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MODIFICATION OF A WATER VEHICLE TO PREVENT ACCIDENT IN WATER

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Abstract- *Overweight causes thousands of accidents in water vehicles every year. This paper proposes a new technology coupled with the main design of water vehicles to reduce the accident. This technology includes water level indicator, Arduino, GSM module, gate valve. When the vehicle has crossed the water level indicator, it will respond with the action so that the main engine stops and transfers the warning message to the authority until overloading is reduced.*

Keywords: Arduino, GSM module, Gate valve, Overweight, Water level indicator

1. INTRODUCTION

Bangladesh is the world's largest delta from the confluence of the three major river system [1]. In the point of traffic intensity, the inland waterway network produces about more than 1.57 million passengers per route-kilometer of the waterway [2]. So, water vehicle such as lunch, ship, boat, etc. are one of the major inland water transport system. At least more than 4000 people died, 520 people injured and 400 people remained missing in more than 550 passenger launch accidents that took place in the last 38 years (1977-2013) [3]. One of the major reasons for the accident is overloading, which is around 43% compared to the other factors [4]. Mainly accident occurs when the vessel has crossed the dead weight tonnage safety limit. This paper introduces a system which has reacted on the action of overloading. Overloading has been sensed by the water level indicator, which has sent signal to the Arduino board. In response with the negative signal the engine fuel supply control valve has stopped automatically by a servo motor and an alarm has switched on to alert the people. Immediately the condition of the vehicle has been sent to a server and a mobile device by GSM module to take proper steps. Until the overload has been reduced the engine has not run. Whenever overload has been reduced, the vessel safety control unit react as normal and the vessel has been ready for start. The main purpose of this project is to minimize the accident in the water. Also, save valuable life and make water transportation system safe and reliable. This project is sustainable because it is economical, environment friendly and easy to install.

2. METHODOLOGY

Mainly, the safety control system of a water vehicle is introduced to ensure that the vehicle is either exceeds the DWT or not. At the beginning of the journey, the water level indicator senses the water level with respect to the DWT. If the water level exceeds the DWT, an alarm will siren to alert people and the engine will shut down automatically. The collected data from the water level indicator has immediately sent to the Arduino board. Hence the microcontroller within the Arduino board analyze the collected data with respect to the programmed condition. When the water level does not exceed the safety limit of DWT, the vehicle functioning normally and indicates a green signal by a LED. In case of exceeding the safety limit of DWT, the microcontroller sends a command to the servo motor to shut down the gate valve of the engine fuel reservoir. Also, turn on the buzzer to alert people about the overloaded condition. GSM module 900D connected with the Arduino board, which is always update data about the condition of the vehicle. This time to time updated data has been sent to a server. Until the overload has been reduced, the vehicle does not start. The whole process is shown in fig. 1 by a flowchart.

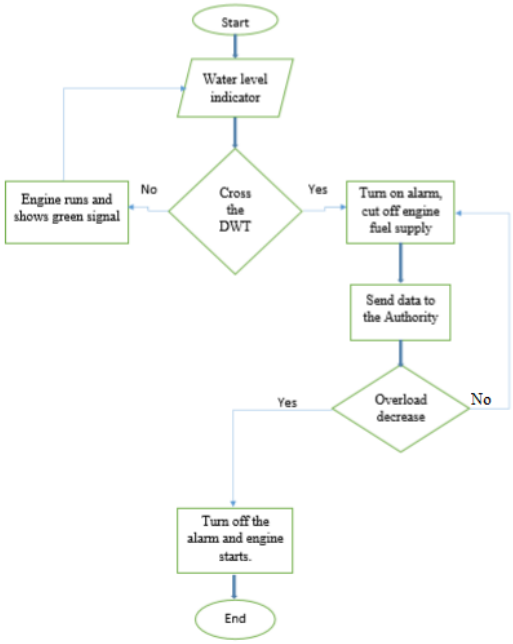

Fig. 1: Flow chart of the control logic

3. MODEL DESIGN

The model of a ship was made by using plastic wood shown in fig. 2. Two water level indicators were mounted on the model. These two were placed on both sides of the ship, where the plane of the center of buoyancy was acted (assumed). The water level indicator was indicated its maximum limit for a fixed load. And the maximum load was fixed 500g for the model. A servo motor was fitted with the gate valve to control it's opening and closing function. Arduino, GSM module 900D, alarm system, led were mounted together on the main control circuit board. A 16 X 2 LCD display was used to show every changing situation of the vehicle.

