SOLAR BASED GARBAGE CLEANING AND SURVEILLANCE SHIP FOR LAKE

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Abstract- *Water pollution has been a topic of concern in recent years both in India and worldwide. The floating objects on the water surface many times get clogged in the drainage system and cause choking of the system which results in other harmful effects. Also, such floating objects are consumed by the animals residing in the waters as food items and become the cause of their death. Another concern is the security of the water bodies. To deal with this problem we are proposing this Garbage Cleaning System (Ship). This system works on solar energy so it is non-polluting. The ship is so constructed that it has two metal frames with a mechanical arm on one of the frames and the solar panel on the other. Two dc motors are used for navigation of the ship and two motors are for the movement of the arm and the bucket. As the ship is designed for the operations in water wireless communication system Zig Be is used to communicate with the ship for reliable operation. When the operator identifies any garbage in the water, then according to his/her commands from the laptop, the ship goes to the desired place, picks up the garbage and comes back. For security and surveillance purpose it has a came amounted on it which records audio-video footage which can be seen when the ship docks back home.Thisdeviceisaprototypethatcanprovetobeusefulincleaninglakes, rivers, ponds, etc. and if implemented wisely can prove to be a great aid for security and surveillance.*

Keywords – Design and construction of ship, Control Circuit, Navigation

1. INTRODUCTION

Cleanliness is the basic need of every society. We tend to keep our surroundings clean but we limit ourselves to the areas on our premises or our neighborhood. A majority of the waste is dumped in the water-bodies like seas, rivers, lakes, ponds etc. Thus, causing a high amount of water pollution which is responsible for various ill effects. Our project tries to get rid of this waste and clean the water bodies. Also, our project has the potential to become a great security aid if used wisely. The world currently is facing a lot of problems regarding the degrading condition of the environment we live in. India also has seen the drastic effects of this degradation. One of such problems is increasing water pollution. In India, water pollution is very common and can be seen everywhere around us. Water pollution can be roughlydividedintotwotypes.Type1-Pollution due to soluble wastes like chemicals, industrial waste, sewage etc., Type 2- Pollution due to insoluble floating waste like plastic, thermocol, flowers, leaves, and other garbage. While Type 1 pollution can be treated in specialized water treatment plants, Type 2 pollution has to be cleaned manually and this is a very hazardous and risky kind of a job for the life of the people performing it. The other concern for the countries is the securities of their coastline.There are areas where manual patrolling is not possible. Also, it is necessary to keep track of the activities happening along the banks of the rivers and around the lakes. This surveillance work has to be done secretly without catching the eye of the people.

ITERATURE REVIEW

When the idea of such a device came into our minds, we searched for the counter measures that can be implemented to limit the water pollution due to floating waste. As the issue is related to the environment and the pollution has been responsible for very drastic changes in the environment, we started searching for various environment-related journals to find any relevant information. In September 2001 Wen Zheng, Zhi-Mei Han, and Cang-Shan Zhao investigated floating matter on theriver Haibein Taiwan City and countermeasures [1] to tackle this problem and published it in Environmental Sanitation Engineering vol 9. This literature helped us in finding ways to tackle the problem. The other major problem was to construct an unmanned vehicle that will follow the instructions given to it by the operator present at a remote location. After searching on the IEEE portal for such devices we found M Caccia's research on autonomous surface crafts [2] published in 2006. Also, the work of J. Manley on the development of unmanned surface vehicles [3] published in 2008 helped us in understanding the concepts of unmanned autonomous vehicles. After gathering information about the autonomous vehicles, we shifted our focus to such devices operating in water. According to our requirement, we needed a mechanical arm which would collect the garbage from the water. For this, the study on hydraulics and pneumatics by Hen-fa Yuan, De-chang Xu, Gui-bin Tan and Bai-Yu Wang[4] published in 2008 proved to be useful in understanding the design, construction and working of the mechanical arm. For any kind of autonomous unmanned device, navigation is the most important part. The failure in communication and errors in the directions given to the vehicle can cause undesired results which can prove to be fatal for the vehicle. To tackle this problem, the literature by M. Chitre on underwater navigation [5] gave us an idea about various aspects of navigation and movements of an unmanned water vehicle. Finally, for the designing and construction of the control circuit, supply from the solar panel and wireless communication the work of A. Vasudevan in IJSRD [6] published in 2013 regarding a solar-based autonomous ship proved to be greatly helpful.

1. DESIGN AND CONSTRUCTION OF SHIP

The ship has to perform two tasks viz. Garbage cleaning and surveillance. For this, the ship is constructed with a mechanical arm with a bucket attached to it. A camera is also mounted on the ship as well for recording purposes.

