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An Innovative and Smart Method to Detect Fluid Level in a Storage Tank

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Abstract

Background/Objective: Our smart underwater system will help detect the current level of fluid in a given storage system (say, a tank) and further detect rate of rise of the fluid in the tank, determine abnormalities in the fluid composition, whether or not the fluid rise is uniform and if the sensors used for the process are faulty. **Methods/Statistical Analysis:** Using the principles of refraction of light in different optical media, and employing sensors measuring the same, the estimation of level of fluid rise (say, water) in any closed tank (or similar enclosure) using certain instruments attached to its sides as 'panels'. **Result/Findings:** Several more applications are made possible by using electronic instruments to measure time, average time, maximum value of photon density, and difference in initial value of photon density. **Conclusion/Application:** Normal functioning of the motor, uniformity in rising rate, alert in advance, change in fluid composition with salt or other deposits (that shows change in optical density), if the panel itself, by repeated use, has any accumulation of salt or other deposits blocking the panel and thereby affecting the working of the panel.

Keywords: Fluid Rise, Motor, Normal Functioning, Optical Density, Optical Media, Photon Density, Refraction, Sensors, Uniformity

1. Introduction

Today it is the need of the hour to conserve water (and other fluids) especially in commercial application where precise quantities of fluids are needed for synthesis, preparing commercial grade products, or in simple apartment water tanks, to prevent overflow and ensure that an alarm may be triggered as soon as the required quantity of the fluid has accumulated in the storage system (a tank).

While this very challenge has already been successfully implemented, our new approach is to achieve using the same using the principles of optics, a field that was been hitherto unexplored.

2. Materials and Methods

A commercial grade underwater-photon flux density sensor will serve as the receptor in charge of receiving the light rays. A torch or similar source of a beam of light may be used to propagate the light in the closed tank. A timer may be employed to extend functionality to speed of filling up (which can help in predicting when a certain level may be crossed), check uniformity of the optical media, efficient working of the filling arrangement (a motor).

The principal method employed is the Law of Refraction: that a light ray changes its path (or direction) when there is a change in the optical densities of

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the media it (the light ray) encounters. When a light ray travels from the air towards water (A denser medium) it changes its path towards the normal to the surface. And when a light ray from water changes optical media, travels through air (an optically rarer medium) it bends away from the normal to the surface[1,2].

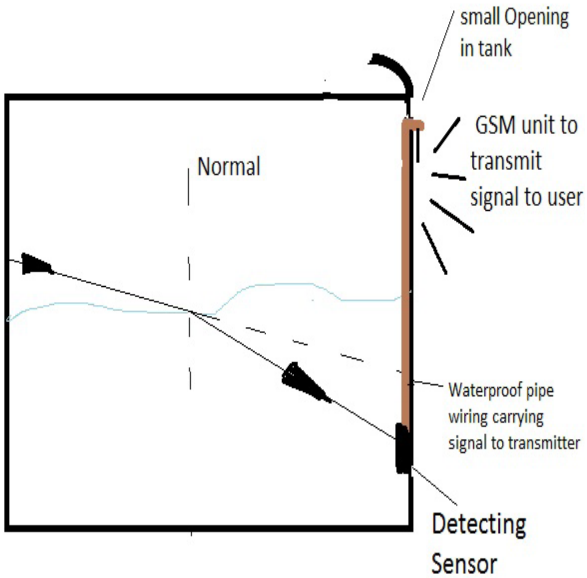

Figure 1. Rise in water level triggering the alarm.

3. Proposed System

For all purposes henceforth, references will be made to closed water tanks in general to represent the working of the underwater sensor arrangement.

In the empty water tank, two points across the tank may be pinpointed and marked. The angle with respect to the horizontal is measured Figure 1. This is to show that if the water level is negligible or anywhere below a required reference point, the light ray from the sensor should be linear (since there isn't any refraction in the light ray) a photon sensor at the receiver would show highest density of light, comparatively to other receivers that can be placed nearby. Though they may also register some amount of light received, the magnitude would surely be at the receiver end. With the entry of water in the closed tank, refraction of the incident light ray would be noticed and that it reaches the other end of the tank at a different position, which can be determined using alternate sensors nearby and their response comparatively to the

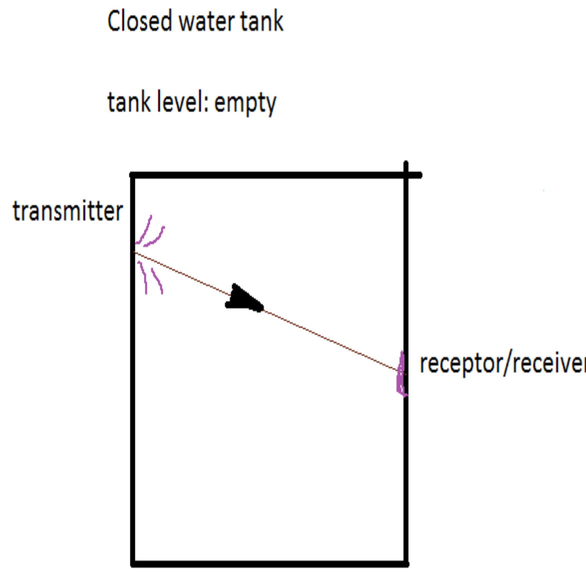

Figure 2. Path of light ray without refraction.

