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FLOOD MONITORING AND EARLY WARNING ABOUT OVERFLOWING DAM USING NEURAL NETWORK

Falguni J Thakkar, Hritik Tayade, Prof S.R.Ghughe

Department of Computer, Sinhgad Academy of Engineering, Pune, India.

ABSTRACT: Water plays an important role in our day to day life in various fields. Introduction of new methods to solve the water related problems includes adaptive management, remote sensing with the new concepts such as water security, global integration of information, etc. Recently, we can see an increasing amount of dam damage or failure due to aging, earthquakes occurrence and unusual changes in weather. For this reason, dam safety is gaining more importance than ever before in terms of disaster management at a national level. Therefore, the government is trying to come up with an array of legal actions to secure consistent dam safety. Other dam management organizations are also taking various institutional and technical measures for the same purpose.

When it comes to dam safety issues, there is hardly a set of rules for how and when water can be released and what should be the standard operating procedure in case sudden release is required. This project proposes an IOT based dam management system. In this, four ultrasonic sensors namely, temperature sensor, humidity sensor, water level sensor and rain sensor are used to monitor the state of dam. Node MCU is used to interface all the sensors and send the data to the cloud. Machine learning algorithm is designed to control the opening of doors of dam via a servo motor.

Keyword: Flood detection, IoT, Python, Embedded C, Node MCU, DNN

I. INTRODUCTION

Far ago, human based resistive mechanisms towards flood control open up multitude problems like dynamic reactions of prior alert about the risky situations and stage of current water level. The growth of Internet of Things (IOT) paved the significant attention in all fields. Today, droughts and floods are a common feature and their co-existence poses a potent threat, which cannot be eradicated but has to be managed. Transfer of the surplus monsoon water to areas of water deficit is a potential possibility. This would also help create additional irrigational potential, the

generation of hydropower, as well as overcoming regional imbalances. From the recent floods in Kolhapur, satara, etc we observed the severe conditions people had to face due to improper management of the Almatti dam situated on the Maharashtra - Karnataka border. Ample people and animals lost their life's, all the living standard was disturbed. Generally, local people lose their important contact with the river once a dam comes up on it. They are scared to go near it fearing for their lives. Dams can easily become a weapon of terror unlike the temple of development they are projected to be as they have the capacity to suddenly release a lot of water downstream. Keeping this scenario and recent incident in mind, there is a need to develop some proper dam management system.

An IOT based dam management system is being developed in this project to avoid floods occurring due to improper management of opening and closing of doors of dam. An attempt to make a system to sense the temperature, humidity, water level and rain presence is made, depending on which the opening door percentage will be decided.

Node MCU is an IOT based platform that plays an important role in the project. Ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Firebase is a mobile and web application development platform developed by Firebase, Inc. in 2011.

Servo motor used to control the opening and closing of doors of dam. Node MCU is an open source IoT platform, whose firmware is developed for ESP8266 wifi chip. This is used to interface the ultrasonic sensors the data from these sensors is sent on cloud for decision making stage that is designed using machine learning algorithm using python. The output of machine learning algorithm will be sent back to node MCU which then will decide how much extent the doors of the dam should be opened.

II. LITERATURE REVIEW

As India faced recent devastating flood in Kerala, there arise a need of efficient flood monitoring systems. Flood forecasting and the issuing of flood warnings are effective ways to reduce damage. The proposed system will be efficient because it has better coordination of monitoring, communication and transmission technologies which are adaptable to background condition. The proposed system in [1] also ensures increased accessibility for assessment of emergency situations and enhances effectiveness and efficiency in responding to catastrophic incidents. In summary, the proposed system would be beneficial to the community for decision making and evacuation planning purposes.

Flooding is a natural phenomenon which has attracted global attention as a result of its negative impact on the society. Developing nations such as Nigeria have been predicted to experience increased flood occurrences in the coming decade. The events of flooding are unlikely to change, however, its impact on our society can be very well reduced. Paper [2] focuses on providing early warnings to areas likely to be ravaged by flood events using Wireless Sensor Network (WSN). The system involves the deployment of sensor nodes at specific flood vulnerable locations for real-time flood monitoring and detection. Flood events relating to flash flooding and run-off water or overflow are successfully monitored in real time which saves individuals plenty of time to prepare against predicted flood occurrence, saving them from the aftermath of flood disaster. The system was tested via simulation of different flood scenarios, and the outcome was efficient and accurate.