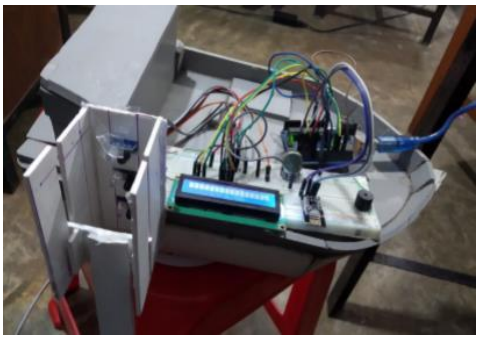

Fig. 2: Model of a ship

4. ELECTRONIC COMPONENTS USED

Arduino: In fig. 3 the main controller of the vehicle safety control system unit is shown, which is Arduino Uno R3. The Arduino Uno is an open-source microcontroller board that can be programmed easily, where the ATmega328P microcontroller is used. It has a 20 input-output pin and some GND, V_{cc} pin, where 6 pins used as PWM and 6 pins as analog input. The board also contains a USB connection, an ICSP header, a power jack, and a reset button. The Arduino board requires a steady 5V power supply to operate [5]. The Arduino board receives data from the input device and processes them in the microcontroller to execute the command in the output device.

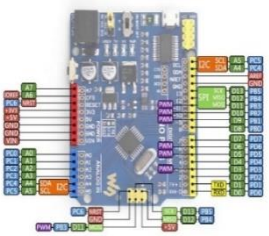

Fig. 3: Arduino Uno R3

IR proximity sensor: Fig. 4 indicates the IR proximity sensor. It is an infrared sensor used for obstacle sensing, line sensing, encoder sensor, etc. The operating voltage of the sensor is 5V. The sensor provides a digital output based on 0 and 1 [6]. It has a transmitter, a receiver and a potentiometer in its circuit board. The water level indicator has been made by using a series of IR proximity sensors in one column. Each sensor is equidistance from each other which are connected to the Arduino Board. The main task of this device is to sense the water level.

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Fig. 4: IR proximity sensor

Buzzer: A buzzer is a D.C. voltage operated audio signaling device which is shown in fig. 5 [7]. It is used to alert people when the water vehicle crosses the safety water level limit.

Fig. 5: Buzzer

Servo motor: A servomotor which is shown in fig. 6, is one kind of actuator that is used for precise control of angular or linear motion [8]. The working principle of the servo motor is the PWM function. The angle of rotation of the servo motor is controlled by the duration of the pulse applied to its control Pin [8]. In this project, it has been used for controlling the action of the gate valve. During the overloaded condition, it automatically shut down the gate valve of the fuel supply system.

Fig. 6: Servo motor.

GSM module 900D: A GSM module is one kind of circuit that is used to establish communication between a mobile device or a computing machine and a GSM system [9]. In this project, GSM module has been used to send time to time situation of the water vehicle to the vehicle safety monitoring unit, which is shown in fig. 7

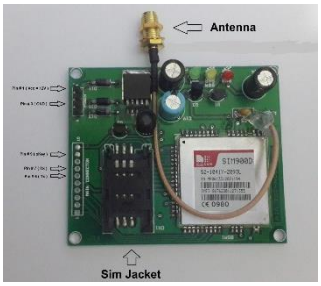

Fig. 7: GSM 900D module

LCD display: A 16 X 2 LCD display which is shown in fig. 8, is a very common electronic display module which is made by the liquid crystal to produce a visible image [10]. In this project, it is used to show time to time update of the vehicle.

