Smart IoT based Disaster Monitoring and Management System for Dams in Oman

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The research paper proposes "Smart IoT based Disaster Monitoring and Management System" in Oman Dams by integrating IoT devices, including water level sensor, Arduino and other complementary equipment. The idea of this research paper is the smart IoT system will collect all real time parameters and weather conditions all around the dam. The sensors will be all over the dam and connected to the Arduino that are responsible for collect the data and send to the nodeMCU which are connected with Arduino. Then the nodeMCU will transform the data to the cloud service and then will show in app for the employee in the dam. If there are any readings indicating a flood, the system will send SMS to the residents near the dam.

Introduction:

The internet of things, or IoT, is a network of interconnected electronic systems, mechanical and digital computers, objects, organisms, or individuals that have unique identifiers (UIDs) and the capacity to transmit data over a network without the need for human-to-human or human-to-computer interaction (S. Gillis, 2019). People will use the internet of things to live and work better, as well as have full control over their lives. IoT is critical to enterprise in addition to providing mobile systems to simplify households. IoT offers companies a real-time perspective of how their processes really operate, offering insights into everything from computer efficiency to supply chain and distribution activities. The Internet of Things allows businesses to simplify operations and reduce Laboure costs. It also reduces waste and increases service quality, lowering the cost of manufacturing and delivering products while also providing insight into consumer purchases. IoT is one of the most important innovations in daily life, and it will gain traction as more industries recognize the ability of smart technology to keep them competitive (S. Gillis, 2019).
The aim of this research paper is to provide a new system based on smart IoT for monitoring the disaster and management system for dams in Oman. That smart IoT will help the current system to be more secure and developed.

Problem statement:

The current network in dam in Oman is old one that are manually add the data to the cloud and control over all the dam part. One of the disadvantages in Oman dams that the maintenance is not available periodically in Oman; Malfunctioning gates, conduits, or valves may cause both upstream and downstream dam failure and flooding. A critical feature of any dam is the spillways and outlet systems. Over time, however, it is possible to block or compromise either the entrance or exit to these systems, posing a serious threat to the dam 's protection. If the spillway is not operating correctly, or if it holds standing water for long periods, the infrastructure may be corroded more easily, leading to further risk of failure. Also, Dam water shutters are manually opened in dams and Manually monitoring the water level in dams and there is no sensers for measuring the percentage of purity of water in the dams in Oman

Literate review:

The Internet of Things (IoT) is a collection of interrelated computing systems, mechanical and digital appliances, objects, animals or individuals that have specific UID identifiers and the ability to transmit data over a network without the need for contact between humans and humans or between humans and computers (Margaret Rouse,2020).
The Internet of Things (IOT) is a network of objects that are physical. The internet is not only a computer network, but it has grown into a network of devices of all sorts and sizes, cars, smartphones, home appliances, toys, cameras, medical devices and industrial networks, livestock, humans, houses, all linked, all communicating and exchanging information based on stipulated protocols to achieve smart reorganizations, positioning, mapping, safe (Keyur Patel,2016). Dams has a huge significance, largely due to their use for hydroelectricity production and irrigation purposes. This has resulted in a variety of dams being constructed over the years in possible locations. As there are

many risk factors involved with the life of these dams, it has become important to establish a proper control and management mechanism for ensuring a safe water level in dams with respect to the opening of the shutters. Dam mismanagement can contribute to manmade disasters. Dams in our state are currently being manually supervised and controlled. The risk of error can be raised by this manual interference which also results in time lag in decision making. The goal of this research is to develop and incorporate a Disaster Monitoring and Management Framework for Dams based on IoT.The model diagram of the system proposed is shown in Fig. The sensors obtain information from the surroundings and the dam. A smart controller provides all the details. To automatically control the overall system, a microcontroller is used, which helps minimize system design and control complexity. It takes parameter data from the relevant sensors at the back end of the system and dumps it into the database. Dumped data is processed for the hosting and further decision-making of the web portal (KAVITHA, 2021).

