

Automatic Low-cost Water Level Indicator for Tanks and Hand Washing Water Dispensers in Kitui; Kenya during the Covid 19 Pandemic

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Abstract

In day to day life, millions and millions of liters of water is being wasted through overflowing or excessive usage. In Kitui specifically, water availability by itself a challenge since the area rarely experiences long rainy seasons, has no flowing rivers, the dams are dry and there are only few boreholes available. It is for these reasons that we propose the adaptation of probe sensors to detect the water level in the hand washing water dispensers and storage tanks of the available boreholes in Kitui. The probe sensors detect the water level when they come in contact with them and in return a light emitting diode of the corresponding probe blinks. The system calculates the water level up to 100% by intervals of 25%. Moreover, the system is also connected to a relay switch that automatically turns on or off based on the water level. When each interval is reached, the light emitting diode blinks. At 25% the water level in the tank is lowest and this prompts the buzzer to produce a sound notifying the attenders that the tank needs to be refilled. An automatic refill also takes place due to the additional circuit connection. At 100% the relay goes OFF and water refill stops hence water wastage is avoided.

Key words-*Light Emitting Diode, Probe, Relay, Resistors, Sensor probe, Transistors, Water Level Indicator*

I. INTRODUCTION

Water is life. The amount of water that covers the earth surface is very large [1]. The bitter truth is that a bigger percentage of this water is also not healthy for humans. The small percentage of water fit for human use is found in rivers, streams and lakes. Treatment of these waters is also necessary for one to be sure of the state of the water one is using. A research was carried out and it was estimated that a person in India uses more than one hundred liters of water per day. It is proposed in the research that the rate of water consumption by a single person would increase to almost two hundred liters by the year 2025 [1], [24]. Various researches are concerned about ways of reducing water wastage or maximizing water use. For instance, Mervat et al. discovered that gas absorption takes place faster when the water and gas mixture streams flow in opposite directions in counter-current flow. This ensures limited water usage and real time actions [2] [3]. In another research work, a conclusion was made that acidic waste water can be neutralized using neem leaves powder [4], [23]. Through the re-use of acidic water, water is saved. Elzaki et al. [5] proposed an anti-hygroscopicity agent for ammonium nitrate. This ensured the ammonium nitrate maintained its quality and water isn't wasted in it since it's not needed; it can therefore be used for other applications. Khalid et al. [6] discovered that the purer the water, the lesser the corrosion of the steel water pipes. Their work has involved water saving indirectly in that if the water was impure, more and more water would cause the corrosion and since that's not the case, less pure water is used and the steel pipes serve a

long period of time which is economical. The neutralizing of Acidic wastewater produced from trinitrotoluene factory by Rock granules ensured pure water which can be re-used is obtained therefore avoiding wastage. This is according to Dafa et al. [7].

Water usage in the whole continent has also increased due to the corona virus pandemic. They say cleanliness is next to Godliness and it is only through proper hand-washing and observation of other safety rules that we can beat the corona pandemic. This necessitates the need for water conservation. A good number of homes use additional water tanks to store water especially during the rainy seasons or they pump water from the wells. These methods are not enough to monitor the amount of water used in a home. Water is still wasted at different working sections. Efficient management of water usage is important. This can be achieved when the amount of water consumed is really known. However it is very difficult to monitor the amount of water in the overhead tanks and hand washing water dispensers. A water level indicator gives information about water level in storage. They are very important since they help reduce water wastage. In this paper we designed a sensor to detect water level in the tank and hand-washing water dispensers at five different levels namely; 0%, 25%, 50%, 75% and 100%. At no point should the tank be completely empty before a refill. This project will help individuals to be able to monitor the water levels in the tanks and hand washing water dispensers therefore curbing water wastage.

