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Automation in Water Reservoir Floodgates and Control Decision System

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***Abstract*— System is applicable for Water Reservoirs or Dams with Hydro-Electric Power Plant and facilitates multi-step off-stream spillways opening. Design of Criterion Decision Analysis for generating accurate value to execute operational methodology of floodgates is prime objective of our system. Overview of Our system is described here: Ultrasonic are machinated to measure the water holding capacity level of particular Reservoir or Dam. Waterflow sensors, determine the water equilibrium level and transmits real-time value to Control Decision System. As per ISO-Code rule set for Water Reservoirs or Dams, Radial System will lift-off the Floodgates on the basis of Multi-Step Optimal Progression Approach. During overflow or flooding, system will activate checkpoint signals and forward fast on the guard Alert message to nearby District Headquarters and National Risk Disaster Management Force to smoothly migrate humans from the flooded river region. System will share detailed information about Inflow and Outflow of water through Canals to Irrigation Department for Knowledgeable purpose. System will be administered by Water Resource Management Director of respective Reservoir or Dam. Finding alternative technology to overcome the issue of Sedimentation that reduces water storing capacity of particular Water Reservoir is future scope of our system.**

Keywords— Criterion Decision Analysis, Multi-Step Optimal Progression Approach, Sedimentation.

I. INTRODUCTION

Automation in Water Reservoir Floodgates and Control Decision System refers to the interdisciplinary operation of Criterion Decision Analysis and Multi-Step Optimal Progression Approach for opening Floodgates that is operated through Control Decision System and monitored by the Executive Head of Water Reservoir or Dams. Its aim is to impart real time value of water holding capacity level excluding the sediment congregated at upstream of Reservoir.

System will incorporate the operational methodology as per the "Rule Operation Model for dams with gate-controlled spillways" while radial system that is machinated to lift-off the floodgates.

During the overflow or flooding, system will convey the "fast on the guard" alert message to nearby District Headquarters and National Risk Disaster Management Force Executive team to migrate humans from flooded region or river banks at the execution of floodgate openings through service functionality of application designated.

II. BACKGROUND

A. Fundamentals

Automate the evaluation of water holding capacity level at upstream of Water Reservoir or Dam. Integrate Criterion Decision Analysis and Multi-step Optimal Progression Approach to operate while radial system lift-off the floodgates on the basis of Rule Operation Model for gate-controlled Dams. Extending the functionality of Control Decision System

during overflow or flooding situation by employing application that sends fast on the guard alert message to nearby District Headquarters and NRDF.

B. Challenges

Due to Sedimentation in upstream strata, it is difficult to obtain the actual water holding capacity level of Water Reservoir. Electric System used by Radial System to lift-off the floodgates needs Human intervention at on-site. Maintenance of Reservoir or Dam Structure is expensive if not regularly investigated. During flooding or overflow situation, Executive Heads need to execute dynamic operations to opened floodgates to stabilize or maintain the posture of Dam. During flooding or overflow situation, District Headquarters and NRDF need to migrate humans from flooded region before the locality goes out of control.

III. Literature Survey

A. Based on gate-controlled spillways of dams [7]

Most of the big dams have gated spillways and gates are raised or lowered to control Reservoir outflow. The dam may also have under sluices to release the water control for irrigation, water supply, etc. The operation of the spillway gates and under sluices depends on the states of the reservoir, level of demands, and the operation policy.

In gated dams, reservoir outflow can be either
a) controlled,
b) uncontrolled, and
c) partly controlled.

Spillways are provided for the storage of the dams to release flood water which cannot be contained in the allotted storage space and at the diversion dams to bypass flow exceeding those which are turned into diversion the dams.

Classification of dam based on size

Classification	Gross Storage	Hydraulic Head
Small	Bet. 0.5 and 10million m3	Bet. 7.5m and 12m
Intermediate	Bet. 10 and 60million m3	Bet. 12m and 30m
Large	Greater than 60million m3	Greater than 30m

B. Sedimentation [6]

Reservoir sedimentation is caused due to the flow of water and sediment into the reservoir. Basically, all sediment (gravel, sand and mud) transported to a reservoir by a river is derived from erosion of land surface. When river flow enters a reservoir, its velocity and hence transport capacity are reduced and the sediment load is deposited in the reservoir. (see Figure 1). The amount of sediment deposited depends on the types of sediment in the river system, the shape of the reservoir, the detention storage time and the operating procedures.