The proposed framework runs on the Internet of Things (IoT), so that the web data base can be used for data sharing. The sensor data is analyzed from the database and the resulting signals are sent to the control station for the dam. A SMS alert system for farmers and ordinary citizens is also included in the scheme, and special SOS signals are sent to the local fire department, disaster management team, police team and emergency response team when the water level rises due to continued rainfall. The system is designed to monitor both the rate of water level change and the level of water on dams. There may be a case where the level of water is regular, but the rate of water change is extreme or both the level of water and the rate of change are of high importance, in these cases the level of water will rise to meet the level of emergency. Rain fall sensor, gate level sensor, flow sensor, water level sensor and humidity with improved sensor. The machine tracks the level of water and several other factors and takes necessary measures to prevent an emergency situation. Each component's output is responsible for the device's operation

Figure;1- working of the system

Methodology:

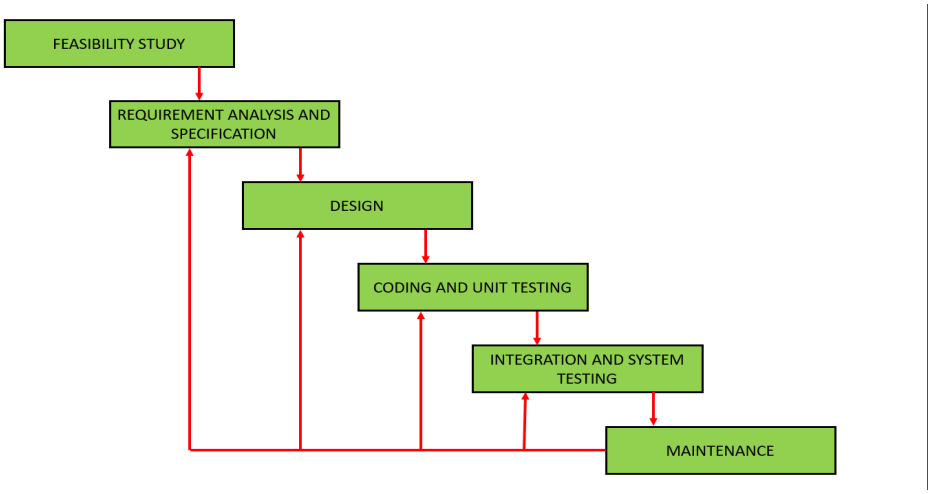
For this project chosen the adjusted waterfall approach as it offers an additional advantage over the versatility of the normal waterfall. This allows the tasks to be overlapped as appropriate, ensuring that it is possible to adjust the sequence of completion of each task. This approach has helped me a lot to overlap some of the phases, particularly during the current situation. I have overlapped some phases of my project to work on other tasks. The updated waterfall allowed me to work on various tasks at the same time without any problems because it was not impaired or affected by the project by its versatility, going back to some tasks from the previous semester, the model supports this kind of transaction between phases with no issue.

Modified Waterfall methodology: To overcome the flaws of the conventional waterfall technique, it was adopted. It consists of the same steps as the standard waterfall technique, but the updated version notes that it is possible to overlap

those steps to allow more flexibility in the process (Waterfall Model: The Ultimate Guide to Waterfall Methodology, 2021)

Advantages	Disadvantages
1- Diminishes the probability of problems. 2- Flexible. Flexible. 3- Documentation reduction	1- Since people are working on various steps at the same time, it could cause miscommunication. 2- Ambiguousness

Table;1- advantages & disadvantages for Modified Waterfall methodology



Figure;2- Modified Waterfall methodology

Previous work done:

