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GOLDFISH – DETECTION OF WATERCOURSE CONTAMINATION IN DEVELOPING COUNTRIES USING SENSOR NETWORKS – ENLARGED: FINAL REPORT

Project summary

Networks of sensor nodes can be used to measure states in the environment such as temperature, pressure, humidity or the concentration of pollutants. In the framework of the EU FP7 project "GOLDFISH", a consortium of 11 institutions joined forces in conceiving, modelling, designing, manufacturing, validating and operating wireless sensors nodes for tracking pollution in remote rivers. The project was funded with 2.6 million Euros, of which about 150'000 were dedicated to the activities of the Faculty of Engineering of Rijeka (RITEH). The used sensor network was hence composed of sensor clusters located underwater and gateways on the riverbank with long-distance communication links. Each node was composed of electronic devices that have to be constantly powered; batteries can be used for this task, but problems may occur when they are to be recharged/replaced. The possibility to use small-scale river flow energy harvesting principles was thus studied by the University of Rijeka GOLDFISH team as a valid alternative: a miniaturized hydro-generator, a piezoelectric eel and a concept of a rotating shaft plucking a piezoelectric beam.

Leader of the RITEH GoldFish project partner

Prof. Saša Zelenika, D. Sc., University of Rijeka - Faculty of Engineering (RITEH) & Centre for Micro- and Nano-Sciences and Technologies (CMNST)

RITEH team members

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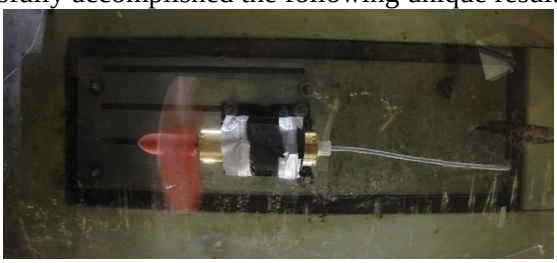
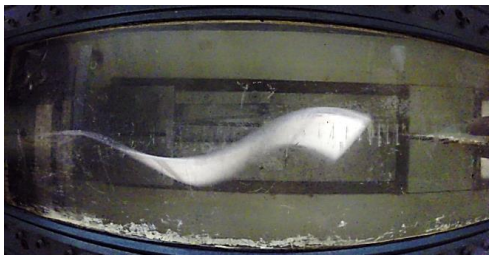
Project framework and outcomes

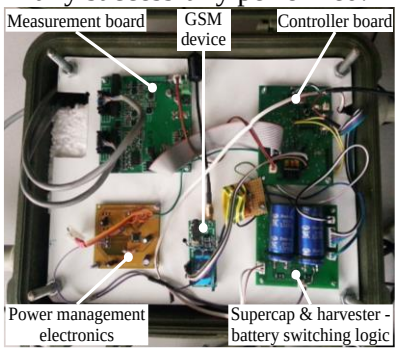
The participation to the GoldFish project constituted the first involvement ever of the Faculty of Engineering of the University of Rijeka in a research project of EU framework programs. The project, which was concluded at the end of April 2015, was appraised by the EC as successfully completed, as it has achieved most of its objectives and technical goals. In particular, the involvement of the RITEH team was especially acknowledged, since the team successfully accomplished the following unique results:



- a DC generator-based miniaturized underwater hydro-turbine was conceived, modelled, designed, tested in laboratory (flow channel) and real river flow conditions, and optimized further up to the level when input powers at the turbine of up to $P_{IN} \approx 1.5$ W and output electrical powers of up to $P_{OUT} \approx 800$ mW, sufficient for the sensor cluster, have been generated;
- the pioneering piezoelectric eel – a composite flag-like compliant device based on a piezoelectric polymer, placed behind a bluff body that induces Karman vortexes coercing the eel to move in a flapped motion, was thoroughly modelled, optimized by using a specialized software and prototyped; its performances were hence functionally tested in laboratory and real river conditions; since output powers limited to few tens of mW were attained, only a network ("farm") of several eel harvesters could eventually be used to successfully power the loads foreseen in the GoldFish project:



- the solution based on 'plucking' a rigid piezoelectric cantilever by means of plectra protruding from propeller's shaft was modelled via a finite element transient analysis, allowing to establish that the achievable power levels do not meet the needs of the foreseen application;
- the electronics used to adapt the voltage levels obtained from the harvesters to the employed sensors was designed, manufactured and successfully integrated with the developed harvesting devices themselves;
- the optimized hydro-generator, integrated with the energy management electronics, was finally embedded into the complete configuration of the wireless system (constituted by the sensors, the conditioning electronics, the transceivers and the gateways) aimed at tracking pollution in remote watercourses using sensor network technology; the GSM transmission of pollution data collected at the Coello river in Colombia was hence finally successfully performed:



Conclusions

The involvement of the RITEH team in the GoldFish EU FP7 project contributed not only significantly to the achievements of the project itself, but also to the visibility of the RITEH project team and of its know-how. In fact, the results achieved during the course of the project were presented as 3 papers in scientific journals, one of which is a high-impact journal especially esteemed in the microsystems community, but also as 9 scientific papers and a poster presented on 6 different international scientific conferences, as well as presentations at scientific broadening events. This added visibility contributed to the fact that, since the end of the GoldFish project, the RITEH team was included in the preparation of several new EU projects aimed not only at research (Horizon 2020), but also at territorial cooperation via EU cohesion policies (Interreg). What is more, the involvement in the project contributed also to the functional integration of the University of Rijeka, since during the project the RITEH team extensively used the equipment of the Centre for Micro- and Nano-Sciences and Technologies at the campus of the University of Rijeka, which was recently obtained via the EU European Regional Development Fund (ERDF) project no. RC.2.2.06-0001: "Research Infrastructure for Campus-based Laboratories at the University of Rijeka (RISK)".