Table 1 List of Components for the construction of the ship

SR. No.	COMPONENTS	SPECIFICATIONS
1	Metal frame for Mechanical Arm	35 mm * 5 mm Aluminiumplate
2	Metal frame Solar Panel	35 mm * 5 mm Aluminiumplate
3	Mechanical Arm	2*(35 mm * 5 mm) Aluminium Plate
4	Pipe	Plastic (2 mm thick)
5	Solar Panel	Aluminum Frame
6	Axel for movement of the arm	Steel threaded bolt 10 mm diameter
7	Bucket	Plastic
8	Belt Drive	Rubber belt plasticpulley with
9	Propellers	Plastic fans

The design and construction of the ship can be divided as follows-

Construction of the body of the ship

Construction of the mechanical arm with frame

Construction of the frame for solar panel Construction of the propeller assembly

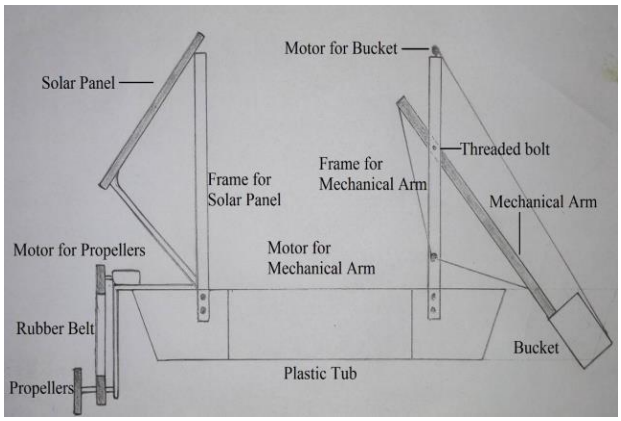

Fig. 1 Schematic of the Ship

The ship is so constructed that less space is occupied by the mechanical arm, solar panel, and control circuit. About 50% of the total space is available for the collection of garbage. Weight is the major area of concern so here a plastic tub as the base of the ship. Two metal frames are erected one for the mechanical arm and one for the solar panel. The frame for the mechanical arm is in the front while the frame for the solar panel is in the back of the ship. This is to maintain the balance of the ship. The frames are made up of aluminum strips which are 35 mm wide and 5 mm thick. Navigation motors are placed on the side of the solar panel. Two motors for movement of the arm and the bucket are mounted on the same frame on which the arm and the bucket are installed. The mechanical arm is movable in the vertical plane. The control circuit is fixed on the rear frame behind the solar panel to protect it from water. As the ship has to float on the water, the weight of the ship plays an important role in the construction of the ship. The weight should not be too high to make the ship sink. Also, it should not be too less to utilize the thrust provided by the motors properly. The weight of the proposed along with the components installed on it with the garbage capacity is given in the table below-

Table 2: Weight of the Ship

Sr. No.	**Components**	**Weight**
1	Plastic tub	700 gms
2	Metal Frame (Arm + SolarPanel)	1050 gms
3	Mechanical Arm	600 gms
4	Solar Panel	1300 gms
5	Motors for navigation	200 gms
6	Motors for Arm and Bucket	200 gms
7	Control Circuit	100 gms
8	Garbage capacity	2000 gms
9	Miscellaneous	450 gms
	Total Weight	6600 gms

Fig. 2 Actual Hardware Setup

The above picture shows the actual hardware setup of the ship. In the above photograph, the structure of the ship is visible and it also shows that the ship can float on the water carrying the weight of the installed assembly. The mechanical arm is mounted in the frame in the front part of the ship with a bucket attached to it. The motors operating the movements of the arm and the bucket are also visible. It also shows the rear frame with the solar panel mounted on it. The control circuit also is fixed on this frame at a considerable height to protect it from water. The propellers along with their motors are also visible in this hardware setup.

2. CONTROL CIRCUIT

The ship requires a control circuit for operation and control. The control circuit is designed by taking into consideration the parameters discussed in the previous chapter like weight, the capacity of the container, etc. The electrical-electronic components required are explained in detail in this chapter along with the block diagram, circuit diagram and other features.