A. Problem Definition of the Proposed Work

Water level indicators have been in existence but still there is time, power and water resources wastage because of the manual monitoring of the system. These manual operating water level indicators have low response rate and frequent breakdown. Moreover, very little research has been conducted regarding water wastage from the hand-washing water dispensers during the Covid 19 pandemic period [8], [9], [10], [25], [26]. Hence this research looked into how water wastage would also be avoided from the hand washing water dispensers [11], [27]. This paper looks into the development and implementation of such a simple and cost effective automatic water level indicator which timely monitors the water level in tanks and hand-washing water dispensers [12], [13], [14], [15], [16], [17], [18].

B. The objectives set to be achieved from this project

- To develop a cost effective water level control system that would check the water level in the tanks and hand-washing water dispensers.
- To check the level of water in the tanks and hand-washing water dispensers. At 25% water level in the tank and water dispenser, the relay goes ON and the motor would cause the automatic pumping of water into the tank; at 100% water level in the tank and hand washing water dispenser, the relay goes OFF and no more water enters the tank and the hand-washing water dispenser as many researchers applied different techniques [19], [20], [21], [22].
- To display the water level by a blink on the light emitting diode.
- To monitor the level of water in the tank and the hand washing water dispenser. If the levels inside is low, the LED turns ON and sound is produced by the buzzer. The tanks are then refilled. Similarly if the tank and the hand-washing dispenser are full, the LED turns ON and water refilling in the tanks stop.

II. HARDWARE ARCHITECTURE

The components used in the fabrication of the water level indicator include; connecting wires relays, light emitting diodes, sensor probes, BC-547 transistors, 220 ohm resistors, buzzers, PCB and 9V battery as shown in see Fig. 1. All the components played a huge role in the proper functioning of the automatic water dispenser.

A. Buzzer

Buzzers are sound producing devices. In this project they are used to notify the users when the tank and the water dispenser are almost empty or full with water. This would prompt the automatic refill in case of an almost empty tank and a stop-refill in case of a full tank. The buzzer is depicted in Fig. 2. Key:

- A Transistor.
- B Printed Circuit Board (PCB).
- C Light Emitting Diode (LED).

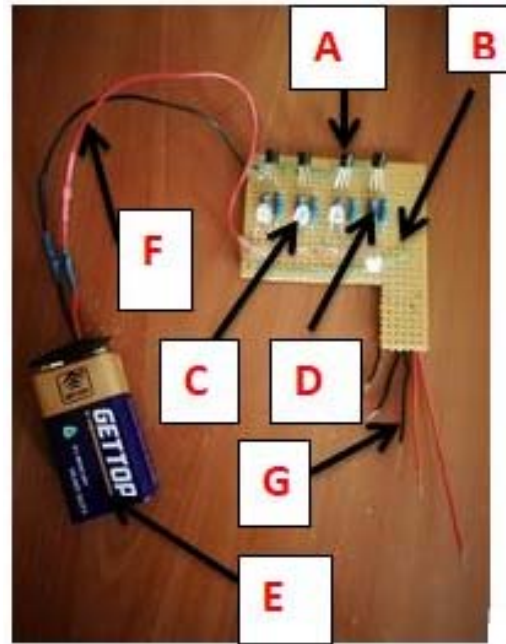


Fig. 1. Water Level Indicator Diagram

- D Carbon Resistor.
- E 9V Battery.
- F Connecting Wires.
- G Water Probes with Sensors (Probes of different lengths).

B. Transistors

A transistor is a very important component in a circuit. It has several functions but the main reason for using them in our project is to be able to control the output current based on the supplied 9V input voltage. It prevents excessive flow of current through the circuit to avoid damaging other components and the final completed device, the water dispenser.

C. Power Supply

Power supply provides correct current to power the loads. A 9V dc power source was used to power the transistors, light emitting diodes, buzzers, relays and resistors in our project.

D. Connecting Wires

Wires are used between components in contact for circuit completion.

E. Relays

Magnetic relays help in isolation of electric circuits as detailed in [1]. The relays in this project act as switches. When the tank and hand washing water dispenser are almost empty, the relay goes ON to enhance automatic water refill in the storages. When the storages are full the relays go OFF and the pumping of water into the storages stops. The relays are made up of an input and an output section which made them very useful in this project.



