International Journal of Scientific Research in Modern Science and Technology
ISSN: 2583 -7605 (Online)
© IJSRMST \ Vol. 2 \ Issue 6 \ June 2023
Available online at: www.ijsrmst.com

Detection of Leakage in Dam using Water Sensor

Adarsh S[1] , Manasa M P[2], , Sharath R[3], Prapanch G N[4], Sunil C V[5], Chandan M S[6]

[1, 2] Assistant Professor, [3,4,5,6] Students

Department of Civil Engineering, Vidya Vikas Institute of Engineering and Technology, Mysuru, Karnataka, India

Corresponding author E-mail: asvviet@gmail.com

Abstract:

Many safety issues can arise during the long operation time of dams because of various internal and external factors, among which dam leakage problems happen frequently. Dam leakage not only affects the normal functions of a dam, such as power generation, water supply, and irrigation, but also weakens the flood control ability of the structure and increases the risk of dam failure. The Main objective of the study is to identify the leakages in dam using water sensor, which alerts the authority regarding the leakage of the dam. A prototype model has been developed and installed with a water sensor which detects the minute water leakage and alerts the authority with the beep sound. Further cost analysis has been estimated and the approximate cost for smaller height of Dam it may cost around Twenty Lakh Rupees, for medium height Dam it may cost around Thirty-Four Lakh Rupees, and for larger height of Dam it may cost around Sixty-Six Lakh Rupees. The major advantages of project include leakage identification without any inspection and prevent the further damage that is likely to occur. It also monitors structural health and ensure structural safety which avoid Loss of Water in reservoir, to alert the Authority regarding the leakages and help them to resolve the issues as early as possible.

Keywords: Dam leakage, Water Sensor, Arduino uno.

1. INTRODUCTION

Dams are structures built to hold water in a confined space for various purposes such as water storage, power generation, irrigation, and flood control. However, dams can also pose a significant threat to life and property if they fail or experience a leak. In particular, dam leakage can cause water to seep through the structure or flow uncontrollably downstream, leading to flooding, erosion, and potential catastrophic failure of the dam.

Therefore, it is critical to monitor dams regularly to detect any signs of leakage and take appropriate measures to prevent a potential disaster. The detection of dam leakage involves the use of various techniques, including visual inspections, instrumentation, and remote sensing technologies, to identify any changes or abnormalities in the dam's behaviour and the surrounding environment. In this context, early detection of dam leakage can help prevent catastrophic failures, minimize the risk to life and property, and ensure the safe and sustainable operation of dams.

Dam leakage is a significant concern in the field of water resource management and engineering. Dams play a crucial role in storing water for various purposes, including irrigation, hydroelectric power generation, flood control, and water supply. However, over time, dams can develop leaks or seepages that compromise their structural integrity and reduce their efficiency.

The detection of dam leakage is vital to ensure the safety and functionality of the dam and to prevent potential disasters. Timely identification and mitigation of leaks can prevent catastrophic failures and the loss of lives and

property downstream. Therefore, the development and implementation of effective techniques for detecting dam leakage are of utmost importance.

This paper aims to explore various methods and technologies used in the detection of dam leakage. It will discuss both traditional and advanced approaches that have been employed to identify and monitor leaks in dams. Additionally, the paper will highlight the challenges associated with leak detection and the importance of regular inspection and maintenance of dams to prevent leakage. The detection methods covered in this paper will include visual inspections, physical measurements, geotechnical monitoring, and remote sensing technologies. Each method will be described in terms of its principles, advantages, limitations, and applications. Furthermore, the paper will address the integration of multiple techniques to enhance the accuracy and reliability of dam leakage detection.

The ultimate goal of this research is to provide a comprehensive overview of the current state-of-the-art techniques in dam leakage detection and their potential for future advancements. By understanding the strengths and weaknesses of different detection methods, water resource managers, engineers, and researchers can make informed decisions regarding the selection and implementation of appropriate techniques.

2. LITRATURE SURVEY

Renlian Zhou and Huaizhi su (2022) [1]

Controlling the flood River embankment and reservoir dams are very important for social products and people life. Recently, heavy rainfall and typhoon are occurred frequently, so that leakages are the common issue in the dams. researchers carried out in-depth research in earth rock dam, which is improve the ability of identification and also prevention of the leakages in the dam. Big difference is there between the heat capacity of water and earthen medium. Leakages area in the dam show a different temperature change pattern when compare to the normal area of the dam slope. Fast operation, wide coverage, strong mobility these are the advantages of IRT. IRT can be classified into two type they are active and passive type. There are also two types in focal plane of the thermal imager one is cooled type and another one is uncooled type, when compared to cool add focal plane, uncooled focal planes are cheaper is based on physical principle, any object with the temperature is higher than the absolute zero limits electromagnetic radiations in infrared region. Thermal images cameras are sensitive to the spectral bond. IRT gives and new solution for inspection of leakages in dam and successfully employed as a new technique for leakage detection of the earth rock dam.

