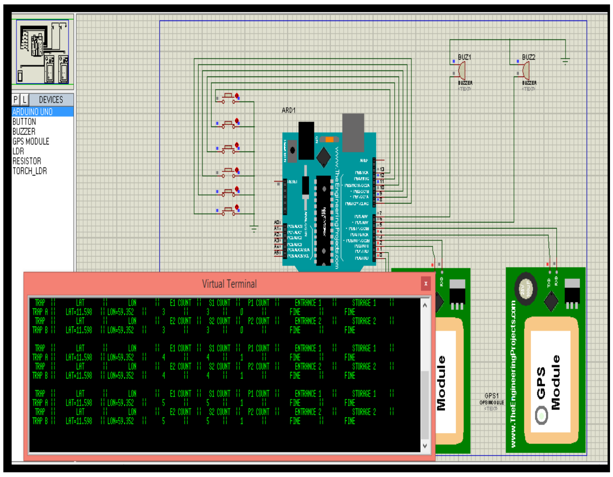

Fig 9 When E1 is ON, S1 is ON, P1 is Low Blink Rate and E2 is ON, S1 is ON, P2 is Low Blink Rate

Condition 3

In Trap1 when IR sensor E1 (Entrance compartment) is ON state and S1(Storage compartment) is OFF state then the Proximity sensor is OFF state.

E1 sensor is to count the number of shellfish enters to the Entrance compartment then it goes to the storage compartment S1.

In the condition S1 is ON state and proximity sensor blink is goes on low.

So, it has an tear in the S1.S1 is increased based on shellfish enters to Entrance compartment at the tear area the shellfish will be lossed. It shows in fig 10.

This same process will done at Trap2. Then, it indicates the tear detected output in the serial monitoring and it produces the beeper sound as emergency alarm.

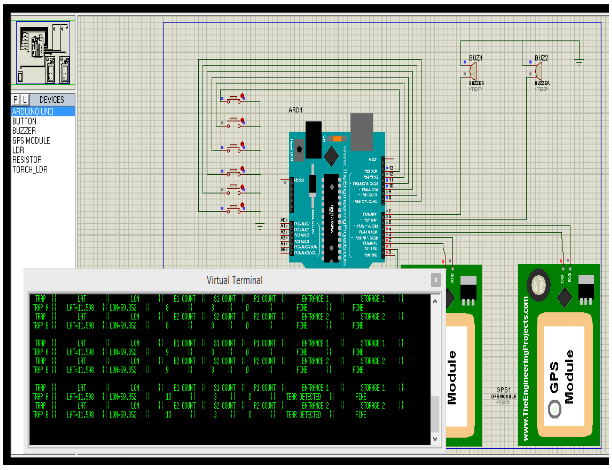

Fig 10 When E1 is ON, S1 is OFF, P1 is Low Blink Rate and E2 is ON, S1 is OFF, P1 is Low Blink Rate.

In trap1 when IR sensor E1 (Entrance compartment) is ON state and S1(Storage compartment) is OFF state then the proximity sensor is OFF state. E1 sensor is to count the number of shellfish enters to the Entrance compartment then it goes to the storage compartment S1.

In the condition S1 is ON state and proximity sensor blink is goes on low. So, it has an tear in the S1.S1 is increased based on shellfish enters to entrance compartment at the tear area the shellfish will be lossed. The same process will done at Trap2.

Then, it indicates the tear detected output in the serial r y a

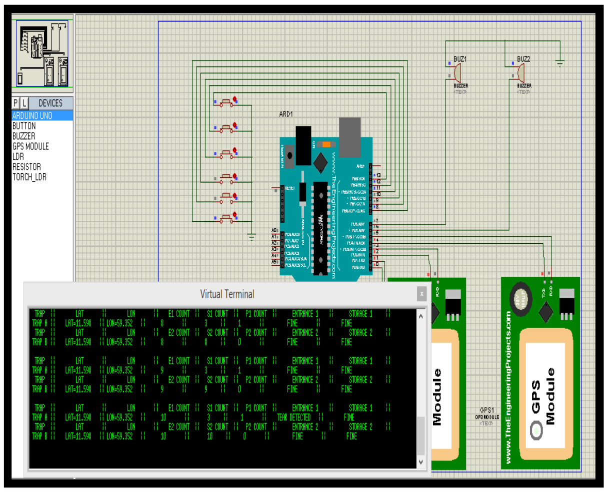

Fig 11 When E1 is ON, S1 is OFF, P1 is Low Blink Rate and E2 is ON, S2 is ON, P1 is High Blink Rate.