Fig. 2. Buzzer

F. Light Emitting Diode ,LED

Light-emitting diodes are semiconductor devices that emit light when current flows through them. They come in different colors and work best as indicators. In this project colorless LEDs were used to produce different color notifications when water was at different levels in the storages.

G. resistors

Resistors normally provide opposition to the flow of current [2024]. In this project, four carbon resistors each of 220 were used. The resistors ensured only the correct amount of current flowed through the LEDs to avoid damage to the entire water level indicator.

H. Printed Circuit Board , PCB

The PCB provided a surface onto which all the electrical components were mounted for effective working of the water level indicator.

I. Sensor Probes

Sensors and probes usually report the presence of particular ions, molecules or molecular events in cells. In this project the sensor probes were used to detect water in the storages. They were cheap and readily available in the locality hence a good reason for choosing them. When the sensor probes detect water they would send a signal to the LEDs which would blink and notify the users of the level of water in the storage.

III. WORKING PRINCIPLE OF THE WATER LEVEL INDICATOR

The operation of the water level indicator is based on three major terms namely; when there is completely no water available in the storages; that is the storages are at 0% water level, when the level of water in the storages is intermediate; that is at (25%, 50% and 75%) and when the tank is full; that is the storages are at 100% water level..

A. No water in the tank (0% water level in the storage)

When the tank and water dispenser have no water completely, no conductive path exists between any probe and the base probe which is connected to the 9V dc source. This would make the sensor region have insufficient biasing therefore it will remain in the cut-off region and the output across transistor collector will be slightly below the 9V. The output

voltage being low would make the sensor prompt the buzzer to beep, the LED would blink, the relay would go ON and automatic refill of the tank would take place.

B. Intermediate levels (25%, 50% and 75% water level in the storage)

At 25%, 50% and 75%, there is some water in the tank and hand washing water dispenser. A conductive path is therefore established between the sensing probes and the common probe therefore the corresponding transistors get enough biasing and starts conducting. The corresponding LED blinks.

C. Water Full in the Tank (100% water level in the storage)

When the tank becomes full, the top level 4 probe gets the conductive path through water and the corresponding transistors get into conduction. This activates the buzzer to beep and LED blink. The relay will then go OFF to stop the motor from pumping water into the storages hence stop water wastage. Fig. 3 shows the cycle of operation of the water level indicator. With the power source connected, the sensor probes senses the availability of water then sends information to the transistor which acts as a switch and finally notify the LED whether to blink or not depending on the water level in the tank.

IV. RESULTS

Levels 1, 2, 3 and 4 shown in Fig. 4 indicate the water levels in the tank and represent the reference values for proposed control scheme. Level 1 is the least water level at height one (H1) as shown in Fig. 4.(a). When the sensors get in contact with the water, the corresponding colorless LED blinks while the buzzer beeps to enhance automatic refill of the tank. This automatic refill is enhanced by the relay mechanism for sustainable and real time operation. In Fig. 4.(b) both level 1 (water level H1) and 2(water level H2) sensors are in contact with the water so the corresponding colorless LEDs blink. Fig. 4.(c) shows that the probe sensors of levels 1, 2 and 3 are in contact with water (water heights H1, H2 and H3 respectively) therefore the corresponding LEDs blink. The last section of the Fig. 4.(d) shows that all the level sensors; 1, 2, 3 and 4 are in contact with water (water heights; H1, H2, H3 and H4) so all the corresponding LEDs blinked. However, since the tank is now full; at 100%, the buzzer beeped to notify the users of the condition of the tank. Moreover the relay went OFF to stop the motor from pumping water into the tank hence water wastage was avoided beside process automating for safe usage. The resulted project's outcome showed the efficiency and suitability of our work in the period of the Covid 19 pandemic.