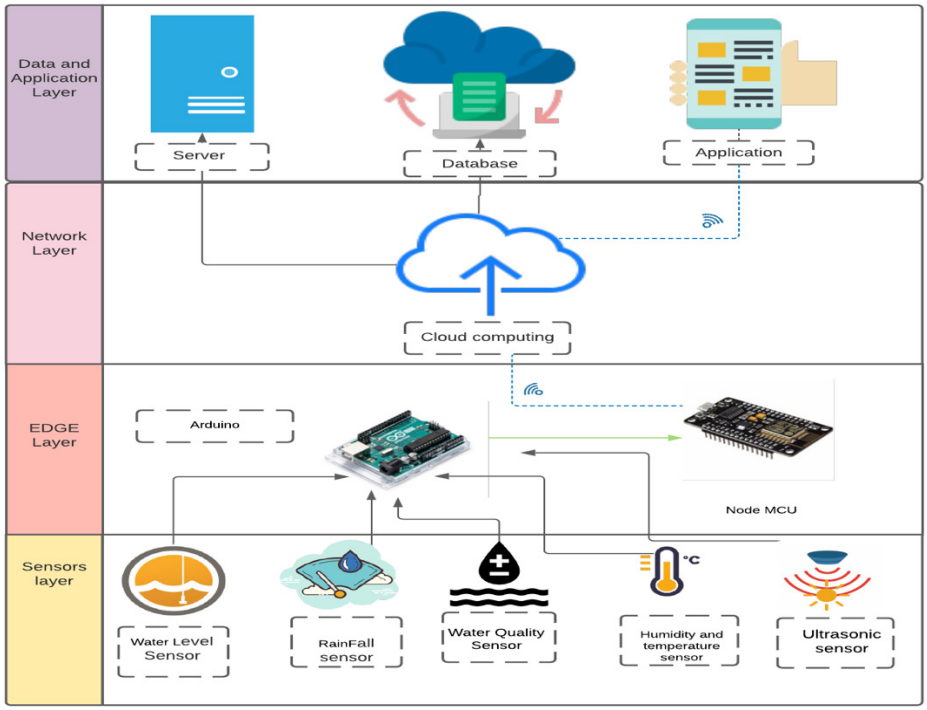
In India nearly 4000 major/medium dams are constructed and many more are in a pipeline. Normally, the range of dam storage capacity of 185 billion cubic meters of water with a surface area of 5,580km. During rainfall, for every 9.6mm the rise of water level increases by 0. 3ft.In the recent analysis by the BC dam safety annual report, from the year 2011-2016 number of dam incidents, dam alerts and dam failures are decreased respectively. With the growing interest in Internet of Things has become a right choice for the pre-alert system for monitoring the rise in the water level in dams. The risk rate of sudden flood occurrence opened up a way for the way the need of the real-time dam water level monitoring and prior alerting system which ensures the public safety. The main purpose of the system carries out an advantage of transfer of information both of the cloud and public smartphone using local Wi-Fi (Martać and Milivojević, 2021)

Proposed system\ architecture:

The model diagram of our proposed system is shown in Fig.2. The sensors gather the data from dam environment. all data are given to a smart controller. A microcontroller is used to control the overall system automatically, which helps

to reduces the design of system and control complexity. At back end of the system, it takes parameter information from the related sensors and dumps it into the database. The dumped data is analysed for web-portal hosting and further decision making. The proposed system works on Internet of Things (IoT), so that data sharing is possible utilizing web data base. The sensor data from the database is analysed and the resulting signals are sent to dam control station. The research study also includes an SMS warning system for farmers and common people and special SOS signals are sent to local fire station, disaster management team, police team and emergency response team as the water level increases due to continuing rainfall. Any number of dams can be connected with this database and it is possible to control these dams from anywhere based on the sensor inputs.

