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INTEGRATED DAM MANAGEMENT SYSTEM USING IOT

Basil Thomas [1], Godson John [2], Jaimon Thomas [3], Vishnu Kumar [4], Simy Mary Kurian [5]

[1] Mangalam College of Engineering, Kottayam, India, basilthomas812@gmail.com

[2] Mangalam College of Engineering, Kottayam, India, godsonjohn707@gmail.com

[3] Mangalam College of Engineering, Kottayam, India, jaimonthomas96@gmail.com

[4] Mangalam College of Engineering, Kottayam, India, vishnuvayalumkal@gmail.com

[5] Mangalam College of Engineering, Kottayam, India, simy.kurian@mangalam.in

ABSTRACT

Dams are the best infrastructures to save water resources and it plays a major role in our life as they are used for purposes such as water supply, irrigation, flood control and mainly the generation of electricity. There are thousands of dams all over the world and most of the countries are still using manual systems for controlling and monitoring them. The manual method consumes a lot of effort and cost, provides less monitoring quality and also it's a failure in effective flood management. This paper aims to present a new solution which is to implement an automated system instead of a manual system that provides effective dam monitoring and flood management, by considering the possibilities of the Internet of Things (IoT) application within the specified system for dam management.

Key words: Internet of Things (IoT), Microcontroller, GSM Module, Ultrasonic Sensor, Cloud Platform.

1. INTRODUCTION

The technological advancement of the current era aims to serve and make human life more comfortable. Dams are the major source of water supply and power generation in many countries and they can have an important role in controlling the complex floods in nature. In most of the countries, the techniques used for monitoring the dams are quite basic and traditional. Dam monitoring is a multistep phenomenon that needs improvisation.

In Kerala, the floods happened in recent years lead to the opening of more than 20 dams which badly affected the people living nearby. This made us think that an integrated dam management system designed scientifically would've reduced the effects and the dam monitoring technique needs to be improvised. There are only a few dams in which automated systems are used and most of the dams today are monitored manually. The manual method consumes a lot of effort and cost and they provide less monitoring quality for measuring the dam parameters such as Water Level, Gate Position, and Water Discharge, etc. The parameters of the dam can be monitored effectively by implementing the Integrated Dam Management System (IDMS) by using the advanced concept of Internet of Things (IoT). The concept is used to control and monitor the dam with the help of a web-based dashboard. The proposed system uses Microcontroller (NodeMCU), Ultrasonic Sensor (HC SR04), Vibration Sensor (SW-420), Water Level Sensor, Ph Sensor, GSM Module (SIM808A) and Ubidots Cloud Platform. The Nodemcu is the main controlling unit, which reads the data from the peripheral sensors and processes as per the predefined code and generates appropriate control signals. The NodeMCU has an inbuilt wifi module which helps in connecting the controller to the cloud platform with the help of a stable internet connection.

Apart from an efficient system for controlling and monitoring the dam parameters, the development of this project focuses on flood management. Real-time monitoring and analysis of past data enable the system to detect current threats and to predict future conditions. By this project, each and every variation in dam conditions will be informed to the authorities, thereby allowing them to take necessary actions at the right time and nearby people will be informed in time via SMS in case of any threats, thus saving lots of lives and making human life more comfortable.

2. LITERATURE SURVEY

The proposed system uses ATMEGA328, Ultrasonic sensor, Water level sensor, Bluetooth & LCD Display in hardware level. The system is built to ensure the safety of people and to reduce man labor. The system uses the Arduino Integrated Development Environment (IDE) written in java. The

system acts as an alert to an abnormality in water level in reservoirs, the system switches ON the shutter and releases excess water at abnormal conditions. The future works of the system include checking the water level in dams and passing notifications to the authorities [1].

The system mainly uses Raspberry Pi. The system monitors every variation of water level in dams and informs the same to the authorities. This would help to prevent unpleasant scenarios saving human life from danger. Float sensors monitor the water level and take necessary actions in accordance with any place. The sensors forward the information to Raspberry Pi and Raspberry Pi unit checks the water level and upload the status to the web [2].

The system can be called as a modern way of a warning system. The system mainly aims at creating a prototype system that reduces human interactions by developing an integrated system between software and hardware using IoT. The system uses Microcontroller, height sensors and Wi-Fi modules are used at the gate of the sensor. The proposed system updates the water level at twitter every 5minutes and sends data to authority every respective minute at the normal water level. When there is an abnormality at water the sensors send data every 5seconds to warn the authority about the situation to take adequate actions [3].

The proposed system decreases human obstruction and continuously monitors the water level of the dam and takes necessary actions. The system passes messages to open or close the shutter whenever necessary with respect to the water levels. The system aims at nodal communication of dams where each dam is considered as nodes and consequently associated with a central command center. These nodes are connected with Wi-Fi. The command center decides whether to keep the gates open or shut. Another function of the central command center is to direct the water flow considering water level in various dams to avoid risk [4].