Flood is an unavoidable natural disaster in Maharashtra, India, causing heavy flow of traffic and can also cause severe damage to properties and lives. For this reason, Kalpesh et al [3] created a flood detection system to monitor rising water in residential areas. Using ultrasonic sensor we created flood level sensing device which is attached to Node MCU controller to process the sensor's analog signal into a usable digital value of distance. The user can get realtime information on monitoring flooded roads over SMS based service. Flood height is determined by subtracting the sensor's height with respect to the floor minus the sensed distance between the sensor and the flood water. Updates on the height of the water level will be texted to the rescue team (Local Government Unit) and to the residents and can the locals can also view level of the flood in the interface of the system. The level of the flood will be divided into four. The flood sensor and microcontroller will be powered by a solar power for the benefit of continuous operation of water flood height detection and network data transmission. The Arduino Flood Detector System is developed to be one of the fastest methods to monitor flood that will help motorists or road user to avoid problem when flood occurred.

The increasing interaction between industrial control systems and the outside Internet world, however, has made them an attractive target for a variety of cyber attacks, raising a great need to secure industrial control systems. Intrusion detection technology is one of the most important security precautions for industrial control systems. It can effectively detect potential attacks against industrial control systems. In [4], authorelaborate on the characteristics and the new security requirements of industrial control systems. After that, we present a new taxonomy of intrusion detection systems for industrial control systems based on different techniques: protocol analysis based, traffic mining based, and control process analysis based. In addition, we analyze the advantages and disadvantages of different categories of intrusion detection systems and discuss some future developments of intrusion detection systems for industrial control systems, in order to promote further research on intrusion detection technology for industrial control systems.

In paper [5], a sensor network architecture is presented. This work proposes an early warning system for river overflows. The sensor network consists of a river level sensor node that measures the distance between the sensor and the mass of water using a precision ultrasonic sensor. The recorded information is transmitted to a receiving node by radio frequency (915 MHz) using LoRa modulation. The receiving node is implemented in a Raspberry Pi; it processes the information in real time and publishes the alert using a social network (Twitter). Finally, a prototype of the river level node was tested, obtaining a measurement range from 20 cm to 2 m. The receiving node was located 500 m away from the sensor node that received the data packets sent without loss of data

The importance of environmental monitoring is undoubted in this age. Knowledge of environmental monitoring is important to determine the quality of our environment. Information gathered through environmental monitoring is important to many different decision makers. So it is necessary to develop a system that monitors the environment conditions or the ambient conditions in real-time. The Internet of Things (IoT) is a field of embedded systems and computing where number of devices collectively gathers data in real time and transfers it through a Wireless Sensor Network (WSN) to the computational devices for processing and analysis. IoT generally combines embedded system with cloud computing and analyzing platforms. Of all the

natural disasters, floods are the most common of them, and cause significant damage to life, infrastructure, and agriculture. Researchers and scientists have moved on from physical parameter based flood prediction to mathematical modeling based flood prediction schemes, and now the methodologies are focused around algorithmic approaches. In this work, an IoT and machine learning based embedded system is proposed to measure different atmospheric conditions to predict the weather information like temperature, pressure, humidity, wind speed and direction, rainfall etc and predict the upcoming natural disasters like floods after analyzing the trend of climate change. The proposed system uses a mesh network connection over ZigBee for the WSN to collect data, and a Wi-Fi module to send the data over the internet and also consumes low power. The data sets from array of sensors are recorded and monitored using cloud database and processed using an artificial neural network model to forecast the different weather events and predict the upcoming disasters [6].

Another previous work is [7], with renewal in the hardware, in which they proposed an architecture that senses the variation of water level by means of the ultrasonic sensor Parallax PING. The ultrasound bursts emitted by the sensor bounce off the water and in this way it is possible to know the distance at which the water level of the sensor is located. The data obtained is published on the social network Facebook using Facebook SDK v5 for PHP

Thanks to the work done by [8], we can see the potential of the LoRa communication protocol, because it performs a series of tests to determine the range of the loss of data packets. It carries out its tests in forest environments along river banks in different settings (urban, semi-urban and rural) and describes in detail the characteristics of the places where the tests were carried out. It was concluded that the environment may affect or benefit the data transfer, depending on the characteristics of the place and in its results it states that it did not obtain a data transfer at distances greater than 1600 m.