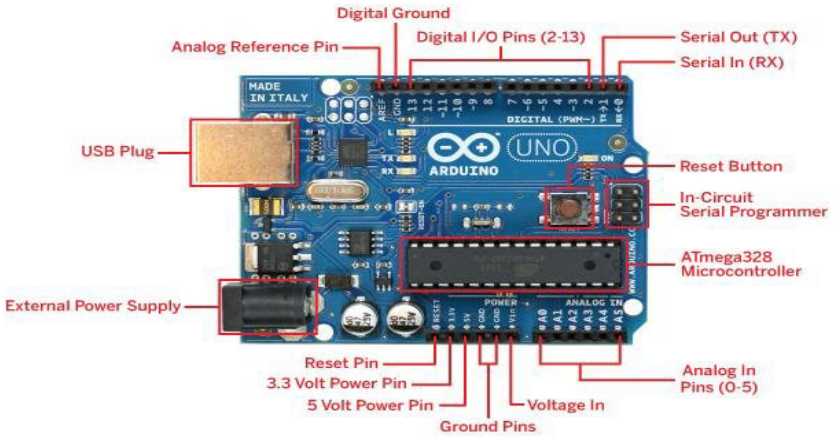
The system is designed to monitor the rate of change of water level, purity of water, Humidity and temperature sensor, Rainfall sensor and Ultrasonic sensor. There could be a situation in which the water level is normal but the rate of change of water is high or both the water level and rate of change is at a high value, in these situations, the water level can increase to reach the emergency level. With increase in the rate of change of water level, the system will have to increase the frequency at which the water level is being monitored.



Figuer;3-

Arduino

Arduino is an open-source electronics platform. Arduino boards can read light inputs on a sensor, a finger on a switch, or a message from Twitter and convert it into an output that stimulates a generator, flips on an LED, and publishes something online. By sending a series of instructions to the microcontroller on the board. In this research study the Arduino will be connecting with the sensers. It will collect data from the sensers and transfer it to the Node MCU.



Figuer;4- Arduino UNO R3

Water level sensor

A water level sensor is a device that sends data to a control panel to show if the water level in a body of water is high or low. This senser Use for determining the water level in dam. A water level indicator's function is to measure and control water levels in a dam.

Figuer;5- ARCELI Water Level Sensor

Humidity and temperature sensor

The sensor consists of a resistive part and a sense of wet NTC temperature sensing equipment and is attached to a high-performance microcontroller. A digital signal output with a calibrated combined temperature and humidity sensor. This senser Use for measuring the temperature and humidity of the dam.

Figuer;6- DHT11 Temperature Humidity Sensor Module

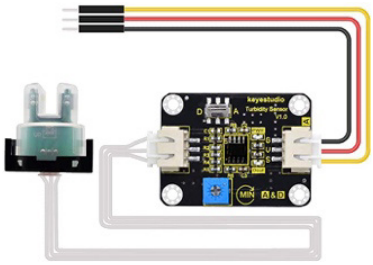
Rainfall sensor

Rainfall Sensor is a method for detecting rain. It is made up of two modules: a weather board that senses rain and a control module that compares analogy values and transforms them to digital values. This senser Use for determining rain in the dam area.

Figuer;7- Oiyagai Water Sensor Rainwater Module

Water quality sensors

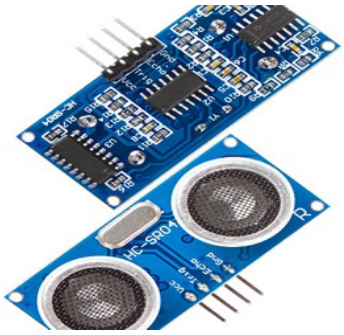
Water quality is measured by the physical, chemical, and microbiological properties of the water. This water quality attributes vary greatly across the world. As a result, the quality of natural water supplies used for various purposes should be defined in terms of the particular water-quality criteria that most influence the future use of water. That is why the dam's water quality sensor is being used. This senser Use for measuring the quality of dam water.



