



Indian National Committee
on Large Dams

INTERNATIONAL DAM SAFETY CONFERENCE



Central Water Commission

DAM HEALTH MONITORING, DATA ACQUISITION AND PROCESSING

Role of Instrumentation in Dam Health Monitoring

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10-12 October 2022 at Jaipur, Rajasthan (India)



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NECESSITY TO MONITOR DAM HEALTH

- Dams are constructed with great attention as per guidelines
- Even though dam accidents are occurring regularly. Post construction dam monitoring is essential to assess the supply and overall stability of the dam.
- In dam monitoring, instruments play important role. instruments required for monitoring varies depending upon types of dams. Geodetic monitoring tools should invariably be used for deformation control in all types of existing dams
- In Tamil Nadu there are about 128 dams , more than 92 dams are about more than 50 years old.
- They need reliable monitoring system to mitigate any probable distress in future.

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INSTRUMENTATION & DAM HEALTH MONITORING

- In general, the dam monitoring is being carried out by analysing the data from the dam instruments which is collected manually.
- Instrumentation is the use of special devices to obtain critical scientific measurements of engineering behaviour.
- The instruments embedded in or installed at the surface of dams and other hydraulic structures keep a constant watch over their performance in service and indicate the distress spots which call for remedial measures.

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INSTRUMENTATION & DAM HEALTH MONITORING CONTD...

- Automatic instruments gives solution for collection of data from the remote places without manual interference.
- Real time monitoring system is a boon for effective monitoring of Dam structures
- The instruments should be sufficiently accurate and stable, low cost, compatible with present construction techniques and less moving parts, reliable ,simple and robust, capable of transmission of signals as a frequency over long cable lengths.

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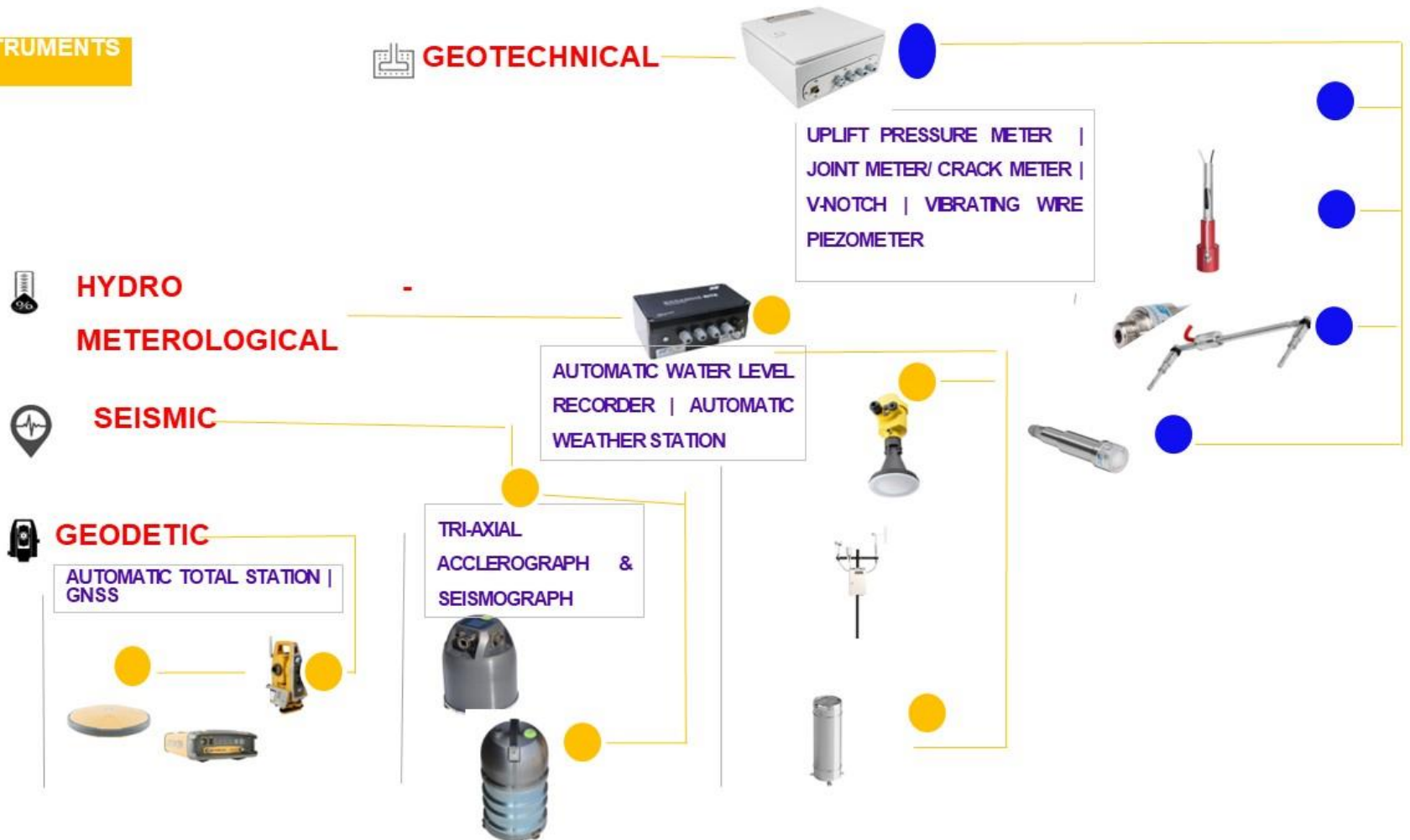
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Dam instruments

