Implementation of Monitoring Feature for Prevention of Inland Boat Capsize Based on Weight Capacity

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Abstract
Inland water transport is most underdeveloped and unsafe means of transport as compared to other means of transportation. Water transport is used not only for transportation of heavy load but also for pleasure rides in urban areas. A carrier ship or motor boat, safety is the basic necessity in both the cases. One of the major reasons for casualties in water transportation is operation in over capacity. In this paper our focus is on the boating activities which take place in rivers or lakes for recreational activities. In such places safety is overlooked and accidents occur. Through this paper we explore low cost, maintenance free and easy to use and construct sensor which will indicate the capacity of people the boat can handle. We also present an idea to prepare a system, to sense, monitor and to some extend control the overloading of boats used for recreational purpose.

Keywords: *Sensor, Indicator, Water, Buzzer, Boat.*

INTRODUCTION

The domain for our topic is the water transportation; may it be over river, lakes or ponds, where Recreational activities take place in the form of boat riding or speed boating. Safety of people undertaking recreational activities in water bodies in the form of boat ride. The maximum capacity of Passengers the boat can carry in very important safety aspect. If this safety aspect is compromised then it has a greater chance of occurrence of an accident. Due to overloading of boat the boat can turn and lead to tumbling of boat and leading to drowning of people. While visitors come to such places with their family to enjoy such tragedies or disaster can shake their faith and thus reduce the number of people undertaking such recreational activities. This in turn can lead to the place losing its significance as a tourist spot and thus hamper economy of people's livelihood and image of the country. Thus, safety at such places becomes inevitable [1].

PROBLEM IDENTIFICATION

The major limitation due to which such safety aspects at such recreational activities go unnoticed are as follows [2][3]:

- The boat operators do not have an indication of capacity of people a boat can handle on their boats.
- The boat operators even if want to look forward towards including safety aspect, it is not cost effective, hence reluctance to go for it.
- No motivation and cheaper means present with the boat operators for implementation of safety.
- The boat operators are unaware of any safety measures existing except for life vests.

Lack of safety culture among the boat operators. Through this paper we are exploring cheaper alternative solutions for the safety of passengers on board.

LITERATURE REVIEW

The maximum capacity of the water boat depends on the size of the boat i.e. its length and breadth of the boat, or in other words, the dimensions of the boat. For the safety of people travelling in the boat, some standards are issued by the government to eliminate the risk of unbalancing the boat due to overloading of its passengers. In various countries, there are capacity plates placed near the operator which indicate, maximum weight capacity or maximum number of people the boat can carry safely in good weather. Maximum weight consists of combined weights of passengers, gear and motors. These capacity plates are for boats whose lengths are less than 20 feet. An example of boat capacity plate is shown in Fig 1 below:

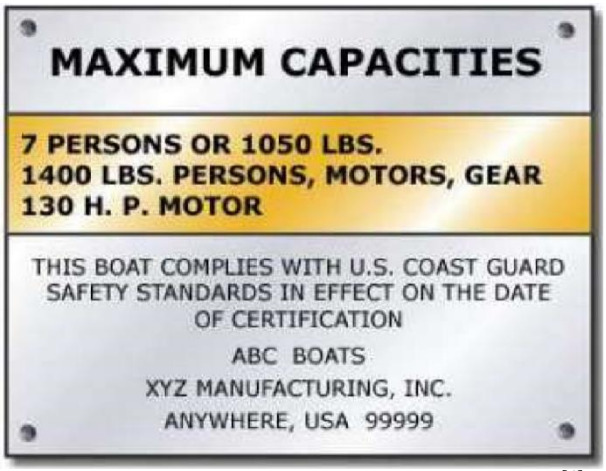

***Fig. 1**: Example of Maximum Capacity Plate* [4]

By using maximum capacity plate operators can know the allowable persons on board and act accordingly. The assumption here is that each person weighs around 150 lbs. i.e. 68 kg approximately.

Calculation

The general rule of thumb for calculating the maximum number of people is done using below mentioned assumptions [5]:

- Assuming the average weight of any person under consideration for weight calculation is 150 Lbs. or 68kg.
- Assuming boat is of length less than 20 feet.

The formula for calculating maximum number of persons boat can carry safely under good weather is approximated based on the water displacement and applying the generic Simpsons rule [6] as follows:

$$Number\ of\ People = \frac{(Boat\ Length\ (ft.) \times Boat\ Width\ (ft.))}{15}$$

Example: For a boat 19 feet long and 7 feet wide, the number of persons is given as

$$Number\ of\ People = \frac{(19 \times 7)}{15} = \frac{133}{15} = 8.86$$

Hence for the given dimension maximum number of people boat can carry safely under good weather condition is 8.