Fig. 8: LCD 16 X 2 display

5. CIRCUIT DESIGN AND SIMULATION

The whole circuit was designed and simulated in the ISIS professional v7.7, which is shown in fig. 9.

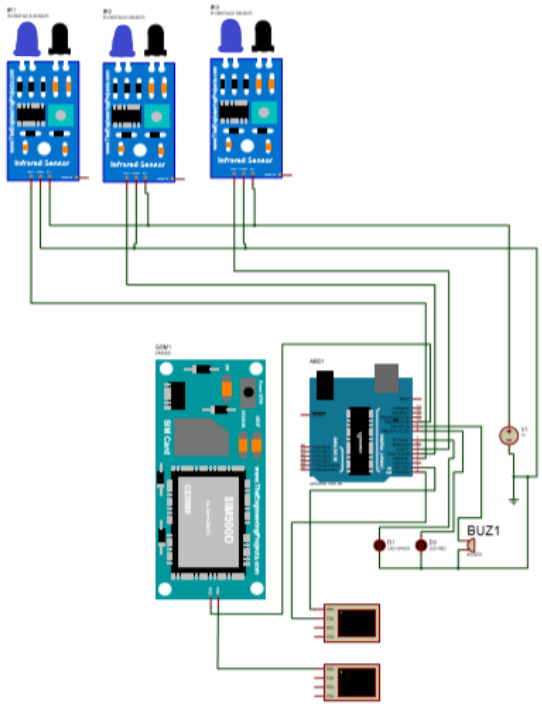

Fig. 9: Circuit arrangement in Simulation software

5.1 Warning message in mobile device

The output data from the vehicle processed in the microcontroller is then transferred through GSM Module 900D to the desired mobile device. A photograph of a warning message in the mobile device is shown in fig. 10.

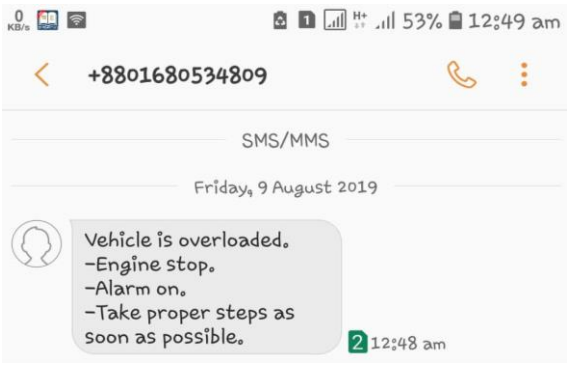

Fig. 10: Warning message from the vehicle

6. PERFORMANCE ANALYSIS

Table 1: Safety control system data analysis

Weight variation (gram)	Green Led	Red led	Alarm	Gate valve
100	On	Off	Off	Open
250	On	Off	Off	Open
300	On	Off	Off	Open
550	Off	On	On	Close

Table: 1 is produced to analyze the performance of this project with the variation of weight.

7. AREAS OF FURTHER DEVELOPMENT

The main safety control system will be developed by using a Raspberry Pi. An Android application will be developed for the passenger to check the overall condition of the ship at anytime from anywhere. A website will be developed so that BIWTA could get all the information about the watercraft. A better servo motor will be used to control the gate valve precisely. The alarm system and water level indicator will also be developed to make the system more reliable.

8. CONCLUSIONS

Every year a lot of people dies in our country due to watercrafts accident. The reason behind this is mainly overloaded the watercrafts. The main motto of this project is to save valuable life and goods. Practical implementation of this GSM based safety control system in Bangladesh can save a lot of people's life. BIWTA can be informed about the watercraft condition by sending an SMS. They will have to play a vital rule in this system. As this project is low cost, economical and easy to install, so it can be installed in any watercraft easily.

9. REFERENCES

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10. NOMENCLATURE

Abbreviation	Meaning
BIWTA	Bangladesh Inland Water Transport Authority.
DWT	Dead Weight Tonnage.
GSM	Global System for Mobile Communication.
ICSP	In Circuit Serial Programming.
PWM	Pulse Width Modulation.