DAM INSTRUMENTS



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DAM INSTRUMENTATION AT A GLANCE

- Plumb line, Geodetic survey instruments are used for measurement of deformation, Uplift pressure gauges, Staff Gauge, Water level measurement, V-notch for flow measurement, etc.
- These instruments are very easy to operate and maintain.
- Gives most reliable and valuable observations for analyzing the safety of dams. The uplift pressure monitoring is very important from the safety point of view.
- Well maintained Instruments, can last for decades.
- In some of earthen dam, many instruments like Double tube piezometers are still in working condition even after 5 decades of service.

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BARRIERS IN DAM INSTRUMENTATION

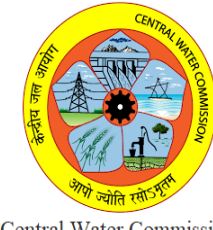
- High moisture content and flooding of the gallery leads to malfunctioning of many instruments of both concrete and masonry dams
- Chocking of uplift pipes are happening frequently and due to this, data may not be available.
- Due to non-availability of inspection Gallery in old concrete and masonry dams, instruments like Plumb lines, uplift gauges, etc., cannot be installed now.
- Tilt meters can be installed at a few critical locations and near to crest of dam for measurement of rotations.

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REAL TIME MONITORING SYSTEM FOR INSTRUMENTATION

- Real time monitoring system means utilising the real time data such as water pressure, water level from the sensors to provide assessments regarding stability as well as any deformity of the dams.
- Data are imported and processed continuously.
- The real time monitoring instruments would help in giving alarm during sudden flood, high uplift pressure, sudden increase/decrease in water level, deflection or tilt observed in dam wall etc, as these instruments would be connected through networks like internet, local area network and mobile networks.
- So it would be possible to monitor the dams from anywhere to protect the structures from all safety threats.

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REAL TIME MONITORING SYSTEM FOR INSTRUMENTATION

- The Tamil Nadu Water Resources Department under the Dam Rehabilitation and Improvement Project, as a pilot project on Instrumentation was done in 17 major prioritized dams using Real time monitoring system(AWS, AWLR, Total Stations, Data Loggers).
- The data collected from the Data Acquisition System at the dam site has been transferred to the Control Unit @ SPMU office, Chennai

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REAL TIME MONITORING SYSTEM FOR INSTRUMENTATION CONTD..

- The table below shows the instruments installed in 17 dams.