Condition 5

In trap1 when IR sensor E1(Entrance compartment) is ON state and S1(Storage compartment) is ON state then the Proximity sensor is ON state. E1 sensor is to count the number of shellfish enters to the entrance compartment then it goes to the storage compartment S1.

In the condition S1 is ON state and proximity sensor blink is goes on low. So, it has an tear in the S1.S1 is increased based on shellfish enters to entrance compartment at the tear area the shellfish will be lossed. At Trap2 E2 is ON state s2 is OFF and p2 is low blink rate, this is shown in fig 12.

Then,it indicates the tear detected output in the serial monitoring and it produces the beeper sound as emergency alarm.

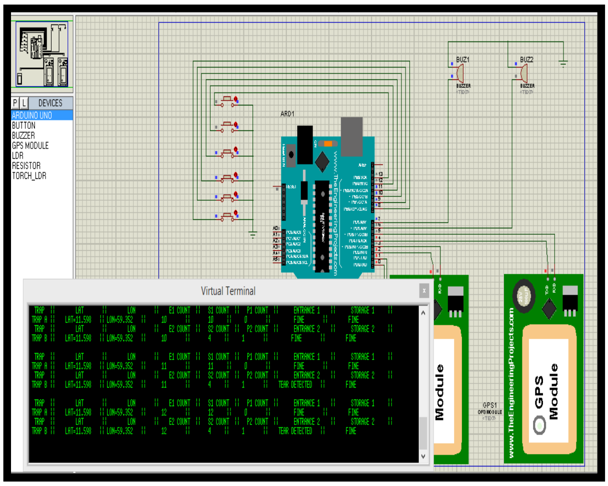

Fig 12 When E1 is ON, S1 is ON, P1 is High Blink Rate and E2 is ON, S2 is OFF, P1 is Low Blink Rate.

Condition 6

As shown in fig 13, when IR sensor E1 (Entrance compartment) is ON state and S1(Storage compartment) is ON state then the Proximity sensor(P1) is ON state. E1 sensor is to count the number of shellfish enters to the entrance compartment then it goes to the storage compartment S1 and proximity sensor blink is goes on moderate.

S1 is increased based on the shellfish entrance to the storage compartment and it stores safely. This same process will done at the Trap2.

Then, it indicates the tear detected output in the serial monitoring and it produces the beeper sound as emergency alarm.

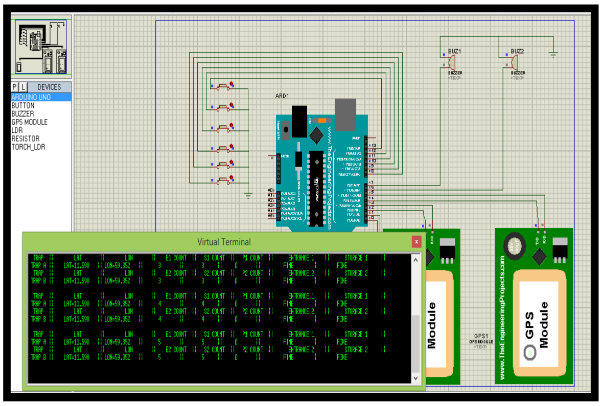

Fig 13 When E1 is ON , S1 is ON , P1 is High Blink Rate and E2 is ON, S2 is ON, P1 is High Blink Rate.

CONCLUSION

The purpose of this paper is to establish low cost, high efficient Smart Shellfish Trap system instead of simple shellfish trap. Instead of simple shellfish, the sensor is installed in a trap to monitoring the process of the catching fish in underground water and displays the information in Serial display at the control room of the Boat.

We can determine the process which is done in the under round water. The main advantage of this system is reduce the fishing time and also reduce the empty traps. Moreover this system will perform multiple trap processing at the same time and increase the commercial fishing profit. For multiple trap we are using GPS to find the location. In previous researchers information comes from static recording of the camera due to expensive, we proposed a system by using sensor for monitoring the fishing.

Future Enhancement

In this paper implemented by wired communication, it needs proper connections, protection and manpower. So, in future it will be better if it is implemented by wireless communication. In wireless communication it needs only the particular frequency and no need of manpower.

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