Table 3: Components used in the Control circuit

SR. NO.	COMPONENTS	SPECIFICATIONS
1	Microcontroller AT89s52	40 pin, 4 port, Output Voltage4V– 5V
2	Relay Driver ULN2003	O V. 5V, rated current. 500mA,peakcurrent 600mA
3	Motor Driver L293D	H bridge IC
4	Voltage Regulator 7805	Output voltage 5VDC
5	Relay	28VDC/250VAC, 7A/10A
6	LCD	16 char * 2 lines
7	ZigBee Interface	operating distance 10-100 mts, Data rate 250kbps
8	Battery	12V DC
9	Solar Panel	20W, VOC. 21.4V, ISC.1.4A, 36 cells
10	Motors	12V, 2*10RPM, 2*300RPM

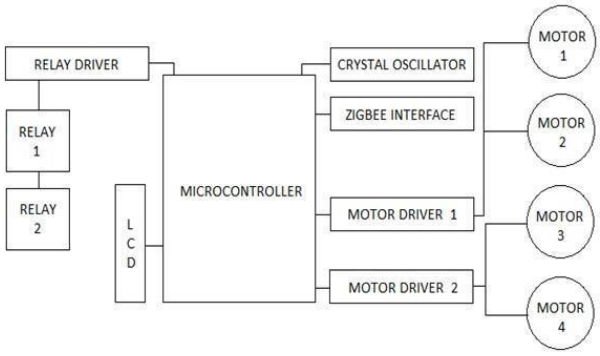

Fig. 3 Block Diagram

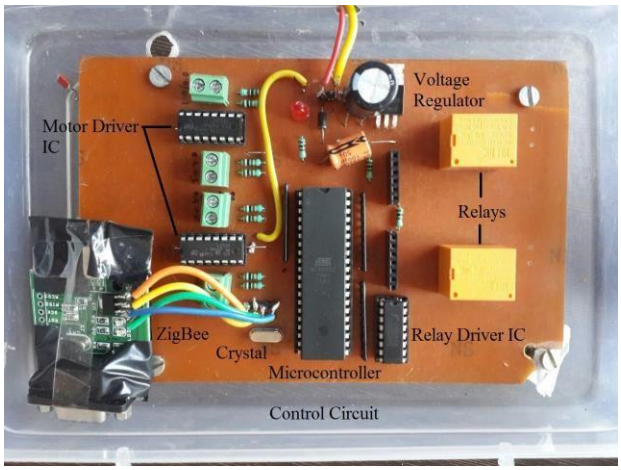

Fig. 4 Pictorial view of Control Circuit

The actual control circuit is used to drive the ship. The microcontroller (AT89s52) is mounted in the center. Two motor driver ICs (L293D) is installed on the left-hand side with provision for motor connections. The crystal oscillator is installed to give pulses to the microcontroller. Zig Bee interface is also connected to the microcontroller. On the right-hand side, a relay driver IC (ULN2003) is mounted along with two relays. On the top of the photograph, we can see the voltage regulator which provides a constant voltage supply to the microcontroller.

3. Navigation

There are 2 belt driven propellers which are used for the navigation of the ship. The navigation can be further divided into the following parts-

A. Forward motion
B. Reverse motion
C. Turning right
D. Turning left

A. Forward motion

To take the ship forward both the motors rotate in the same i.e., clockwise direction. When the operator gives the forward command through his/her laptop/personal computer, the microcontroller sends the signal to the motor driver IC which rotates both the motors in are clockwise direction. The propeller fans thus generate the forward thrust which takes the ship forward.

B. Reverse motion

To reverse the direction of the ship, both the motors rotate in the same i.e., anticlockwise direction. When the operator gives the forward command through his/her laptop/personal computer, the microcontroller sends the signal to the motor driver IC which rotates both the motors in an anticlockwise direction. The propeller fans thus generate the reverse thrust which takes the ship in the backward direction.

C. Turning right

For turning the ship towards the right, the thrust on the left side should be increased for this the microcontroller is programmed such that when the operator sends a command for the right turn, the motor on the right side is turned off generating zero thrusts. The motor on the left-hand side rotates in the clockwise direction thus generating the forward thrust. As a result of the action of both the motors, the ship turns right.

D. Turning left

For turning the ship towards the left, the thrust on the right side should be increased. For this, the microcontroller is programmed such that when the operator sends a command for the left turn, the motor on the left side is turned off generating zero thrusts. The motor on the right-hand side rotates in the clockwise direction thus generating the forward thrust. As a result of the action of both the motors, the ship turns left. An additional control 'STOP' is also provided which is used to terminate the ongoing action at any point in time.

4. Conclusion

The ship can prove to be a helping hand in controlling the increasing problem of water pollution. It can greatly reduce the problems caused by floating waste. Also, it can be effectively used for surveillance purposes and can be used as a piece of good security equipment.

5. Future scope

The ship can be attached with a GPS tracker for the remote location of the ship. Also, a CCTV camera with wireless transmission capacity can be mounted for a live feed of the movements in water as well as on the land. Also, the operating range can be increased.

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