S.No	Instruments	S.No	Instruments
1	Automatic Water Level Recorder	7	Total Station
2	Automatic Weather Station	8	GNSS
3	Digital V Notch	9	Seismograph
4	Uplift Pressure Meter	10	Acceloro-graph
5	Joint Meter	11	Data Logger at dam site
6	Piezo Meter		

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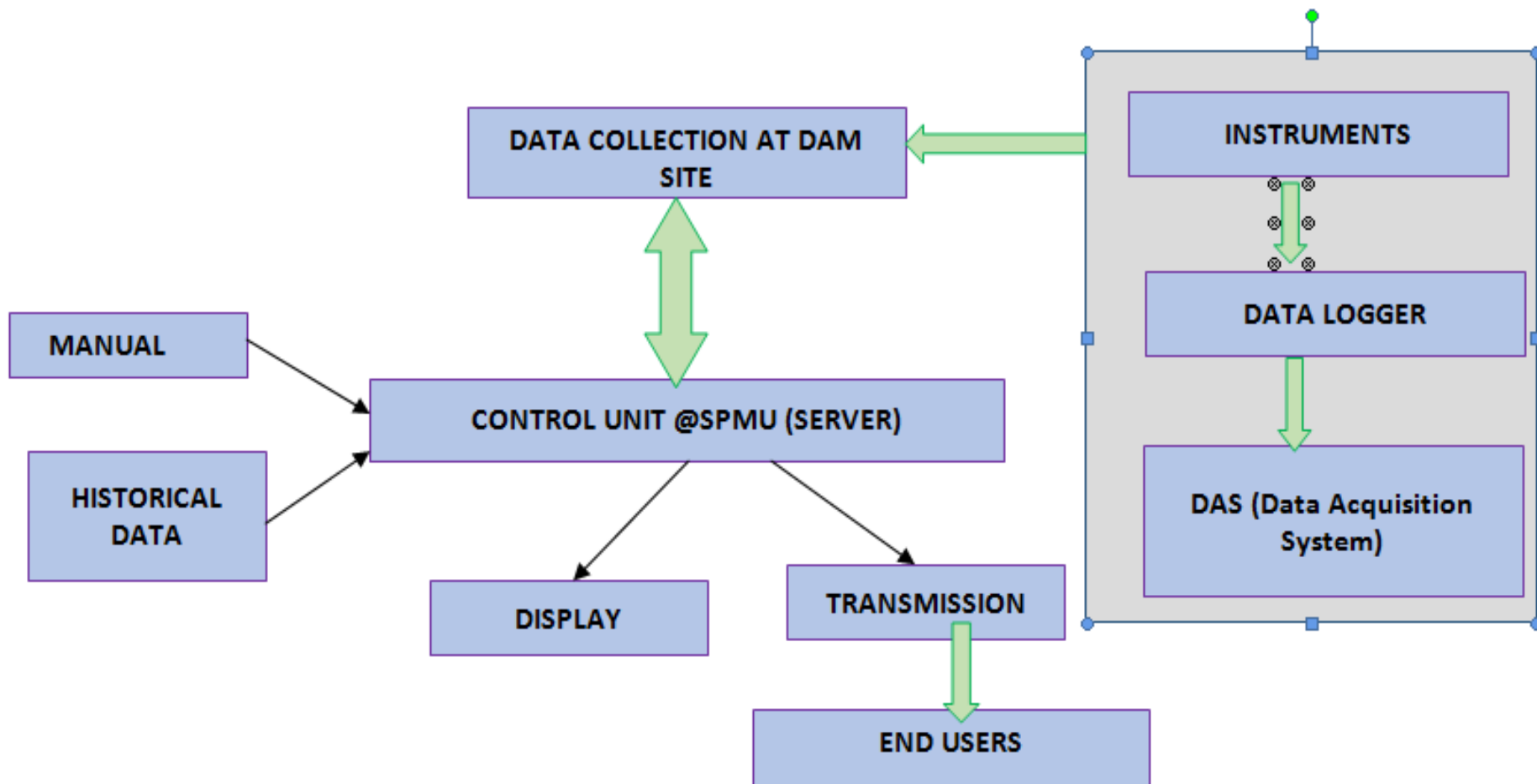


