

# IoT based Sluice Gates Control System for Khazan System in Goa

Devendraprasad C. Kuvelkar

Lecturer in Computer Engineering

Government Polytechnic Curchorem

devendra.kuvelkar@gmail.com

**Abstract:** Sluice gates are simple mechanisms devised centuries ago and operated manually to regulate the flow of saline river water and the *Khazan* fields of Goa. However, mismanagement of the sluice gates by operators (gatekeepers) many a times results in heavy losses to the farmers. In this paper, we therefore propose and simulate an Internet of Things (IoT) based sluice gates control system to help the operators to manage the sluice gates as per their needs.

**Keywords:** Agriculture, Sluice gates, Internet of Things, Microcontrollers, Raspberry-Pi

## I.INTRODUCTION

The *Khaznam* (*Khazan* lands) of Goa, are salty flat lands lying along both the banks of the rivers of Goa. These lands are traditionally community managed, integrated agro-aqua ecosystems, initially with major emphasis on agriculture [1]. Fishing in the *Khazan* is a secondary activity. The *Khazan* system of Goa mainly consists of four main components: the bund, the sluice gate (*manas*), the *poiim* (internal water bodies) and the rice fields - elevated portions of land for cultivation. Each one of the first three components has its own role to play in the cultivation and upkeep of the rice fields [2].

The bund is about 2-2.5m high dam made of the clay soil from the marshlands or mudflats. Apart from protecting the *Khazan* from inundation with brackish water from the river at high tide, bund also helps to maintain water level in the *Khazan* during monsoon.

The *poiim* are the internal water bodies interlinked to one another and connected to the river through the *manas*. These shallow water bodies act as drainage channels connecting the storm drains of the village to the river during monsoon, while during dry season they act as water receptacles for the *Khazan* holding the brackish water leaking through the sluice gate. The sluice gate is a mechanism that controls water flow from *Poiim* to river and vice versa. It allows water from the *Poiim* to drain out into the neighbouring river during low tide and lets the water to enter *Khazan* during high tide. This is done to maintain water level in the rice fields, which is necessary for the healthy growth of rice saplings and also to control spreading of weeds. Hence, the opening and closing of sluice gates is very crucial for the successful working of the *Khazan* system.

The sluice gates of the *Khazan* systems in Goa are manually manipulated to get the required quantity of water inside the fields and require labour. Mismanagement of the opening and closing of sluice gates in recent times have resulted in flooding of the *Khazan* fields leading to heavy loss to the farmers [3]. Therefore, to help the operators to control and manage the sluice gates as per their needs, this paper presents an IoT based self-powered system to manage and operate sluice gates for mutual benefit of both rice and fish productivity.

The Internet of Things (IoT) refers to a type of network to connect anything with the Internet, based on stipulated protocols through information sensing equipment to conduct information exchange and communications in order to achieve smart recognition, positioning, tracing, monitoring, and administration [4]. The goal of (IoT) is to enable things to be connected anytime, anyplace, with anything and anyone ideally using any path/network and any service [5].

In the proposed system, water level on both the sides of the sluice gate is sensed at regular intervals and the process of opening or closing the sluice gate is initiated automatically on the basis of reaching threshold values of water level. Further, numeric values corresponding to water level are stored in a database for predicting high tide and low tide situations and their frequency of occurrence. Operators are alerted about drastic changes in the water level at the sluice gate through push notifications on smartphones. Additionally, operators situated at remote locations are provided with an option of monitoring the status of the water level as well as sluice gate.

The rest of the paper is organized as follows. Section 2 reviews the literature related to water flow control systems. Section 3 describes the architecture of the proposed system. Section 4 describes the working of the system. Section 5 discusses the implementation of the proposed system. Finally, Section 6 concludes the paper.

## II. LITERATURE REVIEW

In this section we present the work carried out by various authors to automate the water flow control systems that are related to our work.

Authors S.K. Bhatia et.al [6] have proposed a mechatronics based system consisting of Raspberry pi to detect the level of water and estimate the water inflow rate in a dam and further control the movement of gates automatically in a real-time. The focus of the proposed system is to keep a track of the frequent usage of water resources from dams for irrigation purposes and efficient operation of dam gates according to the level of water. The proposed mechanism of dam gate control reduces the water wastage and ensures efficient usage of water.

Authors Ashwini Desphande et.al [7] have proposed a system to automatically monitor the industrial applications, generate Alerts/Alarms and make intelligent decisions using the concept of IoT. Proposed work summarizes uses of IoT in industries with Artificial Intelligence for monitoring and predicting.

Authors G. Lakshmi Prasanna et.al [8] have proposed a system to monitor water quality and control water flow in irrigation fields using ZigBee technology. Motor control mechanism for releasing the water is implemented using moisture sensors. Motor switches ON automatically once the moisture level drops below lower threshold level and switches OFF when moisture level rises above upper threshold level.