Figuer;8- Keyestudio Turbidity

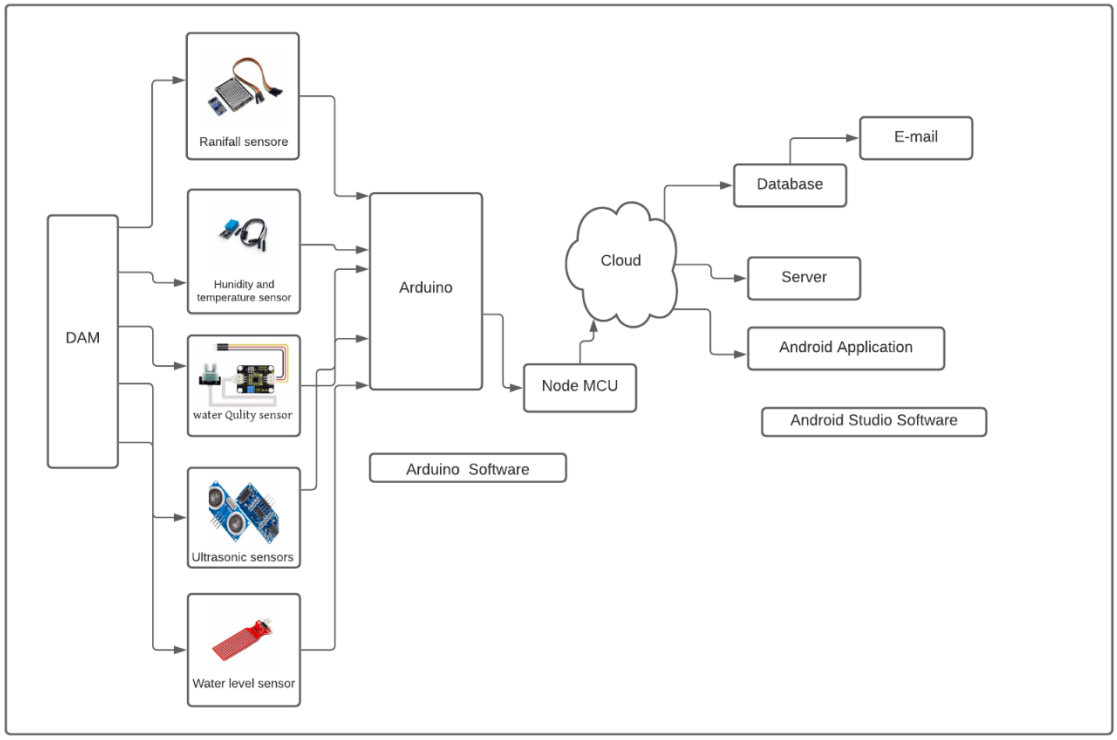
Ultrasonic sensor

Ultrasonic detection is one of the most reliable methods for sensing proximity and detecting speeds. An ultrasonic sensor is a device that uses ultrasonic sound waves to determine the distance between two objects. An ultrasonic sensor employs a transducer to transmit and receive ultrasonic pulses that convey information about the vicinity of an object. This senser Used to measuring the distance between the dam summit and the water level in said the dam to knowing if the water reached the point of flood by read the distance and send it to the microcontroller.



Figuer;9- HC-SR04 Ultrasonic module

TestBed



Figuer;10- TestBad for smart IoT based disaster monitoring and management system for dam in Oman

Result:

Our goal was to implement a smart IoT based disaster monitoring and management system for dam in Oman using different sensors through NodeMCU and Arduino we have achieved the block diagram and the process of operation for this system. In this paper we aimed to show the management of electronic devices remotely which is also has been achieved successfully.

Discussion:

Technology has been developed that affects people's lifestyle. It relies on technology even for everyday activities, the presents of technology switch the lifestyle to a relaxed and sophisticated life. We can see that it is hard to live without technology. Traditional lifestyle has been changed to advance technology in the last few years.

This paper included general idea that explains a Smart IoT based Disaster Monitoring and Management System for Dams in Oman. The proposed method of detecting the movements and the temperature is done through installing sensors in several points. The real time parameters and weather conditions of the dam which the installation of any sensor is known at any time before the critical limit is reached.

Conclusion:

The traditional system for dam monitoring is by physical means. They also developed an IoT-based disaster detection and management system for dams to address the problems associated with manual monitoring and control. We make use of various sensors in this system for data monitoring in real time. They are sent to the cloud server for monitoring and control through the Wi-Fi ESP8266 module. The proposed system would be helpful in solving all the problems associated with water. The machine also sends public safety messages. Our suggested system can therefore efficiently control dams and avoid a catastrophe.

Acknowledgement:

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