Key

- Level 1 25% water level in the tank (Tank almost empty)
- Level 2 50% water level in the tank
- Level 3 75% water level in the tank
- Level 4 100% water level in the tank (Tank full)

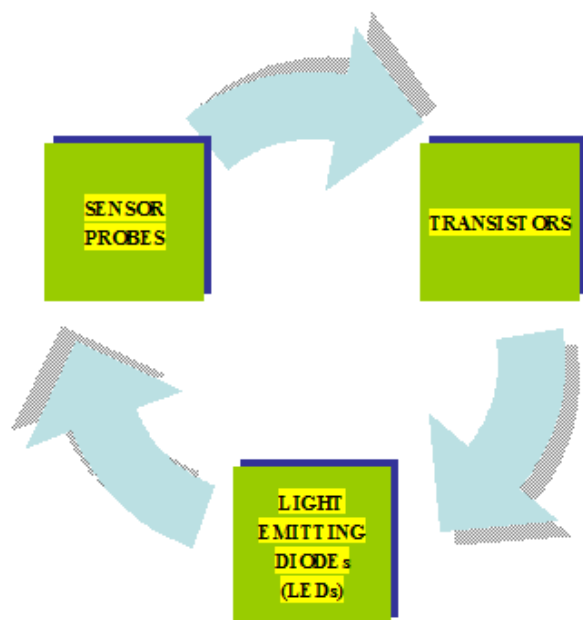


Fig. 3. Cycle of operation of the Water Level Indicator

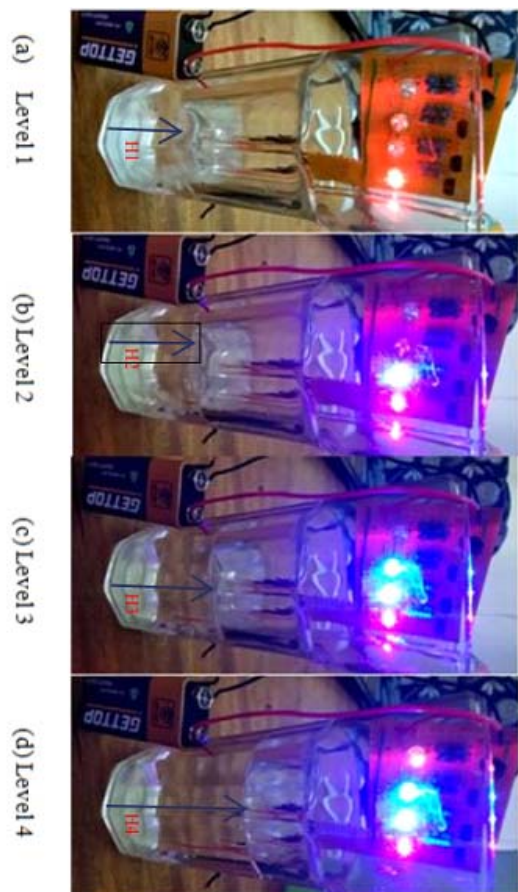


Fig. 4. LED Response to Different Water Levels

V. APPLICATIONS

Water level indicators can be used in offices, hotels, industries, homes and apartments, commercial complexes, agricultural sectors and many more. It can also be used to indicate fuel levels in tanks and vehicles [25-32].

VI. FUTURE SCOPE

The main objective of this project was to avoid water wastage since Kitui is a place which experiences very short rainy season and has very few boreholes. In the near future, we intend to incorporate a circuit which will make users of the project receive notification from their mobile devices in form of a short message of the level of water in the storages. The System can also be modified so that it can be used to detect floods in regions experiencing heavy rains and with poor drainage. This would ensure that a lot of lives are being saved during flood pandemic.

VII. CONCLUSIONS

We conclude that; this system is beneficial in both rural and urban areas, the system makes good use of available water sources, and if the system is used in large scale it can have a major contribution in conservation of water for the current and future generations.

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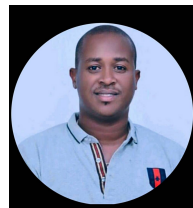
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