## III. PROPOSED SYSTEM

The proposed system as shown in Figure 1 consists of eight major components namely Sluice Gate Controller, Solar Panel Controller, Raspberry Pi (RPi), Web Server, Zigbee module, Database Server, Google Cloud Messaging (GCM) Server and Android Application each responsible for performing dedicated task.

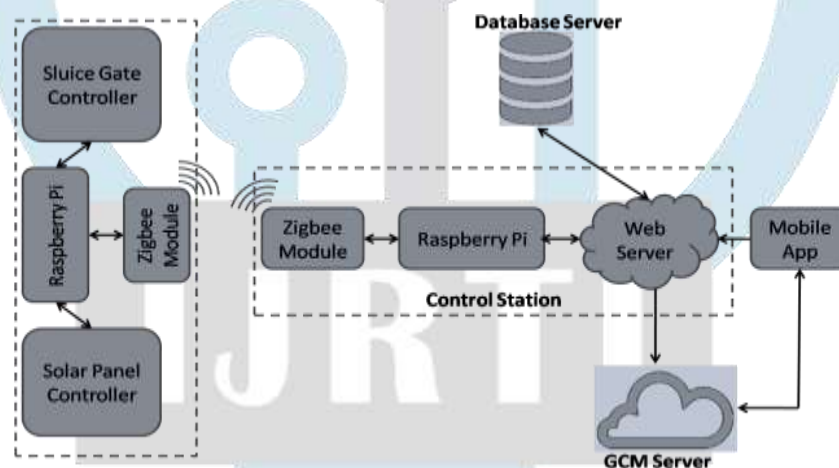


Figure 1 Proposed System Architecture

Sluice Gate Controller senses the water level on both the sides of the sluice gate and enables opening and closing of the gates. This is achieved by installing proximity sensors on both the sides of the gates capable of measuring the distance between itself and the water surface.

Solar Panel Controller is designed to auto track the sun movement and align the solar panel to generate maximum energy using sensor technology. Power generated is then supplied to various components of the proposed system including Raspberry Pi thereby making it a self-powered system. This feature helps to overcome the problem of frequent power failures especially in rural areas.

Raspberry Pi is the core of the system that coordinates the functioning of components of the system. It gives stimulus to the sensors to carry out the process of sensing. Sensed data is then forwarded to the RPi which is further sent to the web server for maintenance on the database server.

Web application is deployed on a web server which is then accessed by the end user for viewing the sensed data. Data is presented to the user in graphical and tabular form for carrying out analysis. Various data filtering techniques are provided through web applications for retrieving desired data. Xbee pro s2b is a ZigBee module which is used to transmit the data wirelessly. The data rate of the module is 2.4GHz and it can transmit the data up to 1500m range.

Data sensed through sensors is continuously maintained in the database (Database Server). Also, information pertaining to users of android applications is maintained for sending push notifications.

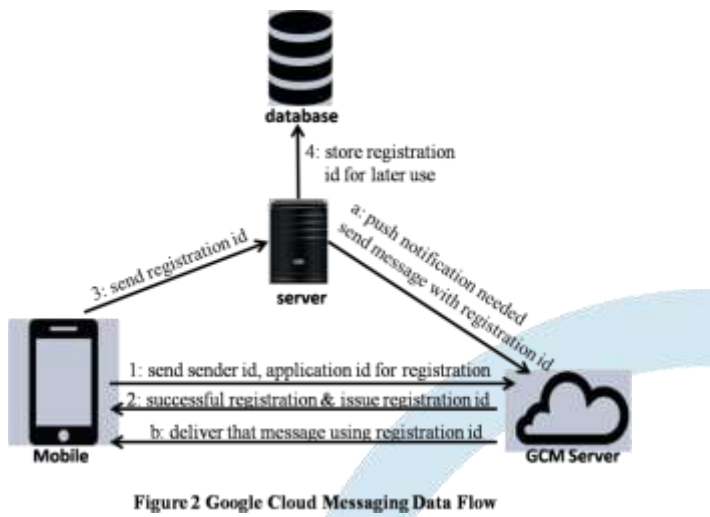


Figure 2 Google Cloud Messaging Data Flow

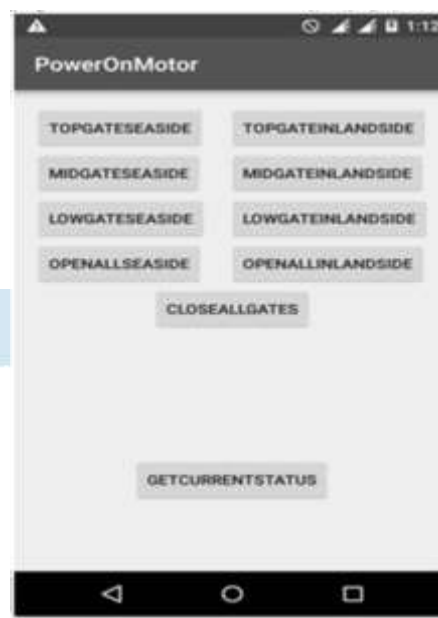


Figure 3 Android Application

GCM server issues a unique ID for each of the mobile application users, which is then stored on the database server for receiving push notifications. Entire process is detailed in figure 2. Android application as shown in figure 3 is designed for receiving status of the system and optionally controlling sluice gates.

