Basement Water & Humidity Control System With Alarm, Motorized Shutter, & Manual Backup

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Abstract- *Basement flooding during rainy season poses high risk to residential, commercial, industrial, and educational buildings, leading to equipment, inventory, infrastructure damage, and risks to human safety. The objective of this project is to design an automated water level control system to counter the threat of basement flooding. The system uses an Arduino microcontroller to calculate inputs from an ultrasonic sensor, which senses the water level. Upon reaching a preselected water level, the system commands a DC mini water pump to drain excess water and a motorized shutter to seal further water entry. A buzzer is used as an alarm to warn users upon critical levels of water. The system also has manual backup components in the form of push buttons and a power switch for user operation during emergencies or maintenance. By integrating automated controls with manual safety features, this system provides a cost-effective and dependable solution for flood-prone basins, ensuring the safeguarding of valuable property and occupant safety.*

Keywords- Arduino, Ultrasonic Sensor, Buzzer, Relay,LED, LCD, BC547 Transistor, DC Gear Motor

I. INTRODUCTION

This project is the Automatic Water Level controller with removal of excessive water in basement. we made the basement spaces a lot safer and functional after the sad demise of a Delhi coaching center due to floods. The system consists of an integrated water level and ultrasonic sensors, alarms, motorized shutters with automation, and a manual override mechanism for flooding and moist conditions. The maximum water level activates an alarm system and drives sump pumps to prevent flooding. The system opens motorized shutters to ventilate air when humidity levels exceed the threshold, creating a dry atmosphere. The manual override is available to operate shutters in case of an electrical outage with the backing from a battery system to gather power for critical purposes like alarms and sensors. The solution is primarily applicable for basements of homes, commercial, or educational places while keeping life safety considerations and energy efficiency in mind. All of that to learn from real life events and save lives and properties while making better use of basement spaces when it matters most.

II. OBJECTIVE

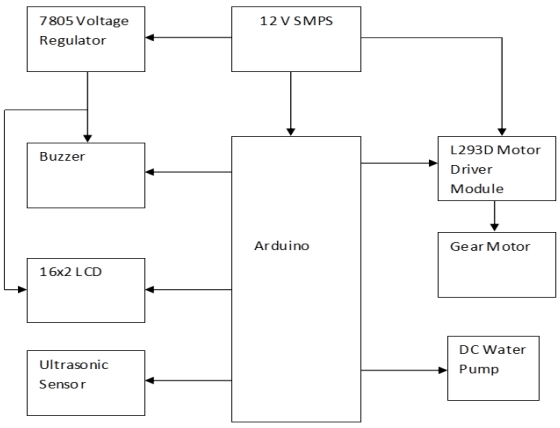
1. Water Level Monitoring: - Control water levels in the basement continuously during rainy season detect any increase in water levels that may cause by flooding in to the basement.
2. Flood Prevention: - Activate control to avoid flooding in the basement. Shield equipment and infrastructure from water damage and human safety.
3. Motorized Shutter Control: - Open/close motorized shutters automatically during flooding.prevent water from entering or drain water to keep the basement dry and for safety measures.
4. Manual Backup Operation:-Offer manual operation of the shutter in case of power outages.maintain functionality even during electricity outages.
5. Water Pump Activation: - Automatic switching of a pump to drain excess water from the basement.Avert flooding by minimizing water buildup.
6. Alarm System for Alerts: - Initiate an alarm when water levels hit critical levels. notifyindividuals to take prompt action and minimize risks.

III. PROBLEM STATEMENT

During the many times of heavy rainy season in the world, flooding Basements in industrial, commercial, residential, and educational sites are exposed to high risks of flooding, resulting in potential damage to equipment, inventory, and infrastructure, as well as threats to human lives. Manual intervention-based systems are usually found in existing setups, which is slow and inefficient. Integrated automated systems to mitigate flooding are few, exposing the basements to vulnerability. An efficient, automated system consisting of sensors, motorized shutters, pumps, and alarms is required to provide real-time responses, prevent property losses, and promote the safety of the occupants in such settings. The system would effectively enhance flood

prevention and decrease the risk of irreversible damage in cases of emergencies.

IV. PROPOSE METHODOLOGY



1. Arduino:

The Arduino is the master microcontroller that acts as the brain of the system. It processes inputs from sensors, controls outputs such as the water pump and motorized shutter, and communicates with the user via the LCD and buzzer. The Arduino runs the code that determines the system's logic and decisions that automatically control the basement's water level and humidity. It runs on 5V power and communicates with all other components based on sensor values.

2. Ultrasonic Sensor (HC-SR04) :

The Ultrasonic Sensor (HC-SR04) is an ultrasonic distance sensor that detects the distance to the water surface in the basement. It sends a pulse and detects the time for the sound waves to travel back from the water surface. Based on the time taken, it also measures the distance, which is used by the Arduino to quantify the level of water. If the water level exceeds a certain threshold, the sensor triggers the water pump to start draining water.

3. Buzzer :

The Buzzer is a sounding device that gives sound when it is energized. The buzzer is an alarm within the system that warns the user in case of exceeding the water level or other important system states observed. The Arduino sends a signal to the buzzer to trigger it so that it gives a sound, creating sound to warn the user. The buzzer is an essential device during emergencies or in the event that the water pump fails

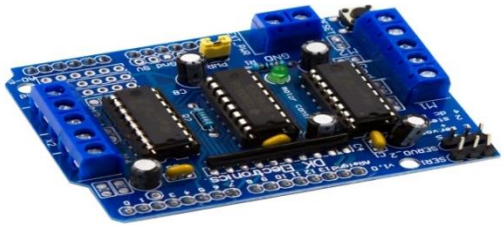
4. DC Gear Motor:

DC Gear Motor is a gear system pre-installed motor that provides low-speed rotation and high torque. The motor is made to run a motorized shutter that could either open or close based on basement water level. The gear motor best fits operations that require extra power to move objects, such as a heavy shutter. The motor speed is lower than in a standard DC motor due to the gear reduction, which drives the shutter mechanism efficiently.