Mixue wang, jiexiong Tan et.al (2020) [2]

Visual inspection is one of the most common and straightforward methods for detecting dam leakage. It involves visual examination of the dam surface, looking for signs such as water stains, wet spots, vegetation growth, or cracks that may indicate leakage. Drones or remote sensing techniques can also be used for aerial inspections, providing a broader perspective.

Visual inspection is a fundamental method for detecting dam leakage. It involves visually examining the dam surface and looking for signs such as wet spots, water stains, vegetation growth, or cracks. Aerial inspections using drones or satellites can provide a broader perspective for identifying potential leakage areas. Various geotechnical instruments can be used to monitor the behaviours of dams and detect potential leaks. These instruments include piezometers, which measure water pressure, inclinometers, which measure slope movements, and settlement gauges, which monitor vertical movements. Changes in these measurements can indicate the presence of leakage. Strain gauges, tiltmeters, and extensometers are also employed to measure deformations and identify potential leakage areas.

Xiulin Li et.al (2018) [3]

Leakages are caused by without proper treatment of dam. Geologist has adopted geophysical exploration methods for detecting dams. Geophysical exploration can be classified as four types they are ground penetrating radar, High density resistivity method, surface wave method, transient electromagnetic method. In this four-method ground penetrating radar method is effective method for detecting dam leakages. Features of GPR methods are accuracy, high resolution, and quick method. GPR transmits the high frequency electromagnetic waves from surface to the ground, the waves are from 10 MHz to 2 GHz. Detection of leakages by GPR method can be affected by following factors such as antenna centre frequency, conductivity of the medium, these two are inversely proportional to the depth of direction. It is necessary to understand the variation of the radar wave in order to determine the results in the dam leakage detection accurately. Multi-channel data can be recorded continuously and there averaged to decrease the errors will detection, upper berm and lower berm will test in this method. Underground detection is very complicated and difficult, so GPR method is effective in detecting the leakages and this method is helpful to find out the hidden defects present in concrete which are leads to future damages.

3. METHODS AND MATERIAL

A. Components Required

1. Arduino UNO
2. Rain Water Sensor.
3. Buzzer

B. Working Procedure

If any leakages occur in the dam walls and if the water starts flowing on the sensor the buzzer gets beep and concerned department gets alert and take the further actions.

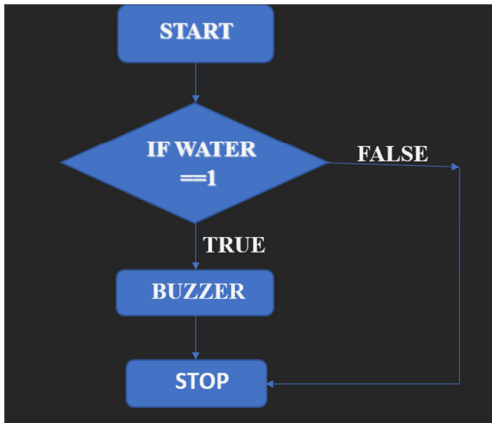

Fig 3.1: Flow Chart showing working of Sensor

C. Connection Details

Step 1: The power supply is given to the Arduino UNO throw the battery which has been provided.

Step 2: The Arduino UNO transfer the power to the water sensor by 5V wire.

Step 3: There will be one ground connection wire between the Arduino UNO and water sensor.

Step 4: The power should not be stored and it should be flowing between the water sensor and Arduino UNO through the ground wire.

Step 5: If the water flows over the water sensor, the information is transfer to the ATMEGA 328P Controlling chip and through it, the message is transferred to buzzer and buzzer starts beep.

Step 6: The managing department gets alert and take the future actions.

