Providing Real-Time Hydrologic Data Using Webcams

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Challenge

- Access to network scale hydrologic data is rare in developing countries, resulting in higher risk to residents and infrastructure.
- Providing real-time data to local authorities is critical for preparation and swift response to extreme hydrologic events.

Source: Getty Images

Source: Reuters, Erik de Castro

Proposal

- A **visual, image-based water level measurement system** would provide the following advantages over traditional water level measurement systems:
  - Reduced Maintenance
    - Non-contact measurement
    - Remote, visual verification of water level
    - Remote calibration
    - Images available for post processing
  - Low-cost
    - Open-source (GPL) software
    - Off-the-shelf camera

Implementation

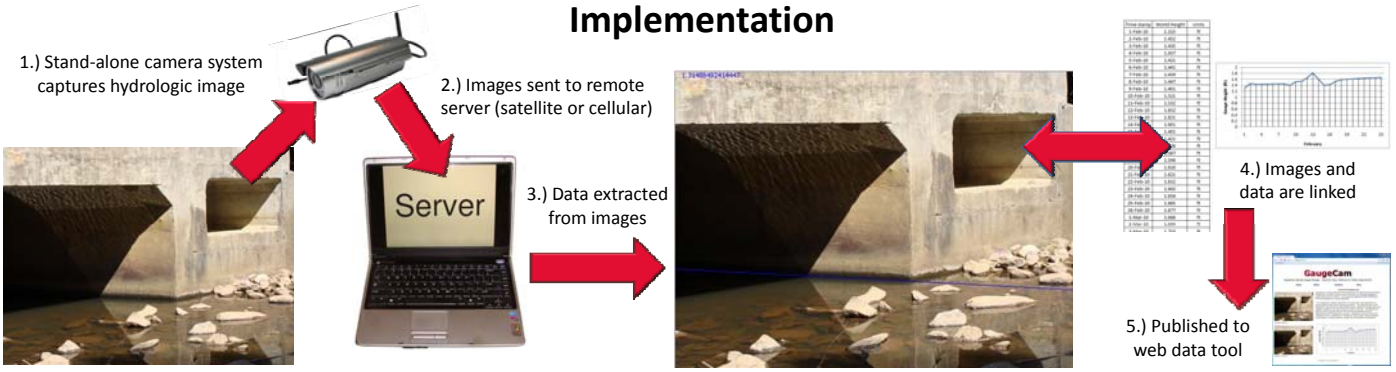

*Image of camera courtesy of Microseven Systems

Innovation

- Unparalleled ability to verify data visually using images
- Unique ability to post process images for data correction
- Minimal training required for installation of camera
  - Installed camera requires only lens cleaning
- Real-time, remote calibration using fiducial recognition
- Web data tool
  - Water level visualization using animation
  - Image – data link provides decision support for emergency personnel

Pending Research

- Field application to evaluate performance relative to USGS stream gauge
- Automated illumination tests to assess impact of glare, shadows
- Evaluation of system using bench with interchangeable backgrounds (effects of color, capillary action)
- Evaluation of system using wave generation
  - Evaluation of bias when using IR or ambient illumination
  - Development of web-based data management tool

Current Research

- Bench-scale evaluation of precision and accuracy
- Use of infrared (IR) illumination for night-time measurements
- Application of GaugeCam Remote Image Manager (GRIM), based on open-source (GPL) KamVu libraries
- Determination of GRIM research toolbox robustness for water level application

Research Partners

- Jeff Pillis (Lab automation)
- Christian Chapman (GaugeCam server)
- Jianhua Cao (Microseven Camera Systems)

www.gaugecam.com

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ABSTRACT

Predicted consequences of climate change include higher rainfall amounts and more extreme hydrologic events. While real-time flood forecasting in developed countries relies on a solid network of flow monitoring stations, such networks are rare in developing countries. This is due in part to the high maintenance costs and skill level demanded by the traditional flow monitoring technologies in access- and power-limited remote areas. The challenge is to develop new ways to provide local authorities with reliable, real-time flow rate information at the network scale and at an affordable cost. We are applying existing machine vision technologies to automatically recognize water level in streams and rivers from images taken by rugged on-site webcams. Day- and night-time images of the water level are captured at custom intervals and sent via solar powered wireless or satellite technology to a server. The server analyzes the images, calculates water height and flow rates on a real-time basis, and stores all the information in a database. This database is accessible anywhere in the world using a web-based data management tool. While the initial cost is comparable to existing technologies, maintenance is dramatically reduced and data is more reliable because site conditions can be assessed remotely. At critical times, life saving decisions can be supported with visual information as well as automatically recorded data.