WORLD METEOROLOGICAL ORGANIZATION

WMO HydroHub

CASE STUDY:

Open source non-contact river flow observations with cameras for Africa

WMO HydroHub Second Innovation Call

Implementation dates: November 2020 to May 2021

Innovation supplier: Trans-African Hydro-Meteorological Observatory (TAHMO)

Project implementation country: Tanzania and the Netherlands

Challenge

River flow observation sites are declining worldwide. Non-contact flow observations using image velocimetry methods are very promising for river flow observations because they are non-intrusive, can be used for remote data collection – assuring that events are not missed and reducing fieldwork costs – and have the potential to be affordable. But so far, operationally viable products using this technology are only available from commercial firms with proprietary software and hardware solutions, making them expensive and unsustainable for low-income countries. Therefore, the transfer and practical uptake of this promising method in both high and low-income countries is very limited. This project established OpenRiverCam, an entirely free and open-source software stack for velocimetry-based flow estimation and rating curve development. The solution uses conventional, and easily accessible, camera hardware, opening doors for the establishment of new operational river monitoring sites in both high and low-income countries.

The Software

The fully open source, user-friendly, low cost and sustainable hardware and software stack with an Application Programming Interface (API) developed in the project allows practitioners everywhere to establish and maintain river rating curves (relationships between geometry and river discharge) in small to medium-sized streams. The hardware/software stack allows hydrology practitioners anywhere in the world to monitor and maintain rating curves with a staff gauge, an Internet Protocol (IP) camera (can be a smartphone) and simple and affordable survey equipment without any costs for software. It can be deployed by local people, using local devices and open-source software, leading to job creation and sustainable services for National Meteorological and Hydrological Services (NMHSs) or their service providers. The technology offers flexibility in site selection (does not need to be installed on a bridge) and provides situational awareness of the site's conditions.

The installation of the solution can take place during low water flows and rating can be performed remotely using routinely and automatically collected movie shots during any flow period (especially at high flows). This will reduce the deployment of staff, for example, from the Ministry of Water and Irrigation of the Government of Tanzania (MoWI) and the Tanzania Meteorological Agency (TMA), required in the field during high water levels. The Rainbowsensing site demonstrates that once a site and camera are configured in the software, it takes a practitioner roughly 30 minutes after an event to analyse short videos and augment the rating curve with new points from the event.

Approach

The project was implemented in three phases:

1 The solution's functionalities and technical abilities were co-designed with partners – the MoWI, TMA, the Waterboard Limburg and KNMI – to fit local contexts in both Western and African countries.

2 Experimental sites were established in Limburg and Dar es Salaam to provide continuous operational video data feeds used to develop and test the software stack throughout the project.

3 MoWI, TMA, student groups, innovative tech companies, Non-Governmental Organizations (NGOs) and potential donors all received training to operationalize the equipment and use the software.

Results

- The project increased the low-cost monitoring sites to six sites in Dar es Salaam, Tanzania, and one site in Limburg, the Netherlands.
- The software is entirely open source so that its code can be further developed by multiple parties, and releases can be obtained freely and unconditionally.
- The project delivered OpenRiverCam: a functional web-based software that can be used on a local laptop/desktop, local server or remote cloud server for camera-based ratings.
- https://openrivercam.mybluemix.net/portal/ The project rolled out the software as a service in the cloud, allowing all users to process their data without any extra hardware requirements.
- The software code is available on GitHub. It is available on https://github.com/TAHMO/OpenRiverCam.
- The project delivered a guidance manual for the site set up and software use, allowing practitioners anywhere to collect and process data for developing/updating rating curves via https://openrivercam.readthedocs.io.
- A blog demonstrates the software, using an event on 29 April 2021 in Dar es Salaam. https://rainbowsensing.com/index.php/2021/04/29/rainfall-and-river-flow-during-the-event-of-29-april-2021/.
- The project was presented at the European Geosciences Union General Assembly in April 2021 (Session HS1.2.2 https://meetingorganizer.copernicus.org/EGU21/EGU21-5880.html) and at the International Surface Velocimetry Workshop organized in May 2021.

Way Forward

1 **Incorporate other Velocimetry methods in the software stack to make it more robust and to open it up for other applications worldwide.**

2 **Automate the readings of gauge plates (it is manual at the moment) but it is functional and can be used in Early Warning System set-up in low resource settings.**

3 **Automate ingestion of videos from camera APIs or FTP servers.**

4 **Scale the system to other countries with the support of development partners and NMHS.**

Partners

Trans-African Hydro-Meteorological Observatory
Tanzania Meteorological Agency
Royal Netherlands Meteorological Institute
Ministry of Water and Irrigation of the Government of Tanzania
Waterboard Limburg
Delft University of Technology

To contact the team please send an email to: hydrohub@wmo.int