The system proposes remote monitoring and controlling of dams that uses remote control technology linked to web technology. This uses a thin client and server application and has suggested using HTTPs communication. A real-time system has been used for monitoring the water conditions every minute and the alert system sends an e-mail to the concerned authority. The proposed system facilitates reduced complexity in controlling or monitoring the dams as it uses advanced technology to control the dam remotely [5].

3. PROPOSED WORK

Here the concept is to control and monitor the dam with the help of a web based dashboard.The system consists of a central controller and a set of peripheral sensors. The data from these sensors are read by the controller and processed according to the predefined code and appropriate control signals are generated. The system can be connected to the internet with the help of a stable internet connection which helps in viewing and analyzing dam parameters through a web portal.

Figure 1: Current system

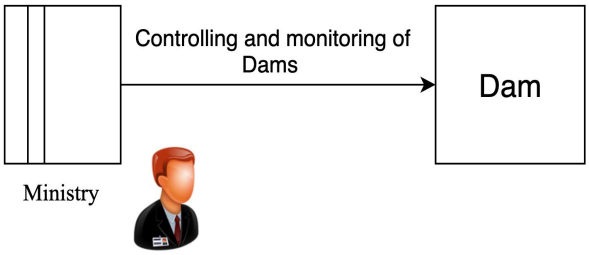

Figure 2: Proposed system

3.1. Data acquisition stage

The different sensors collect various dam parameters and transfer it to the controller unit. The data can be analog or digital depending on the sensor and the data we want. Parameters like water level, vibration, water purity etc.. are measured for efficient disaster management.

3.2. Data processing and cloud connectivity

The data obtained from the sensors are pre processed as per the written code.Through the Wifi connectivity of the NodeMCU the pre processed data is uploaded into a cloud platform.We can use any cloud platform of our choice

3.3. Data analyzing

The data from the cloud platform is fetched by a web platform where we can analyze the data. Different threshold values are set for different parameters so that if the data exceeds or goes down that particular threshold value certain precautions can be made.

3.4. Alert system

One of the important safety measure is to warn the civillions if there is an emergency situation. By using the GSM unit serial communications can be made. Warning systems can be made manual or automatic according to the intensity of the upcoming disaster. In serious conditions a warning message will be sent to the people living in the danger zone automatically without any permission from the authorities as the safety of the citizens is our first priority.

4. SYSTEM ARCHITECTURE

4.1 Power supply

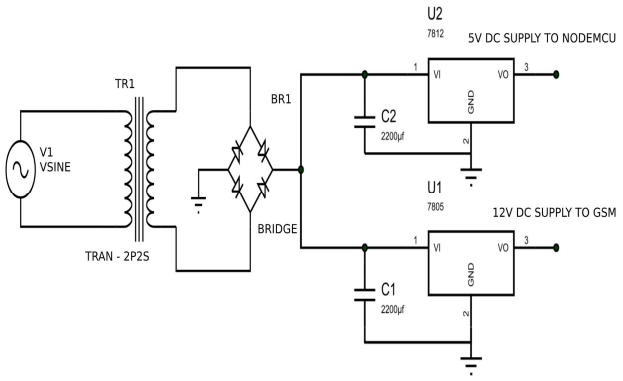

Figure 3: Power supply diagram

The power supply to the system needs to have two outputs. 5v DC for the smooth working of our microcontroller(NodeMCU) and another 12v supply to ensure the working of the GSM module used for serial communication.

4.2 Interfacing of sensors

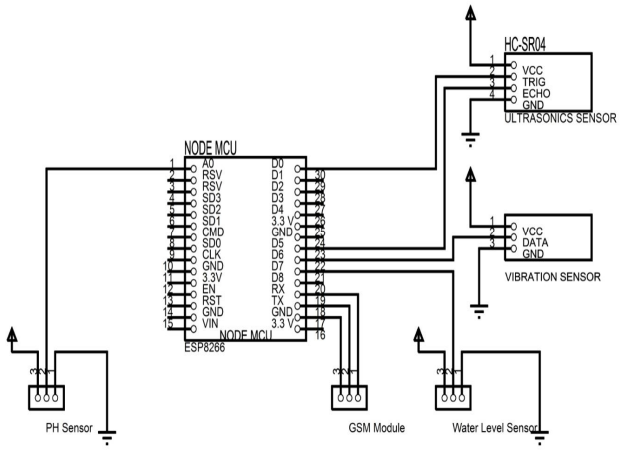

Figure 4: Sensor interfacing diagram

The NodeMU has both analog and digital input pins. The various sensors used are having both analog and digital signals as their output. In our system, the ph meter has an analog output and is connected to the A0 port of the NodeMCU and the other sensors having digital outputs are connected to the digital pins of the controller. The other sensors used are vibration sensor and Ultrasonic sensors. The GSM module is used for serial communication and is connected to the serial pins of the controller.