#### IV. WORKING OF THE SYSTEM

Circuitry consisting of proximity sensors and Light Detecting Resistors for sensing water level and tracking sun movement respectively is attached to Raspberry pi which is then wirelessly connected to a control station consisting of Raspberry Pi and Web Server through Zigbee module for exchange of data.

Water level is continuously sensed through sensors installed on both the sides of the sluice gate. Values corresponding to high tide (upper Threshold) and low tide (lower threshold) are predefined for the system considering the depth at the meeting point of the river and poiim near sluice gate. When the water level either exceeds upper threshold or drops below lower threshold Raspberry Pi automatically opens or closes sluice gate and composes a message consisting of water level value expressed in meters and date/time. Message is then transmitted to the control station through a wireless network and stored in a database for analysis of collected data to enhance system performance and reliability. At the same time a push notification is sent to the operator, informing about the status of water level and action taken with respect to opening and closing of the sluice gate. Operator is also provided with an option of controlling the sluice gate through an android application.

#### V. IMPLEMENTATION OF THE SYSTEM

**Hardware:** Sensors (Ultrasonic HC SR04) senses and measures the distance between itself and the water surface. Servo motors enable the opening and closing of sluice gates in either clockwise or anticlockwise direction taking into consideration the level of water on either side of the sluice gate. Intensity of sunlight is sensed through Light Detecting Resistor (LDR) for enabling and controlling the rotational movement of solar panels through stepper motors.

**Software:** Python is a programming language used for implementing logic responsible for sensing the water level and sending collected information to database server through web server. In order to take advantage of the fact that many users use android smart phones an android application is designed for presenting the data and notifications to the users. Apache Web Server hosts web application designed using PHP. All the data is maintained on MySQL database server. Web application designed using PHP enable users to view the data in the form of text as well as graphs for better utilization of features of the system.

GCM is responsible for generating Push notifications; a way of sending notifications to the users even when they are not actively using the application. Push notification helps the user to receive notification of a new message or event and can be broadcasted either to the mass audience or a select set of users.

#### VI. CONCLUSION

The proposed work shows how IoT can be used to regulate the operation of sluice gates in the *khazans* systems of Goa. The system provides a mechanism to monitor water level by using web portals and android application and reduces the requirement of human labour for monitoring and opening/closing of sluice gates. Using the self- power generation feature of the system, a significant difference in terms of cost incurred towards electricity requirements can be achieved between the proposed system and traditional system.

**REFERENCES**

- [1] Sonak, Sangeeta, Saltanat Kizi, and Mary Abraham, "Khazans in troubled waters", New Delhi : TERI Press, (2005).
- [2] Shetye, Satish R., M. DileepKumar, and D. Shankar, "The Mandovi and Zuari Estuaries" (2007).
- [3] Kamat, N., "History of Khazan land management in Goa: ecological, economic and political perspective", Seminar on History of agriculture in Goa. (2004).
- [4] Patel, Keyur K., Sunil M. Patel, and PG Scholar<sup>1</sup> Assistant Professor, "Internet of Things-IoT: definition, characteristics, architecture, enabling technologies, application & future challenges", International Journal of Engineering Science and Computing 6, no. 5 (2016).
- [5] D. Giusto, A. Iera, G. Morabito, L. Atzori (Eds.), "The Internet of Things", Springer, ISBN: 978-1-4419-1673-0 (2010).
- [6] Prof. Mrs. S.K. Bhatia, Navale Ravindra, GawadeAshwini, ShisodeRaghuvansh, "Automatic Dam Gate Control System Using Raspberry Pi", International Engineering Research Journal (IERJ) Volume 2 Issue 1 Page 389-391, 2016, ISSN 2395-1621
- [7] Ashwini Deshpande, PrajaktaPitale, SangitaSanap, "Industrial Automation using Internet of Things (IoT)", International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 5 Issue 2, February 2016
- [8] G.LakshmiPrasanna, S.Rajendra Prasad, Dr. C.D Naidu , D. Ramesh Reddy , "Water Quality Monitoring And Controlling In Irrigation Using Zigbee Technology", International Journal of Science, Engineering and Technology Research (IJSETR), Volume 4, Issue 1, January 2015