PROPOSED SOLUTIONS

The paper proposes to automate, the passenger safety onboard, by indicating and monitoring the weight of the people on board and hence limiting the boat capacity.

There are several ideas which can be implemented keeping in mind the conducting property of water. The various ideas which can be used be implemented are as follows:

1. We can use a compression type of load cell below the board on which the passengers are to be seated, to measure the weight of the passengers. Four load cell will be required for it and they will be connected in averaging mode. As soon as the maximum capacity of getting passengers on board is reached there would be a metallic plank which would get out of the boat, through a hole and will make contact with water. With the plank a buzzer circuit will be connected, so that when plank makes contact with the water the buzzer will go on indicating maximum load has been achieved. This alarm will allow operator to take necessary action for safety. The block diagram is as shown in Fig 2. The costing for making this system involves the cost of 4 load cells, controller circuit and motorized circuit to move conducting rod forward and backward i.e. in and out of the water.

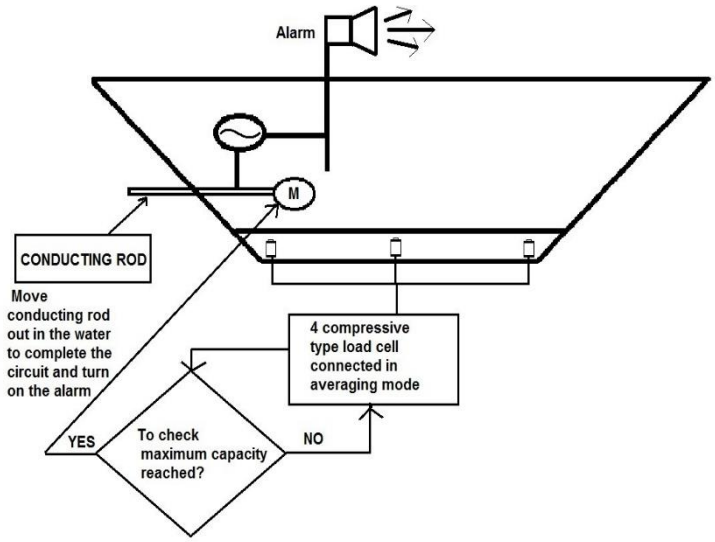

Fig. 2: *Block Diagram of Implementing Method 1*

2. We can use metallic or rod made of conductive material so that when it comes in contact with the water present in water body it conducts. We plan to mount these rods in the shape of inverted 'L' from all four sides of the boat. This method uses the phenomenon of displacement of water due to the load in the boat. As the weight in the boat increases the boat will displace water and dig into water, and increase water level around the boat. The rods will thus make contact with the water and circuit will be completed to get the buzzer on and set alarm on. The block diagram is shown in Fig 3. The cost involved in this technique is only of the conducting rod which we are going to place around the boat for weight measurement and the circuitry involved to turn buzzer on and off. There is no maintenance involved in the system. Troubleshooting the system is also easy. This low cost- and hassle-free feature makes the boat operators to go for its installation and provide a safe ride to the visitors.

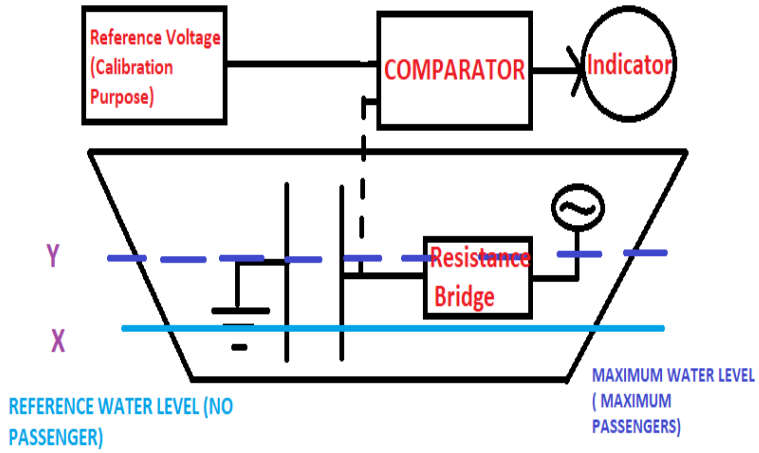

Fig. 3: *Block Diagram of Implementing Method 2.*

LIMITATION AND FUTURE SCOPE

The major limitation in the second method is that water is not steady, hence while people are getting into the boat the buzzer can go on, even if the maximum capacity of the boat is not reached.
The future scope is to take steps to remove the limitations and implement it for putting it into commercial use.

CONCLUSIONS

This indicator and monitoring system is a low cost, easy to use and maintenance free system. This provides safety to the visitors coming for recreational activities and optimize operator's profit.

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