In this article, the LoRa communication is tested in a closed space. In [9] it is mentioned that the interest of testing this communication protocol is due to the fact that it is being very attractive for companies due to its characteristics, which are very favorable in terms of transmission ranges. Your network consists of a link port, a server, and a final device. In his experiments, he says that there is a “delay” between transmissions since the transmission device can’t continue sending data packets until it finishes receiving them and this time is more or less than 273 ms that is induced by the link serial. Likewise, in his conclusion he mentions something very interesting, that is, through experiments, they observed that the transmission speed is very important because it is too fast and data packets can be lost.

The communication protocol chosen for the development of this prototype is LoRa since it is a wireless communication protocol that has a considerable range of about 15 km. In [10] they present us with a development that integrates this type of communication, and the objective of them was to design an architecture for the control and monitoring of the electricity of buildings. They tested the RN2903 module, this is a certified 915 MHz module, based on LoRa wireless technology, tested at different distances: 1 m, 5 m, 10 m, 20 m and 30 m, and each of these tests sent 10 data packets and in none of the distances there was a loss of information. But if they mention that they used in other environments, they can affect the transmission as well as it can benefit them depending on the transmission and reception area of these devices.

III. PROPOSED SYSTEM

The guidelines of the Central Water Commission on dam safety say that an emergency flood warning system should be in place for downstream areas and technical instruments should be invented and adopted to ensure the safety of the dam and the life and property of people downstream besides identifying vulnerable points and setting up signboards, hooters, sirens and mobile vans equipped with a Public Address (PA) system.

For detecting changes in humidity and temperature the system has a DHT11 Digital Temperature Humidity Sensor. It is an advanced sensor module with consists of resistive humidity and temperature detection components. The water level is always under observation by a float sensor, which works by opening and closing circuits (dry contacts) as water levels rise and fall. It normally rest in the closed position, meaning the circuit is incomplete and no electricity is passing through the wires yet. Once the water level drops below a predetermined point, the circuit completes itself and sends electricity through the completed circuit to trigger an alarm. The flow sensor on the system keeps eye on the flow of water. The water flow sensor consists of a plastic valve body, a water rotor, and a hall-effect sensor. When water flows through the rotor, rotor rolls. Its speed changes with different rate of flow. The system also consists of a HC-SR04 Ultrasonic Range Finder Distance Sensor. The Ultrasonic sensor works on the principle of SONAR and is designed to measure the distance using ultrasonic wave to determine the distance of an object from the sensor. Flow sensor calculates flow of water in dam and from whose value Arduino decides width for opening of gates of dam. All the sensors are connected to Node MCU controller, which processes and saves data. The system has Wi-Fi feature, which is useful to access the system and its data over IoT.

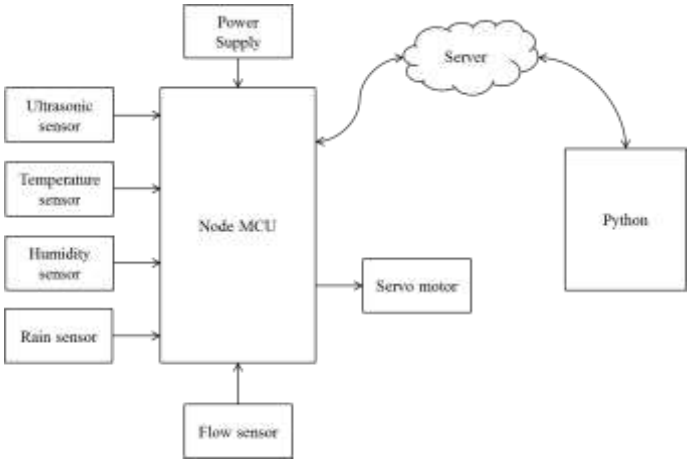

Fig block diagram of proposed system

Firebase server is used as a mediator between hardware (Node MCU) and software (Python). Node MCU sends data to server; Python fetches different values of sensor from server. Machine learning algorithm is used to predict flood condition and accordingly gate of dams are either remains closed or open.

IV. CONCLUSION

It has been observed that wireless sensor network based environment monitoring systems are low cost, small size and easily reliable. But these systems cannot be used for large area because each node is usually energized by energy limited battery. This paper performs survey of various environmental and flood disaster detection & monitoring systems and different communication technologies which help to improve upon the effective flood detection and flood warning problem. So in the near future, these systems with highly reliable sensors and effective IoT cloud platforms will critically be used for large scale environment monitoring and disaster prevention.

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