Vision-based sensors for water cycle

vicomtech
visual interaction & communication technologies

Motivation

- The **use of redundancy** to enhance the understanding of environmental processes is an important aspect that it is hardly dealt with in the bibliography
  - Access to several sources can provide **much greater understanding** about the current environmental situation
  - Recent technological advances have opened the possibility to use **visual sensors** to achieve redundancy at water monitoring networks
  - As the interpretation of raw data is performed remotely, there is **no need for onsite calibration** and only **low skill maintenance** such as cleaning the camera lens is required

Motivation

- Use of image sensor for measuring water level is the most recent approach
  - It can provide the surrounding information around the sensor as well as the water level so that the measured data can be confirmed
  - It is unaffected by weather

Motivation

- Some existing examples
  - A cloud-based Image Water Level Gauge system combines digital images taken by cameras or CCTVs about the river flow condition and water level measurement

Motivation

- Some existing examples
  - Some researchers have discovered that an image-based water level sensor could measure river stage as part of a field-based particle image velocitimetry (PIV) system
  - Water level measurement methods have been proposed, where the top of a bridge support column has been used as the reference indicator as it is parallel to the water surface
  - Further research projects have analysed several flow measurement devices, most of which depend on water level to calculate discharge
  - A cloud-based Image Water Level Gauge system combines digital images taken by cameras or CCTVs about the river flow condition and water level measurement
  - A framework for counting the fallen trees, bushes and debris passing for river automatic supervision has been implemented in order to use the obtained statistics to take preventive actions before floods
  - A novel approach has been proposed to monitor flow in sewers based on video images and computer vision techniques for water level and flow velocity estimation

Objectives

- Implementation of a **low-cost off-the-shelf camera** as a **redundant sensing modality** to measure hydraulics (water level and flow measurement) and detect other visually detectable phenomena (foaming, hydrocarbons, coarse floating objects) of the treatment assets in drinking and waste water treatment facilities

Potential scenarios

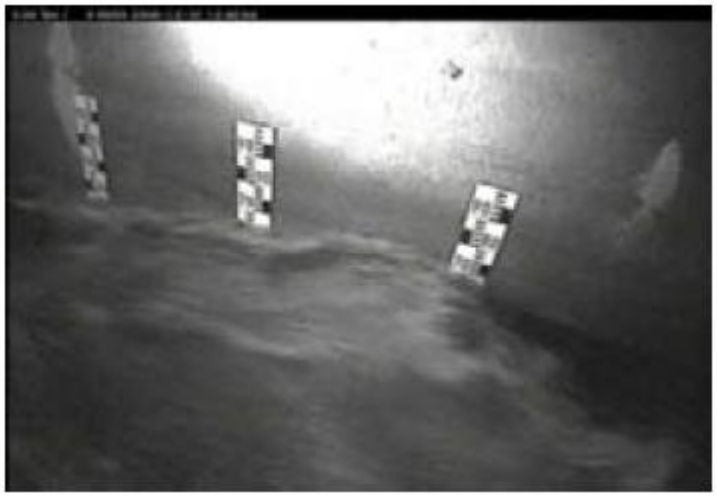
- Scenario 1: Screening at the intake of both drinking water and waste water treatment systems
  - Efficient removal of large non-biodegradable and floating solids will protect the downstream plant and equipment from any possible damage, pipe blockages and the accumulation of unwanted material that will interfere with the treatment processes
  - Manually cleaned screens require frequent raking to avoid clogging that can cause build-up of a mat of solids on the screen, increasing labour costs
  - The image-based sensors will **track large suspending objects** at the intake to the water treatment processes, so that cleaning processes will be optimized on the basis of the detected volume of solids to ensure a safe performance of the screens

Potential scenarios

- Scenario 2: Detection of visually detectable floating pollutants
  - Detecting the **sheen of hydrocarbons** will replace the human eye by automatic detection algorithms that will alert the managers of the drinking water treatment systems
  - Another visual element that could be easily detected is the **foaming in activated sludge process**, which can result in a multitude of operational problems including the reduction in the performance of the plant; physical hazards to operators from exposure to pathogens and walkway obstruction; blockage of pipes or interference with essential plant monitoring system

Potential scenarios

- Scenario 3: Water level measurement
  - Critical parameter for hydrological, transport and biological models used to manage waste water systems
  - Robust monitoring of wastewater flow discharge, as cameras are placed above the water, thus clogging and instrument loss are avoided



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  - Critical parameter for hydrological, transport and biological models used to manage waste water systems
  - Robust monitoring of wastewater flow discharge, as cameras are placed above the water, thus clogging and instrument loss are avoided
  - These measurements will open the possibility for identification and measurement of particular hydraulic behaviours by means of image visualization, thus providing a better understanding of the hydraulics of sewer systems and CSOs in particular

Expected impact

- The assessment of the environmental state of European surface waters comprises the collection and aggregation of a large amount of information. Such information is used to identify areas with severe environmental problems; assess environmental threats at regional and global levels; ensure sustainable development of communities; and improve the environmental state of the water bodies
- Thus, reliable high quality information about the state of the surface water is crucial for managing water and improving its quality, especially in relation to the **Water Framework Directive** (WFD). Specifically, as stated in **Article 8** of the WFD, Member States shall ensure the establishment of programmes for the monitoring of water status in order to establish a coherent and comprehensive overview of water status within each river basin district
- This project clearly aims at improving the monitoring of water status, being fully aligned with this Directive

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