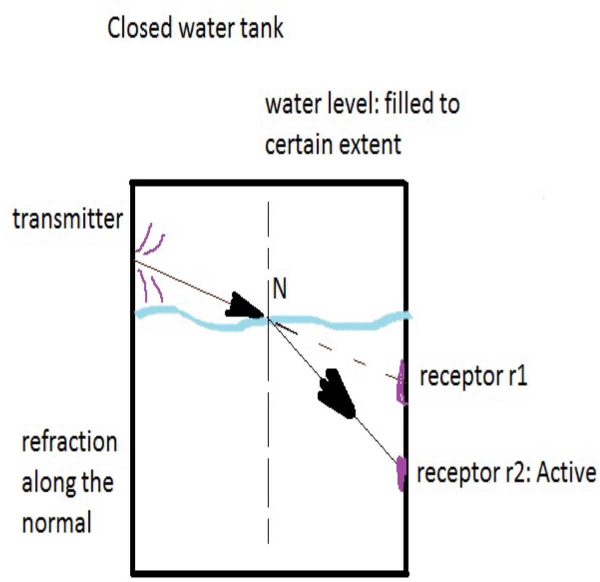

Figure 3. Refraction of light ray triggering second receptor.

incident light ray. The path of light ray without refraction is revealed in Figure 2.

Figure 3 So when the water level rises, at the point of change in media (point N onwards) there is refraction.

The receptor is a device that will monitor photon flux density and expect constant input. When receptor R1

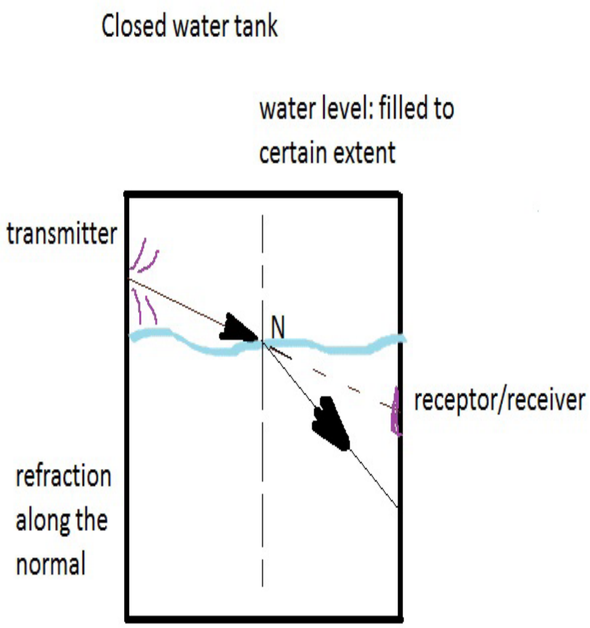

Figure 4. Refraction of light ray triggering receptor.

(previously actively high) doesn't trigger a signal, and when receptor R2 senses the light beam (within a particular time interval too) the distance between the two receptors being given as a value to a comparator, can return the rough equivalent of the angle of refraction, and with that comes its direct dependence on the level of media. Multiple transmitters may also be employed for clarity and precision[1,3].

Using a similar approach, when there are 2 receivers, receiver 1 not receiving the stronger photon flux density means that water level has crossed the desired level and receiver 2 receiving the stronger photon flux means that the water level has been confirmed and alarm suitably triggered by sending the signal through the waterproofed piping to the GSM unit. In Figure 1 more receivers (or receptor units) may be used for more precision[2,3] (Figure 4).

3.1 Possible Applications can be Achieved

- The water level in a closed tank can be determined using our unique system.
- The rate of water flow can be detected and calculated by taking the average time for the water rise between two adjacent receptors and time counters.
- By identifying the rate of fluid rise in the closed tank and its precise water level at a point, a GSM unit can be employed to trigger an alarm system to the user.

4. Feasibility

The arrangement for this functioning is such that the closed tank should be covered from any optical interference, but the opening may be kept with an opening that may be opened as the user wishes.

The light rays employed may be ordinary light rays (the same used by divers and professional marine scientists, say waterproof torches which must be more powerful with increasing depths, say in large tanks, dams). The power source for the torch may be given by a battery that will alert the user when its power has gone below a certain level (so that the battery may be replaced in time).

4.1 Cost Factor

A simple torch (for a source of light) to be employed underwater, can be assembled, costing around $7. The sensors required for determining strength of photon flux density can be procured from an overseas manufacturer (LICOR Inc.) and have priced the sensors around 300 USD, but provision for exemption in customs for large transaction made by educational universities. A GSM unit or similar device for issuing alert can be used, which is quite affordable. Piping, to transfer the signal from the sensor to above the unit, is required, with costs varying according to user's choice of materials.

5. Conclusion and Future Prospects

Though the method may not be the most economically viable, it gives rise to a new field of optics underwater that was hitherto unknown and undiscovered. For large dams that are constructed with similar designs, or commercial units that deal with specific composition of fluids like aerated drinks, medical fluids (like Dettol, hand washes, syrups) etc. the arrangement is also feasible.

6. References

1. Polvani D. Underwater navigation by aided light sensor. 2009 Mar 17 (Patent No: US7505364).
2. Bartz R. Under water lights catering sensor. 1994 Sep 27 (Patent No: US5350922).
3. Mileski PM, Morency RL. Optical motion sensor for underwater object. 1996 May 28 (Patent No: US5521376).