Use case diagram

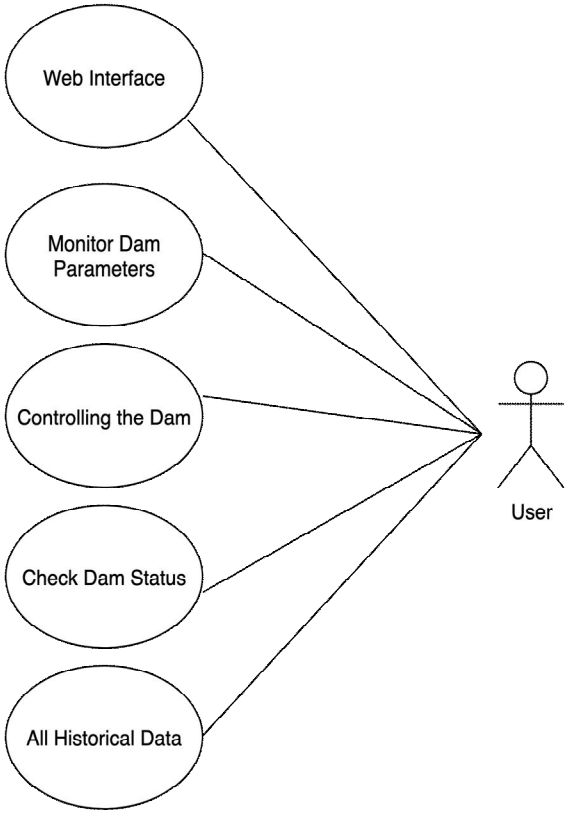

Figure 5: Use case diagram

5. RESULT

The results of this IoT powered dam management system is expected to be 70% more efficient by the excellent working of the prototype model. As convolutional methods involve more human interference this model makes use of the power of modern technologies for an accurate, real time analysis of dam and different security parameters of it. The prototype was able to perform real time operations efficiently by using cellular networks and it can be made more efficient by using more stable and reliable internet connection. Different dams have different capacity and other features, so the parameter limits vary according to the dam. The dam specific threshold values should be fed into the NodeMCU controller on the implementation stage. Our innovation is different from the

convolutional methods by it's efficient and unique usage of technology. In 2019, the effect of flood in kerala was doubled due to the non scientific and unplanned opening of neumerous dams. This is a clear example of how inadequate the current systems are. By using our findings managing dams becomes very simple and smart. It can also measure the quality of water present on the dam to know what purposes it is good for. Totally the project is lifesaving, eco-friendly and beneficial.

An example of the interface is given below with data from four different sensors:

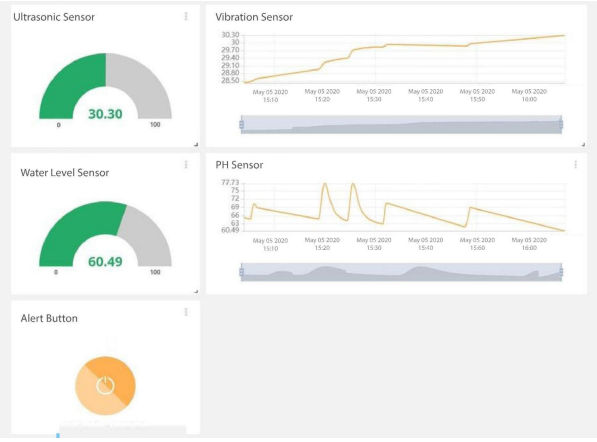

Figure 6: Example of user interface

The data obtained from the sensors are shown as a graph in the interface. The X axis of the graph corresponds to time and the Y axis corresponds to the value obtained from the sensors. In case of vibration sensor, the value on the Y axis will be the intensity of the vibration and in case of water level sensor that will be the amount of water present in the reservoir. Each graph will be having a maximum point. If the data from the sensor exceeds that threshold value, precautions needs to be taken.

6. CONCLUSION

The integrated dam management system is a complete solution for all the issues related to the dam monitoring and provides an efficient framework which allows the authorities to control and monitor the dams remotely. Application of IoT on dams would provide more efficient recording of sensor data, which would significantly reduce the probability of risk occurrence and provides effective dam monitoring and flood management. All data processing would be done on a cloud, which would considerably make the functioning of the system for data collection faster and more reliable. The system is highly flexible, smart, intelligent and fully acquires the other advantages of IoT technology.

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