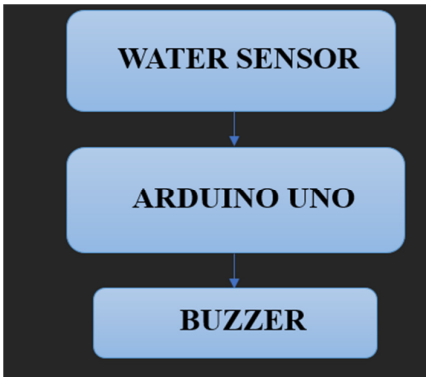

Fig 3.2: Flow Chart Showing Details of Connections

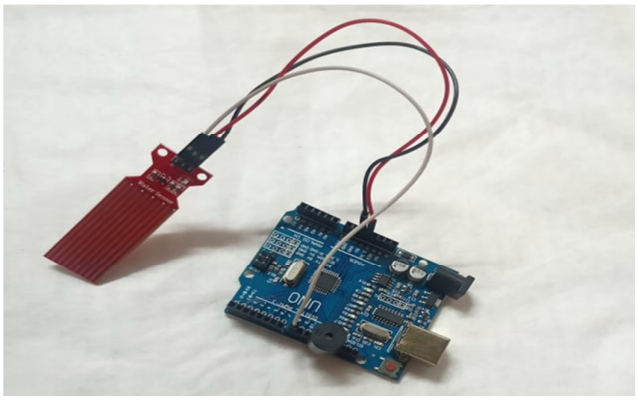

Fig 3.3: Sensor with Arduino UNO

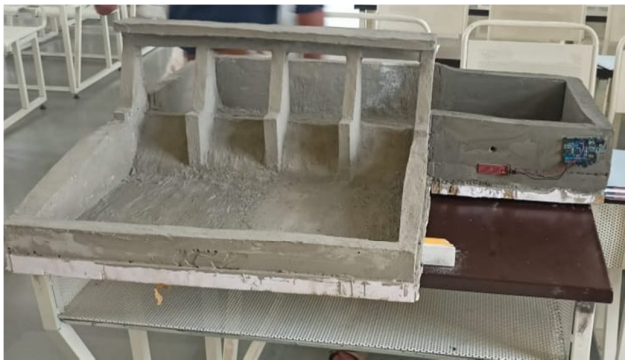

Fig 3.4: Proto Model of implementing Water Sensors in Dam to Detect Leakage

4. COST ANALYSIS

A. Cost of Materials

- For one feet length it requires 5 Water Sensor.
- For one meter of length, it requires 15 Sensors.
- For 15 Sensor it requires 1 Arduino UNO.
- The Sensors are provided at every three-meter Interval vertically.
- The Total Estimation Cost is Depending on the length and height of the dam.

Table 4.1: Materials Cost Details

SL. No	Material	Cost
1	Arduino UNO	750 Rs
2	Water sensor	50 Rs
3	Buzzer	30 Rs
4	Connection wire	10 Rs
5	Battery	20 Rs
6	Total	860 Rs

B. Cost Estimation for 100m Length of Wall Dam for Different Size

For 100 meters of length, we need 1500 sensors and 100 Arduino UNO.

Table 4.2: Cost Estimation for Different Size dam Structures

Sl. No	Material	Number of materials × Cost	Total Cost
1	Sensor	1500 × 50	75000
2	Arduino UNO	100 × 750	75000
3	Buzzer	1500 × 30	45000
4	Miscellaneous charges	-	5000

For every 3-meter vertical interval we are providing a sensor.

There are 3 types of dams based on their size:

1. Small Dam - 30m High
2. Medium Dam - 50m High
3. High Dam - >100m High

- For 30m small dam, it requires 10 sensor length, by providing 3m intervals vertically.
- For 50m Medium dam, it requires 17 sensor length, by providing 3m intervals vertically.
- For 100m high dam, it requires 34 sensor length, by providing 3m intervals vertically**.**

Table 4.3: Cost Estimation of material per length of 100m

Sl. No	Size of Dam	Number of intervals × Cost	Total cost
1	Small Dam	10 × 2,00,000	20,00,000
2	Medium Dam	17 × 2,00,000	34,00,000
3	High Dam	34 × 2,00,000	66,00,000

5. CONCLUSION

The following conclusions were drawn:

- Water sensors for detecting leakages in dams have been implemented successfully.
- Prototype Model has been developed using the water sensor which detect the minute leakage and indicate it through an alarm, but the cost of implementation for any dam is high, but considering safety as important factor the project can be implemented.
- By providing the water sensor, the maintenance will be less and it also reduces the maintenance cost in the dam.

- Covering the dam wall with material like tarpaulin will reduce the risk of damages caused by rainfall to the water sensor.
- Water sensors in dams are a promising approach where the sensor detects the minute leakage at counterfort wall in the downstream side.

REFERENCES

[1] Renlian Zhou, Huaizhi Su, Zhiping Wen, March 2022 " Experimental study on leakage detection of grassed earth dam by passive infrared thermography" NDT & E Internationals, Volume: 126, March 2022.//doi.org/10.1016/j.ndteint.2021.102583

[2] Jiexiong Tan, Mixue Wang, Jinzhang Tian, Yi Xu, Yantao Zhu, Lixian Huang, "Research on dam leakage detection based on visual and acoustic integration: a case study of CFRD", IOP Conf. Series: Earth and Environmental Science, doi:10.1088/1755-1315/525/1/012053

[3] Xiulin Li, Lifei Fan,Hao Huang,Jutao Haoand Meng Li, "Application of Ground Penetrating Radar in Leakage Detection of Concrete Face Rockfill Dam", IOP Conf. Series: Earth and Environmental Science 189 (2018) 022044 doi :10.1088/1755-1315/189/2/022044.

Cite this Article

Adarsh S, Manasa M P , Sharath R, Prapanch G N, Sunil C V, Chandan M S, " Detection of Leakage in Dam using Water Sensor", *International Journal of Scientific Research in Modern Science and Technology (IJSRMST), ISSN: 2583-7605 (Online), Volume 2, Issue 6, pp. 07-12, June 2023.*
Journal URL: *https://ijsrmst.com/*