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PROCESS OF DATA ACQUISITION



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SOFTWARE AND NETWORKING COMPONENT

- The software is capable of acquiring data from geodetic, geo technical , weather and seismic sensors, screening and filtering the data for inconsistencies and outliers, processing the data and storing in SQL database.
- The data acquired by the monitoring system shall be assessed, visualized, analysed, alarmed and reported via secure web interface.
- Access to the internet interface shall be strictly controlled by customizable levels of access for group of users with the system administrator having control and management of the access facility

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SOFTWARE AND NETWORKING COMPONENT

- Network connectivity from the Centralized Control Unit @ SPMU to the remote dam sites through Cellular Modem Network.
- The real time data collected at dam sites shall be transmitted to the control room through cellular modem network. Necessary workstations, software , laptops of suitable configuration are placed at the Centralized Control Unit and Data Acquisition centres at dam site.

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RESULTS AND DISCUSSIONS

- The output data are generally presented in the display unit of the Centralized Control Unit in the form of maps, graphs and tables.
- The output data after validation at Centralized Control Unit is proposed to be shared with the Government & Disaster Management agency and all the stakeholders in the required formats.
- In addition to the interpretation of results, the real time data may also be linked with the GIS for various analysis.
- Based on the history of the data stored in the SQL database forecasting of hydro-meteorological parameters in the particular dam site may also be carried out which may be considered as the future scope of this system.

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DATAS FROM CCU

Type	Site Name	FirstData TimeStamp	LastData TimeStamp
D	Aliyar_Dam_ALI_V1	2021-09-28 21:03:00	2022-08-12 12:00:00
1	Battery Voltage	1 Week	1 1
2	Seepage/Water Level	1 Week	2 3
D	Aliyar_Dam_ALI_V2	2021-09-29 09:02:00	2022-08-12 12:00:00
D	Aliyar_Dam_ALI_V3	2021-10-08 12:00:00	2022-08-12 12:00:00
D	Aliyar_Dam_ALI_V4	2021-10-08 18:00:00	2022-08-12 12:00:00
D	Aliyar_Dam_ALI_V6	2021-10-08 18:00:00	2022-08-12 12:00:00
D	Aliyar_Dam_AWLR	2021-11-24 14:32:00	2022-08-12 15:00:00
D	Aliyar_Dam_Weather_AWS	2022-01-04 20:24:25	2022-08-12 15:00:00
1	Wind Direction	1 Week	3 3
2	Wind Speed	1 Week	3 3
3	Air_Pressure	1 Week	1 1
4	Atmospheric Temperature	1 Week	1 1
5	Relative_Humidity	1 Week	1 1
6	Solar_Radiation	1 Week	1 1
7	Instant_Rain	1 Week	1 1
8	Daily_Rain	1 Week	1 1
9	Evaporation	1 Week	1 1
10	Datalogger Status	1 Week	1 2
D	Amaravathy_Dam_AWLR	2021-11-22 11:24:00	2022-08-12 15:00:00

[Instrumentation](#)

Aliyar_Dam_Weather_AWS.Wind Direction



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PRESENT AND FUTURE PERSPECTIVE

- Presently baseline datas are being collected at CCU.
- Shall be preprocessed, data wrangled(translating the raw data into usable form)
- The preprocessed data are trained and tested and effective machine learning model can be created.
- The created model can be used for the future prediction(i.e using the temperature, humidity, pressure, evapotranspiration datas , Rainfall can be predicted

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Dam Rehabilitation & Improvement Project



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PRESENT AND FUTURE PERSPECTIVE

- The communication facilities in the dam instruments can be improved and modified into Internet of Things devices.
- Dashboards can be used for dynamically displaying the hourly details.
- Automation can be done in the form of SCADA(Supervisory Control and Data Acquisition) by using the Artificial technology.

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