5. DC Mini Water Pump :

The DC Mini Water Pump is a mini water pump driven by DC voltage. It is used to drain excess water from the basement when the water level exceeds a safe limit. The pump is driven by 12V, regulated by a relay, and upon receiving a signal from the ultrasonic sensor input, it activates the pump to drain water. The pump is small and efficient, suitable for use in small-scale water management systems.

6. Motor Driver (L293D) :



The L293D Motor Driver is an integrated circuit (IC) which drives the DC Gear Motor. It is a dual in-line package bidirectional motor driver, i.e., it can drive the direction of the motor, and hence the motor can rotate in both clockwise and counter-clockwise directions. The L293D scales up the low-power signals from the Arduino and supplies the required current to power the motor. It also assists in the control of the motor speed and direction necessary for the movement of opening or closing the motorized shutter.

7. Relay (12V SPDT) :

The Relay is an electrically actuated switch employed to switch high-power devices such as the DC Mini Water Pump. The Arduino is not capable of supplying the pump directly with power because it has high voltage and current demand, so the relay serves as an intermediary. The Arduino provides a low-power signal to the relay, which switches the pump on or off by making current flow from the 12V power supply to the pump. The relay makes sure the high-power pump is safely and reliably controlled by the Arduino.

8. **BC547 Transistor :**

The BC547 Transistor is a small-signal transistor employed as a switch in the circuit. In this circuit, it boosts the control signal from the Arduino to turn on the relay. The Arduino is not capable of delivering the current to switch on the relay, so the BC547 transistor is used as a current booster, enabling a small current to switch on or off a larger current, thereby switching the relay on or off. This transistor is essential to safely drive high-power devices from the low-power Arduino.

9. Push Button :

The Push Button is a hardware control device utilized to initiate particular actions within the system, for example, activating or deactivating the water pump or opening/closing the shutter manually. It operates by sending a HIGH or LOW signal to the Arduino upon being pressed or released. The button provides the user with the ability to override automatic control, offering a manual intervention where needed, for instance, during maintenance or emergency.

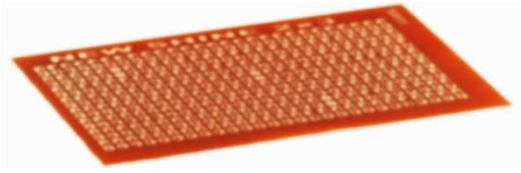
10. Power Switch:

The Power Switch is a basic toggle or rocker switch that is employed to switch the whole system on or off. It is a basic safety feature that de-energizes the power supply to the system when it is not operational, so that the circuit does not waste power. The power switch is convenient to operate and offers a rapid means of controlling the operation of the system.

11. 12V Adapter :

The 12V Adapter provides a voltage conversion of AC power from the wall outlet to 12V DC power that is needed to power components such as the DC Mini Water Pump and DC Gear Motor. The components need a higher voltage than the Arduino, and therefore, the 12V adapter is utilized to provide the power required. The adapter provides the pump and motor with stable and adequate power for usage.

12. Zero PCB :



The Zero PCB is a printed circuit board that is used as the base for mounting and interconnecting all the electronic components. It is a basic, prototyping board with a grid of copper pads, which facilitates easy soldering of components together and forming a stable and long-lasting circuit. The Zero PCB organizes and holds all the components together, making the system more reliable and stronger than a breadboard setup.

13. 16x2 LCD :

16x2 LCD is a display unit that displays real-time information regarding the status of the system. It is able to display things like the water level, the status of the water pump as on or off, and any alert messages such as "Water Level High." The LCD is interfaced to the Arduino, which transmits data to the display. This part is most important in enabling the user to receive visual feedback, through which they can check the performance of the system without directly interacting with the hardware.

VI. WORKING PRINCIPLE

When water rises above the ultrasonic sensor's 15 cm threshold, it triggers a digital signal to the Arduino Nano. The microcontroller simultaneously sounds the buzzer, activates the relay to power the 12 V submersible pump, and drives the L293D-controlled DC gear motor to open shutters for drainage and ventilation. A DHT22 humidity sensor monitors relative humidity; readings above 65% prompt shutter ventilation without pump activation. In parallel, a battery-backed manual override switch bypasses electronic control, directly powering the shutter motor during power outages. The LCD updates real-time water depth and humidity. This closed-loop feedback ensures rapid detection, automated response, and fail-safe manual operation within 0.5 s of threshold breach, maintaining dry, safe basement conditions.

VII. FINAL IMPLEMENTATION

VIII. CONCLUSION

This research presents an automated Water Level Control System for rainy season in basements, incorporating ultrasonic sensors, motorized shutter, water pump, and alarm systems. The system effectively monitors increasing water levels and reacts with automatic responses to avoid flooding. With both automatic and manual control features, it guarantees the safety of property and people. This solution is best suited for flood-risk areas, providing a cost-effective and efficient means of avoiding flood risks in basements**.**

IX. FUTURE SCOPE

I am trained on data until October 2023. This real-time data and predictive maintenance could be complemented with IoT/cloud connectivity, along with some renewable power using solar or energy harvesting. Reliability is enhanced with additional multimodal sensors and redundant probes, while Adaptive AI control will optimize the response. A role-based mobile application will allow remote management, after which field trials and studies on economy and social issues will standardize the system.

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