The principal sedimentation processes in reservoirs fall into mainly three categories:

• deltaic deposition of the primarily coarse (gravel and sand) materials (in entrance section of reservoir)
• deposition of the fine sediments (silt and mud) from homogeneous flow
• deposition of the fine sediments (silt and mud) from stratified flow (turbidity current)

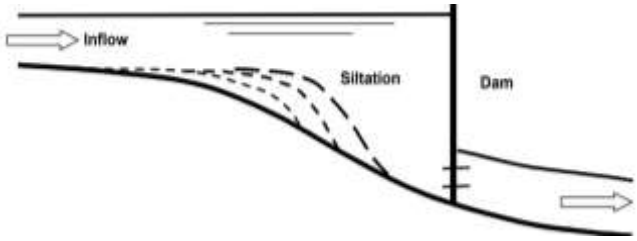

Fig 1: Siltation in a resevoir

Measures to reduce the sediment input into a reservoir are:

• replanting and reforestations of eroded areas (soil conservation)
• crop rotation and regulation of grazing
• terracing of relatively steep valley slopes
• bypassing of sediments (bypass channels)

IV. System Process

A. Architecture diagram

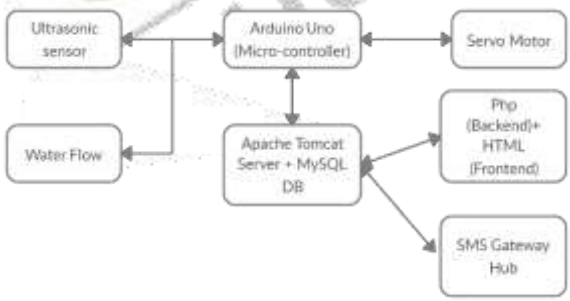

Fig2: Overview of system architectural diagram

B. Prototypes

a) Ultrasonic sensor evaluates depth of sedimented cluster present at upstream.
b) Water flow sensor determines the water holding capacity of reservoir.
c) Servo Meter triggers radial system which lift-offs floodgates when limit gets exceed.
d) SMS Gateway Hub acts as bridge to transmit alert message to administrator.

C. *Mathematical Model*

System S as a whole can be defined with the following main components:
Let S be the
System
S = {I, O, P}
where,
I = Input
O= Output
P = Processing

I = {iu, if, ia, ic}

Hardware Input:
iu = ultrasonic sensor
if = water flow sensor

Software Input:
ia = system administrator
ic = system controller

O = {sdistv, smfgo, altmsg}

sdistv = sediment present at distance value
smfgo = servo motor - flood gate opening
altmsg = alert message to system administrator

P = {Dsync, Sdist, Gopt, EA}
i.) Dsync = Database Synchronization
ii.) Sdist: Sediment present at
distance = duration×0.34/2
iii.) Gopt: Operations on floodgates opening:

Case 1
—> wlevel>=50:
smfgo = 45°

Case 2
—> wlevel>=100:
smfgo = 90°

Case 3
—> 100<=wlevel<=150:
smfgo = 180°

Case 4
—>
150<=wlevel:
smfgo=270°

EA: emergency alert
wlevel=>100 && smfgo = 90°
==> altmsg = 1 (message enabled) || altmsg = 0 (message disabled)

VII. References

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VI. Conclusion

System is deployed at Water Reservoir with multi-disciplinary functionalities such as water storage and distribution to Irrigation and Hydro-electric power plant. System simulates and optimizes the operational methodology by integrating Criterion Decision Analysis and Multi-step Optimal Progression Approach based on Rule Operation Model for gate-controlled Dams while Radial System lift-offs the floodgates with dynamic execution during flooding or overflows. Application functionality extends the Control Decision System to transmit Alert message to nearby District Headquarters and NRDF Team to ensure there is no human loss during overflow or flooding. System performs execution smoothly unless there is no Hardware failure detected.