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Continuous measurement of open channel discharge using a video data logger and subsequent LSPIV analysis

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Accurate flow data form the basis for describing hydrological runoff processes and extremes. While the continuous measurement of the water level is a standard task in hydrometry, the continuous measurement of flow velocity is more complex and often involves greater effort. Videometric methods like LSPIV (Large Scale Particle Image Velocimetry) allow a contactless acquisition of surface velocity distribution in open channels. Ready-to-use instrumentation for that purpose is hardly available and requires permanent electricity supply.
Therefore, a simple self-made measuring system, consisting of a data logger with camera and a distance sensor, is introduced. It enables not only the detection of the water level but also the recording and remote transmission of video data. Based on an Arduino microcontroller and a Raspberry Pi Single Board Computer the battery-powered data logger is freely programmable with open source software and supports the operation of various sensors with digital interface at low power consumption.
The measuring system with its wide angle camera is intended to be mounted on bridges or steep banks with longitudinal or transverse to flow camera alignment. The water level is detected by an ultrasonic range transducer, a raspberry pi camera module with wide angle lens records videos in 1080p resolution. The water level data and the videos are remotely transmitted via cellular network to a server that provides the data to the subsequent LSPIV analysis. The LSPIV analysis enables a high-resolution measurement of the velocity distribution at the water surface and in combination with the known channel geometry and the height of the water level it offers an accurate discharge determination.
Particularly with regard to extreme events the use of video data brings considerable advantages as it allows a visual on-site inspection of the situation. Information such as the condition of the local vegetation, icing or disturbing influences at the gauge site can be derived and included in the flow rate determination.